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"To the solid ground
Of nature trusts the Mind that builds for aye."—WORDSWORTH.

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NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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Jubilee Meeting of the Indian Science Congress

THIS week, the twenty-fifth meeting of the Indian Science Congress Association opens in Calcutta, the jubilee being marked by the attendance of a strong delegation from the British Association; Lord Rutherford was to have presided at the meeting, but fate decided otherwise, and the Association has been fortunate enough to persuade Sir James Jeans to take his place. It may be hoped that this meeting will confirm the growing appreciation in India of the value of modern science.

In the address prepared for the meeting by Lord Rutherford before his death, he pointed out that prior to the first decade of this century, scientific research in India was, with a few notable exceptions, confined to the great scientific services, initiated and maintained on a generous scale by the Government, such as the Survey of India, the Geological Survey, the Botanical Survey, the Departments of Agriculture and Meteorology, and others. To the work of members of the Trigonometrical Survey we owe the principle of isostasy, while the development of the mineral resources of the country has been due largely to the activities of the Geological Survey. In forestry, the fine research institute at Dehra Dun is a monument to the enthusiasm of past members of the Indian Forest Service. The Indian Medical Service has been the means of giving the world, not India alone, new weapons for the attack on tropical diseases such as malaria, cholera and leprosy.

While this work was going on steadily, the Indian universities were being founded, and at first attention was mainly directed to the instruction and examination of students. There were always a few, however, who realized the role the universities must eventually take in the promotion of research, and, as a result of the Curzon Commission on Education in 1904, many of the universities introduced honours courses, and by new appointments and improvements in laboratories stimulated research in science. Amongst the pioneer men of science in India who distinguished themselves by original investigations, Lord Rutherford mentioned in his address Sir Alexander Pedler, Sir J. Chandra Bose, Sir Alfred Bourne and Sir Prafulla Rây.

For geographical reasons, personal contact between scientific workers in India is difficult. Occasional meetings of specialists may be arranged by the Board of Scientific Advice, but these meetings do not affect the university teachers, and in the autumn of 1911 two newly appointed professors, P. S. MacMahon in Lucknow and J. L. Simonsen in Madras, feeling the isolation in which they worked, considered that the time was ripe for the organization in India of a body having the same aims and functions as the British Association for the Advancement of Science. After considerable discussion, and acting on the advice of Sir Thomas Holland, a small committee was constituted to consider the formation of such a body. This committee met on November 2, 1912, and it was decided to ask the Asiatic Society of Bengal (now the Royal Asiatic Society of Bengal), to arrange for the holding of a Science Congress in Calcutta in January 1913. Various difficulties, however, necessitated the postponement of this meeting until January 1914. The arrangements for the meeting were in the hands of the Royal Asiatic Society of Bengal, and thus commenced an association to which the Congress undoubtedly owes much of its success. The organization of the Congress has followed closely that of the British Association although, in view of their special importance in India, sections of medicine and veterinary science were included.

The numbers attending the first meeting, when the late Sir Asutosh Mukherjee, vice-chancellor of the University of Calcutta, was president, were small; some thirty scientific communications were read, mainly by authors resident in Calcutta or its vicinity. This appeared to justify the critics of the scheme who had suggested that geographical difficulties would preclude its success. However, the Government of India early recognized the potential value of the Congress and authorized the payment of expenses to selected Government servants. As a result, the second meeting, in Madras in 1915, was more largely attended and communications were received from authors as far distant as the Punjab and Ceylon. Since these early days, the Congress has grown very greatly, as shown by the size of the *Proceedings*, which in 1914 filled six pages and in 1928 four hundred and twenty.

Whilst this increase in the number of communications read to the various sections provides evidence of the growth of scientific inquiry in India, the main success of the Congress has been, as the original promoters had hoped, in the social contacts which it has provided and the public interest in science which it has aroused in the various centres it has visited. It has stimulated also the formation of such specialist societies as the Indian Botanical Society and the Indian Chemical Society.

While substantial progress in both teaching and research has been made by the universities of India, their responsibilities—and with them those of the Indian Science Congress Association—must inevitably increase. In this present scientific age, efforts are everywhere being made to develop natural resources to the utmost, to improve industrial processes and to increase our knowledge in pure science. It is to the universities and technical institutions that we must look for men to carry out this work. The universities must be able, not only to give instruction, but also to select those who are to be trained in the methods of research. From the latter we may expect to obtain future leaders of research, on whom the prosperity of the country will largely depend.

The utilization of science implies, moreover, a planned scheme of research. Here the experience of some of the Overseas Dominions may prove of service to India. In Canada and in Australia, there are State or Provincial Governments as well as a Federal Government, and in both cases it has been found expedient that the research organization of the country should be truly national and responsible to the Federal Government alone. Even in an Empire the size of India, where the resources and needs of various provinces are widely different, it would seem that centralized organization of research is the only way of avoiding waste of money and effort. The detailed planning of research must be in the hands of those with the necessary specialized knowledge, and they must be able to act without suspicion of political or racial influence. Here the Indian Science Congress Association has shown, over a long period of political turbulence, what can be accomplished, for a marked feature of the Congress has been the complete absence of racial and communal strife; it has remained quite unaffected by these tragic influences, doubtless due in part to the tact of the various general officers and to the very valuable services of the secretary of the Royal Asiatic Society of Bengal, Mr. J. van Manen.

Since the foundation of the Indian Science Congress Association, it had always been hoped that it might prove possible to arrange for an over-seas visit of the British Association to India. The necessity, for climatic reasons, of holding such a meeting during the cold weather (November to February), the middle of the academic year, offered serious difficulties. However, they have now been overcome, and, moreover, the precedent has been established of sending a delegation to a joint meeting with another organization. This is undoubtedly of great significance. Valuable as are personal contacts within a country, such contacts with workers in other countries and the opportunity of seeing the conditions under which they work are of even greater value, while the presence of a body of distinguished scientific visitors in India cannot fail to be a source of inspiration to students and scientific investigators in that country.

Medicine as a State Service

Socialised Medicine in the Soviet Union
By Dr. Henry E. Sigerist. Pp. 382. (London: Victor Gollancz, Ltd., 1937.) 15*s.* net.

DR. HENRY SIGERIST was the successor of his great master Sudhoff as professor of the history of medicine at Leipzig, and now occupies a similar post at Johns Hopkins University, Baltimore. He is a prolific writer of popular books on historical subjects related to medicine, and many readers of NATURE will know his books on "Man and Medicine" and his biographical account of "Great Doctors". He has now embarked upon a survey of the medical policy of the Soviet Union, of which he appears to be a warm admirer. Indeed, it is not too much to say that he is something more than favourably disposed, and this should be borne in mind in weighing his evidence. Sidney Webb, well known as an advocate of Soviet policy, furnishes a foreword to the book, and concurs in Prof. Sigerist's view that the Soviet method is planned throughout on a scientific basis. It banks on science for its salvation. As Sidney Webb says elsewhere (1937),

> "it refuses to accept as knowledge or as the basis of its code of conduct any of the merely traditional beliefs and postulates about man and the universe for which no rational foundation can be found, or any of the purely subjective imaginings of the meta-physician or the theologian".

Prof. Sigerist vigorously criticizes what he calls the 'compromise system' of the capitalist countries in respect of medicine. State medicine, he says, insurance medicine, charity medicine and private medicine exist side by side. The fight against disease is not planned, not led by one general staff; it is without design, and with all the deficiencies of a compromise. In other words, it has grown, in response to need, over the centuries, charity medicine (or medical alms-giving), organized private practice, a public health service, health insurance—which is the more correct order of events—emerging as "individualism" and becoming more fully organized as the community requires. Dr. Sigerist finds this historical process unsatisfactory, and prefers the Soviet model. The Soviet health system is described in these words:

> "(1) Medical service is free, and therefore available to all, (2) the prevention of disease is in the foreground of all health activities, (3) all health activities are directed by central bodies, the People's Commissariats of Health, with the result that (4) health can be planned on a large scale."

This definition is clear, and not unappetizing, but to the ancient world (which, *inter alia*, is England) it has, at first sight, the appearance of one more top layer super-added to the palimpsest. In the author's view, shared presumably by everybody, this plan can only be that of a Marxist socialist State. He claims if a society is to function successfully it requires healthy members; to obtain them health must be accessible to all, and free of charge. Medicine, like education, must be, he says, not a trade but a public function of the State.

> "The great majority of the population (74 per cent in 1934, more to-day) consists of wage-earners and collective farmers. The wage-earners receive their wages from the State as all enterprises are State enterprises. The collective farmers sell their crops to the State. Both groups purchase whatever they buy from the State. All money goes therefore from the State to the population and back to the State, which redistributes it every year. In the course of production, surplus values are created which are controlled and distributed by society through its various agencies. Part of this surplus serves to finance the health work of the nation."

The scheme begins with the most complete social insurance system, the costs of which are part of the cost of production; the health work is operated and controlled by the Commissariats of Health and their subordinate organs, at the cost of insurance surplus and the local central budgets; the system is designed to be preventive, and "prophylaxis is in the foreground of all medical considerations"; the Soviet medical man is not a private practitioner but a civil servant, a citizen and a worker, and all his actions are for the benefit of society; a Scientific Medical Council advises the Commissariat in all medical matters, distributes the doctors and differentiates their work, and organizes research.

> "The State has but one purpose, to promote the welfare of the people, of all the people, without distinction; to raise the material and cultural standard of the population; to liberate man from the bonds of poverty, of ignorance and disease. This and only this justifies the existence of the State."

In the Soviet Union, where physicians work on a salary basis, fees and the money issue are eliminated. Medical service is given through health centres of various kinds, dispensaries, polyclinics, ambulatoria, preventoria, prophylactoria, or hospitals. Certain groups are especially provided for, such as labour or mothers and children, and these are often dealt with at the factory clinic or at the school. For bed cases institutional treatment is available. Physical culture and recreational exercise are encouraged and provided for. Convalescent homes and popular resorts are developed, as also are housing reform and food supply, all on a more or less communal basis. Social diseases (tuberculosis, venereal, prostitution, abortion) are especially dealt with, and as they are common a large and elaborate organization has been set up. In 1920, as is well known, the Soviet Government legalized abortion and the practice spread rapidly, but in 1936 a law was passed making abortion a criminal offence, and providing new facilities for maternity, infants' nurseries and family allowances.

Neither Dr. Sigerist nor anyone else can say how this vast experiment will turn out. Indubitably it is favoured by the mass of the population, and in the cities is bringing a measure of health never known before in Russia. Apart from the wild scheme of encouraging abortion, maternity and childhood are safeguarded, insurance is more complete than elsewhere, and abundant amenities are brought to a people accustomed to few or none. It is too early to consider vital statistics. The imposition of so huge a medical scheme, varied and costly, inelastic and continually being altered, at such incredible speed, would seem to be courting disaster, yet it is being accepted by a communistic world. As for the future, Dr. Sigerist is sanguine and confident. He has certainly produced the most interesting book which has yet been written on the organization of medical science in Russia. This is not the occasion to explain the cogent reasons why the Soviet system of State Medicine cannot be adopted in Britain, though we should be wise to learn from it what we can.

GEORGE NEWMAN.

Chemistry of the Cell Wall

The Biochemistry of Cellulose, the Polyuronides, Lignin, etc.
By Dr. A. G. Norman. Pp. ix + 232. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 15*s*. net.

DR. A. G. NORMAN has done a real service to an increasing number of research workers by putting together the literature relating to the very complex group of compounds which constitute the cell wall of plants. The field is a developing one of scientific interest and technical importance, the established facts are few and somewhat scattered, whilst the literature retains much that is unsound. He is not afraid to give a lead at times in being both critical and trying to give the right perspective: in our opinion the book forms a platform from which future work can be initiated on sounder lines than in the past, and as such should be widely and carefully read.

Cellulose has been closely studied by chemists, who have cleared up most of its structural problems: there is a controversy as to whether its chain of glucose molecules joined end to end is a mere one to two hundred units long, as postulated by the Birmingham School, or whether it is ten times greater in length as is even more widely held and is indicated by physical measurements. Prof. W. N. Haworth gets out of the difficulty by joining his molecules together by co-ordination valencies, whereas the opponents do not see any reason to discard chemical valencies: it is considered that Haworth worked with an already degraded cellulose.

It is a moot question whether any of these large molecules can be properly considered as defined chemical entities. In the cell, where they have visible structure, the aggregate number of unit molecules is a very large one; probably the attempts to transfer the substance from the cell to the laboratory flask result in its simplification. Indeed, if the process be carried too far, there is a definite change in physical property, as, for example, loss of tensile strength in a degraded cotton, which has been proved to have a shorter average chain-length.

Cell wall chemistry would be relatively simple if glucose were the only sugar elaborated by the plant. In fact, it produces also galactose and mannose, which are isomeric with glucose, also two pentose sugars, xylose and arabinose, and possibly still other of the many isomeric sugars that are theoretically possible but which are difficult to identify. In addition, there are the uronic acids, which apparently make up the whole molecule of pectin and can be regarded as the half-way stage between the hexose and pentose sugars: it is considered that xylose is made from glucose in the plant and is not a product of original synthesis. The process involving oxidation followed by decarboxylation has so far baffled observation, and therefore particular interest attaches to recent work of Campbell in which he has obtained carbohydrates from wood and from oak leaves, representing as it were a transition stage between starch and the mixed polysaccharides.

In studying such substances the initial difficulty is to obtain them sufficiently free from similar compounds to make them worth analysis and at the same time not to break them down during the process of purification. Where this has been accomplished, results have begun to accrue which are startling in the sense that they disclose a greater complexity of structure than might perhaps have been expected. Whereas in cellulose, as also in starch, the end carbon of one little six carbon chain-molecule of glucose is joined to the fourth carbon from the end of the next glucose, it is found with the so-called hemi-celluloses that the join is to the sixth carbon and sometimes to the fifth carbon.

Whilst the natural syntheses are definitely selective and no doubt catalysed by an enzyme, it is clear that many alternative syntheses which the chemist can picture on paper also take place under other conditions and give rise to substances which though closely similar are intended to meet other functional ends.

Incidentally, the term hemi-cellulose is unfortunate, as these compounds are in no sense degradation products of cellulose or even related to it: the author suggests the term amylo-uronides in substitution.

It is possible only to indicate a few of the problems covered by the book: it also includes a chapter dealing with lignin, a polymeric material containing an aromatic group on which much work is still to be done. E. F. A.

Babylonian Mathematics

Mathematische Keilschrift-Texte

Herausgegeben und bearbeitet von O. Neugebauer. Teil 3: Ergänzungsheft. (Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik, herausgegeben von O. Neugebauer und O. Toeplitz, Abteilung A: Quellen, Band 3.) Pp. vi + 83 + 6 plates. (Berlin: Julius Springer, 1937.) 26.60 gold marks.

THIS Part 3 of the volume of mathematical cuneiform texts forming vol. 3 of Section A of the "Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik", though only supplementary to Parts 1 and 2, published in 1935, is a substantial volume of more than 90 large quarto pages, and contains additions and corrections necessary to make the volume complete. It includes texts which have become known to the editor since 1935 and revisions of a number of the texts which were included in the earlier parts, but could not then, owing to illegibility or otherwise, be dealt with more than provisionally.

In the meantime, other workers in the same field have been active; the first text, that of British Museum No. 13901, was first published by Thureau-Dangin in 1936; the second (B.M. 34568) was almost entirely contributed by Waschow; the third in Chapter i, one of the texts of the Yale Babylonian Collection (Y.B.C. 6504), was first recognized as mathematical by A. Götze, and F. J. Stephens helped in preparing the text. Chapter ii contains improved texts of the inscriptions belonging to the Yale collection mostly included or mentioned in Part 2; chapter iv (15 pages) is important, giving many additions and corrections to Parts 1 and 2. There are substantial improvements, again owing much to the labours of Thureau-Dangin, Waschow, O. Becker, Kurt Vogel, Bartolotti and others. Chapter v gives a complete glossary to the texts dealt with in chapters i to iii and additions and corrections to the glossary in Part 2; in chapter vi we have observations on the general character of the Babylonian achievements in mathematics, with fresh indications of their nature furnished by astronomical texts. Special attention should be directed to chapter vii, containing indexes, the last of which is a "Sachregister", or index to the subject-matter, of all three parts. Such an index is absolutely indispensable in a work of this kind; and the present one does not fail us.

The editor seeks to show that, not only in astronomy, but also in the purely mathematical domain, there existed, in addition to the texts which we have, and which contain multitudes of examples worked out on uniform lines but without any statement of general rules, works containing such rules and deserving to be described as 'text-books'. This view is, he thinks, supported by one or two passages where we are told what to do in general terms, as in the following case from B.M. 34568: "Take (*a*) the sum of the length, breadth and diagonal and (*b*) twice the area. Subtract the latter from the square of the former. Take the half of the remainder", and so on. These cases may indicate that there existed formulæ for solution stated generally and not merely in the concrete numbers of a particular case; but it still seems that we look in vain for any indication how the formula was arrived at, and for anything of the nature of a *proof* of its correctness.

Among details calling for notice are the following: (1) The consideration of the text of B.M. 13901, which goes back to the Hammurapi period, shows that it deals with the same type of problem as what the editor calls "Serientexte", which must therefore go back to the same period (1955–1913 B.C.), although the surviving examples of the series are somewhat later in date. Again, another B.M. text of the Seleucid period (321–64 B.C.) has an example exactly analogous to one which is more than a thousand years earlier. (2) The terminology for negative quantities (as such) can also be traced back to the earliest times. These things suggest that there was a continuous tradition all through the interval. (3) There is a problem in Part 2 about compound interest, in which it is required to find the period in which a capital sum accumulating at 20 per cent interest will double itself. The answer was given, but it was not clear how it would be arrived at. The mystery would now appear (p. 63) to be perfectly cleared up. It would be seen from exponential tables that the period is between three and four years; it is now shown that the working is consistent with the assumption that the time by which the period falls short of four years was obtained by the process of "linear interpolation".

T. L. H.

Hydroxides and their Applications

Hydroxyde und Oxyhydrate
Von R. Fricke und G. F. Hüttig. (Handbuch der allgemeinen Chemie, herausgegeben von Paul Walden, Band 9). Unter Mitwirkung von H. Zocher und Hj. Saechtling. Pp. xx + 641. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 60 gold marks.

SINCE the time of Lavoisier, metallic oxides and their hydrates have played an important part in the development of chemistry, leading to the determination of atomic weights of elements by Berzelius and the enunciation of the periodic classification of elements by Mendeléeff and Lothar Meyer.

Metallic oxides either singly or in mixtures have been utilized as catalysts by Haber, Sabatier, Senderens, Bosch, Bergius, Mittasch, and others in ammonia synthesis, hydrogenation reactions and other industrial operations. In the chromatographic analysis for the separation of the plant pigments (Tswett), in the isolation of enzymes (Willstätter) and in the separation of carotinoids (Kuhn, Karrer), metallic oxides and hydroxides are being used. In the development of colloid science, sols and gels of oxides of metals and non-metals have taken a very prominent share. The adsorptive capacity of the silica, alumina and other oxides in the soil mainly controls the moisture retention and other properties of the soil.

Profs. Fricke and Hüttig, aided by Dr. Zocher and Dr. Saechtling, have done a useful piece of work in collecting and summarizing the literature on the subject in the work under notice. The book is divided into two main sections; in the first, the preparation and properties of almost all the oxides and their hydroxides (including those of rare earth metals) are described, along with the sols and gels obtainable from many of the oxides. The colloid chemistry of the well-known sols of the hydrated metallic oxides is fully discussed.

In the second section, a general account appears of the X-ray analysis of several oxides and hydrates, their ageing with time both in the solid state and in the colloidal condition, their vapour pressures, the velocity of their hydration, their solubility in alkalis, their thermochemical, magnetic and dielectric constants. The X-ray diagrams are well reproduced in the case of several hydroxides, and a summary of the crystalline characteristics and constants of seventeen hydroxides as derived from X-ray analysis is tabulated. The investigations on the phenomenon of ageing, including X-ray analysis, diffusion measurements, dialysis, potentiometric titrations, etc., are ably summarized. The hydration and dehydration of several oxides and hydroxides have been studied, notably by van Bemmelen, Zsigmondy, Bachmann, Willstätter, Hüttig, Fricke, Hackspill, Patrick, and others, and this important subject has been dealt with satisfactorily from different viewpoints. The thermochemical properties, specially the heat of hydration of numerous oxides and hydroxides, are tabulated. An adequate account of the magnetic properties of the metallic oxides and hydroxides and a brief summary of the dielectric constants of some hydroxide sols and their change with time form the last two chapters of the book.

As is expected in the case of handbooks of this type, there is an extensive bibliography of original papers. The subject matter is of interest not only from the academic point of view, but also because it has considerable industrial and practical use. Since Profs. Fricke and Hüttig and their collaborators have themselves made important contributions to the subject, the book is authoritative, and should prove useful to senior students, research workers, and teachers of chemistry.

N. R. DHAR.

My Friend Mr. Leakey

By J. B. S. Haldane. Pp. v+179. (London: The Cresset Press, Ltd., 1937.) 6*s*. net.

PROF. HALDANE here applies his imaginative and literary craftsmanship to the conquest of new worlds. His friend Mr. Leakey is the most lovable of magicians, with a finer sense of right and wrong than one had learned to expect of his profession, and with limitations—to his still exceptional powers—which are at once convincing and endearing. We can picture few greater joys than dinner with Mr. Leakey; should this note chance to reach Prof. Haldane's eye, perhaps he will relent and put the address of Mr. Leakey's flat (not 221*a* Baker Street, because it is quite near Haymarket) in the next edition—although we should not be surprised if it had to be in the next edition but one.

It must not be supposed that this book is a frivolous one. It is full of information of the kind that every active-minded reader wants: how to tell a caiman from a crocodile, the difference in display between the *Daily Mail* and the *Daily Herald*, the correlation between brain size and versatility, what a man-size—or rather woman-size—butterfly would look like, the physical properties of tungsten, the rivers and glaciers of London, and so on.

Of course we could not hope to understand all the ways of magicians and their friends. So perhaps we may never know why the rat-catching magnets were put in holes that had to be specially dug, instead of being put into the docks, which would surely have suited more than somewhat, nor why Mr. Leakey navigated south-eastward from London to get to India, when every Boy Scout knows that you should start off north of east, nor why he said that the beam wireless to Australia (the Rugby-Sydney axis as the other spell-binders would call it) went over Persia (shouldn't it be Iran?) when it really goes over Moscow, nor why Prof. Haldane chose "none were" instead of "none was" from the two forms which every Girl Guide knows to be permissible, nor why he said "Bortsch" when every Komsomol boy or girl knows that it sounds more like "Borstch".

We hope Prof. Haldane will write some more on afreets in Fleet Street.

Le milieu et la vie en commun des plantes

notions pratiques de phytosociologie. Par M.-A. Reynaud-Beauverie. (Encyclopédie biologique, Tome 14.) Pp. 238. (Paris: Paul Lechevalier, 1936.) 60 francs.

THIS comprehensive book is largely a compilation, based mainly on extracts from Braun-Blanquet's "Plant Sociology", as well as from other writings by the same author and those of Profs. J. Pavillard and P. Allorge. The book, which will be appreciated chiefly by French-speaking people, owing to the fact that "Plant Sociology" has not been translated into that language, is evidently intended to attract the intelligent amateur as well as those who are professionally interested in the subject.

Until comparatively recently, the activities of natural history societies have been mainly directed to collecting and naming specimens and compiling local lists of species. This has given rise to the popular view that "Le Botaniste est un Monsieur qui vient dans nos bois, dans nos prairies, cueille nos plus belles fleurs, les fait sécher entre deux feuilles de papier buvard où elles perdent leurs brillantes couleurs, et ensuite . . . il les insulte en latin". It is to be hoped that this book will help to broaden the outlook of, and suggest new lines of investigation to, those whose activities have hitherto been directed to the mere acquisition of collections as an end in itself. This should help to disperse the narrow conception of the nature of a botanist mentioned above.

All who are interested in the study of plants in their natural environment will find this book full of interest, but nowadays the subject is one which can be approached from so many angles that a good grounding in all branches of botany, and some knowledge of physics and chemistry, is desirable before the subject-matter of the book as a whole can be fully appreciated. That this is so will be realized from the diversity of subjects dealt with, which range from particulars of equipment for collecting plants to the influence of light, temperature and rainfall on vegetation, or the detection of nitrates in the soil. It is noteworthy that in the section dealing with the effect of light on vegetation the only methods described for measuring the light intensity in different habitats are those based on the use of sensitized paper. The application of the photo-electric cell for this purpose, which gives more accurate results, is not mentioned.

A fairly extensive bibliography is given at the end of each section of the book; but most of the references cited are French, although some English and German ones are included. The book ends with a short subject index.

With Camera and Notebook:

a Naturalist's Calendar (1938). Edited by Phyllis Barclay-Smith and Rudolf Zimmermann. Pp. 60. (London: M. C. Forrester, 1937.) 3*s*. 6*d*. net.

A CALENDAR which will sustain interest and give pleasure throughout the year is not easy to find; Shakespearian quotations have become stale, and the Aberdeen joke is satiating after the first hundred. Perhaps the nearest approach to general interest has been achieved by the landscape calendars published by various newspapers, but the idea of a naturalists' calendar on the present scale is a new and excellent one. Each week has its photograph, reproduced by fine-meshed half-tone block about 5 inches by 6 inches in surface, and its appropriate news item, and the fact that the photographers include Seton Gordon, Mortimer Batten, C. W. R. Knight, J. D. Rattar and K. Herschel, is a guarantee of the value of the pictures, scientifically and æsthetically. They are mostly of mammals, birds, insects and wild flowers, and although a few are from Continental examples all the species illustrated are members of the British fauna. Miss Barclay-Smith and Rudolf Zimmermann of Dresden are to be congratulated on the beauty and interest of the photographs they have chosen. The stranded jelly-fish, mistakenly identified as *Aurelia aurita*, appears to be an *Æquorea*.

The Sense of Hearing in Fish*

By Prof. K. von Frisch, University of Munich

THERE is an old dispute as to whether fish are able to hear or not. It has seemed improbable that they can. Three main reasons have been brought forward against it.

(1) A biological reason: most fish seem to be dumb; a sense of hearing would therefore not be of biological significance for them.

(2) An anatomical reason: the inner ear of mammals has two main functions. It is the organ of equilibrium and the organ of hearing. Perception of equilibrium is the function of the utriculus and the semicircular canals. It is not yet clear if the sacculus of mammals has to do with equilibrium or with hearing. At the sacculus we find the cochlea; it is generally supposed that the cochlea alone is the organ of hearing. Comparative anatomy shows that there is no cochlea in the inner ear of fish. We find only a cavity of the sacculus, the lagena (Fig. 1, *L*), which is supplied with a stone and macula just like the sacculus (*S*) and utriculus (*U*). It has been suggested that fish cannot hear because the organ of hearing is not yet developed.

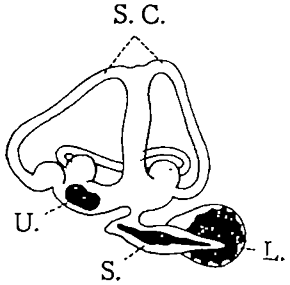

FIG. 1.
THE LABYRINTH OF A MINNOW. *U* = UTRICULUS; *S.C.* = SEMICIRCULAR CANALS; *S* = SACCULUS; *L* = LAGENA.

(3) The third reason against the acceptance of a sense of hearing in fish was a physiological one. Many investigators tried to clear up the matter by making experiments, but they could not observe any reaction of fish to sound. But on this point there is no agreement. For example, American investigators, especially Prof. Parker and his collaborators, made experiments with various fish with positive results. Opponents, especially in Germany, could not confirm it. It was argued that if there is a reaction to sound it would be a reaction to the movement of water and not to sound vibration—it would not be true hearing.

So the question arises: What is hearing? I think that, in vertebrates, it is not difficult to define it. Human beings can perceive very loud sounds by means of the skin and by means of the inner ear. Perception through the skin we call feeling; perception through the inner ear we call hearing. In all vertebrates the inner ear is a homologous organ. We should only speak about 'hearing' in the case of the perception of sound vibrations by means of the inner ear in vertebrates.

But the first question must be: Is there a reaction to sounds in fish? There was no agreement on this point. Many observers could not see any reactions to whistling, or to notes from a violin, or to the voice of a singer, and so on. But that is not astonishing. The voice of a singer or the sound of a violin or whistle is not of the slightest biological significance for fish. We should not wonder, therefore, if they do not react to it.

I thought, however, it might be possible to give a biological significance to sounds. If we whistle every time when we give food to the fish, then whistling acquires a biological significance, because the food is announced by it. First I performed the experiment in the following manner. I had a little catfish, *Amiurus nebulosus*, in an aquarium. It lay mostly in an earthenware pipe put on the bottom of the aquarium. The fish was blind, both eyes having been removed, and so it could not see what happened. It got the food from a glass feeding-rod. When the food was brought near the opening of the pipe the fish perceived the meat by means of its chemical sense, came out and swallowed the food. Then, every time I gave it food, I whistled with my lips. Thus I tried to train the fish to the whistling. After some days the fish came out when I whistled before I put the feeding-rod into the water, swam upwards and sought for the food; and always after that it could be called out by soft whistling not only from nearby but also from a considerable distance, for example, from the other side of a large room.

Later these experiments were continued by my collaborator, Dr. Stetter. He used various kinds of fish. The best results were given by our little minnows (*Phoxinus lævis*), and therefore they have been studied very thoroughly. To produce sounds tuning forks were generally used for low sounds and whistles for the higher ones. The sense of sight was eliminated by removal of the eyes. Then the fish was trained to a certain sound by four to five training feedings daily. After a few days the fish gives a very typical reaction to sound. The kind of reaction varies from individual to individual. When the sound is given, some fish dive down and snap for food on the bottom, others go up and snap on the surface, others stop and snap vigorously on whatever spot they may be, but all snap and seek for food because they are accustomed to get the food when the sound is given. After a few seconds we put the feeding-rod into the water; the fish gets the food, and so the training is continued.

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* Substance of a lecture delivered at University College, London, on March 4, 1937.

There is not the slightest doubt that there are clear reactions to sound. Further experiments by Dr. Stetter gave a great many results. It seems to me that three of them are of special interest.

Dr. Stetter tried to train fish to very low and to very high sounds, and so to find out the limits of the sense of hearing. The upper limit in minnows is between D^5 and A^5 (about 5,000–7,000 vibrations a second). Training to higher sounds is without results. There are slight individual differences; but there is a far greater difference between various species of fishes. Thus *Amiurus* gave positive results up to 13,000 vibrations a second. This is about the same upper limit as in human beings. Dr. Stetter was unable to find a lower limit. The lowest tuning fork, C_2 (frequency 16), gave good results.

A second result concerns the acuteness of the sense of hearing. A minnow was trained to E^2 (frequency 660). Then the sound of the whistle was diminished gradually to a very low intensity. The aquarium was put on a table in a long corridor and the soft whistle was given from farther and farther away in a series of experiments until reactions could no longer be obtained. Reactions could be obtained from a distance of about 200 feet. We ourselves could hear the whistle from that distance only as a very weak sound. But it is difficult to understand what this means, because we do not know to what extent the sound is weakened on entering the water. We therefore brought a large aquarium to the same spot and one of our students dived down and was tested in just the same manner as the fish. The experiment showed that our best fishes could hear as well as men in the aquarium, or even a little better than men. It was very surprising to us.

The third result concerns the discrimination of sounds. It is possible to prove that minnows can distinguish between different sounds. The following method was employed. A fish is trained to a certain sound, that is, the feeding sound. When there is a good feeding reaction, we introduce another sound one or two octaves higher or lower than the feeding sound. But at this sound no food is given, and if the fish begins to snap and seek for food, it is punished by a light blow with a glass rod. This other sound we call the warning sound, because it means a punishment. After some time of training, the fish gives the feeding reaction only to the feeding sound; to the warning sound it gives no reaction, or even a very distinct flight reaction to avoid the punishing blow. Now the interval between the two sounds can be gradually decreased, and thus we can find out what interval can be distinguished. Most fishes can easily be trained to distinguish between two sounds at an interval of one octave. The best fish could distinguish perfectly between the two sounds of a minor third, D^1/F^1 (frequencies 290 and 345).

During 1936, Dr. Wohlfahrt in our laboratory was able to improve these results by employing a new method. In the experiments of Dr. Stetter there was always a period of at least a quarter of an hour between the feeding sound and the warning sound. The fish, therefore, had to keep the sound in mind and decide by memory. It was clear from these experiments that the fish has some sense of absolute hearing—but not a very good one. Wohlfahrt gave short sounds so that they immediately followed one another, just like a trill. In this way he was able to show that minnows are able to distinguish even a half-tone interval.

Judging from all these results, it is very probable that there is a true sense of hearing in fishes. To be certain we must seek for the organ of perception.

Experiments have been published by Prof. Parker and his collaborators indicating that the inner ear especially has to do with hearing in fishes. Some observations seemed to show that the sacculus especially, or the lagena, would be the seat of the sense of hearing. But the results were not very convincing, because the methods employed to eliminate the sacculus and the lagena were not satisfactory. The method of training the fishes to sound, combined with careful operations, promised a clear result.

I removed various parts of the labyrinth in minnows. I tried first to remove the utriculus and the ampullæ and to leave the sacculus and the lagena intact. There is no difficulty in doing this. To perform the operation the fish is narcotized by means of a 0·5 per cent solution of urethane. As soon as the fish recovers from the narcotic we find that it has completely lost its sense of equilibrium. It lies on one side on the bottom of the aquarium, and when it swims it turns over and curves the body in a peculiar manner. Nevertheless, it is possible to train such fish to sounds as easily as normal ones. Training can be carried out in the same manner, in the same time, and within the same limits as in the case of normal fishes. There is not the slightest sign that the utriculus and the ampullæ have anything to do with the sense of hearing. They are only organs of equilibrium. It is more difficult to remove the sacculus and the lagena; but I have succeeded in doing this. It was very surprising to see that such fish, with both sacculi and lagenæ and their large otoliths removed, swim in perfect equilibrium. But it is impossible to train them to sounds. Generally I did with each of them more than a hundred training feedings, but the fish gave no reactions to the sounds. Normal fish or fish only operated upon on one side gave reactions after five to fifteen training feedings. I carried out the experiment also in the following manner. I trained a normal fish to a sound. Then it was operated on on one side. The reaction was as clear as before. The fish was operated on on the other side, and then it was never possible to get any reactions.

All this applies only to sounds higher than *C* (frequency 130). The fish without sacculus and lagena can be trained to low sounds, if they are loud enough. It can even distinguish between different sounds in the low region as well as normal fish. The low sounds are perceived as well as before, even if the whole labyrinth is taken away or if the sense organs of the lateral line, too, are fully destroyed. We can therefore assume that the low sounds are perceived through the skin.

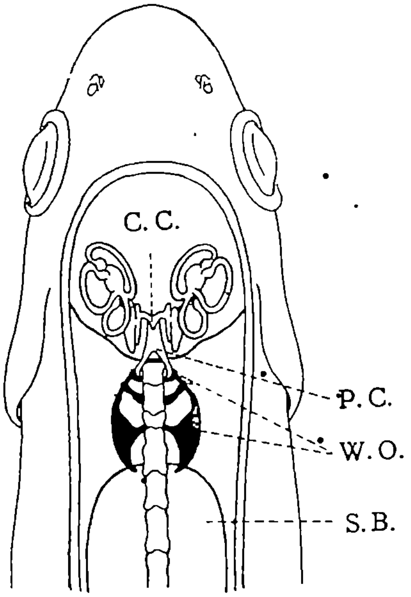


Fig. 2.

C.C. = CROSS CANAL, CONNECTING THE SACCULI WITH ONE ANOTHER; *P.C.* = POSTERIOR CAVITY; *W.O.* = WEBERIAN OSSICLES; *S.B.* = SWIM BLADDER.

From special experiments it can be concluded that the lowest sounds are perceived only with the skin, low sounds from frequency 25 up to about 130 with the skin *and* with the inner ear, and all the middle high and very high sounds from about frequency 130 up to the upper limit only with the labyrinth. That is more or less the same as in human beings.

It is stated above that minnows, in the region of middle high sounds, can distinguish between different sounds even when there is an interval of only half a tone. Now we know that these sounds are perceived by the sacculus and lagena. Thus we find that there is a remarkable ability to distinguish between different sounds in the fish labyrinth, in spite of the lack of a cochlea and therefore in the absence of a membrana basilaris. The function of the cochlea and of the membrana basilaris in higher vertebrates may be to improve the discrimination of sounds to the high degree known in man.

Certain anatomical facts are very important for understanding the acuteness of the sense of hearing in minnows. In minnows, as in all Cyprinids, there is a connexion between the labyrinth and the swim bladder by means of the Weberian ossicles. The sacculus of the right and left labyrinths are connected with one another by a cross canal (Fig. 2, *C.C.*) with a posterior cavity behind the labyrinth (*P.C.*) with one opening on each side. The opening is closed by a little bone connected with other bones by articulation (*W.O.*), the last of which is fixed to the anterior end of the swim bladder (*S.B.*). Sound vibrations in water must be transmitted to the swim bladder, from the swim bladder by means of the little bones to the cavity, from there to the cross canal and thence to the sacculus. Now it is very interesting that the shape of the otolith of the sacculus seems to make it suitable to take up the vibrations coming from the cross canal—a fact first recognized by the Dutch worker, Prof. de Burlet, in *Amiurus*.

We want to know, however, whether this connexion is necessary for sound perception. Consequently I took away the swim bladder through an incision in the ventral body wall of the minnow. I closed the wound by a suture and after recovering the minnows could be trained to sounds as before. But the acuteness of the sense of hearing was very much reduced. It seemed from these experiments that this connexion between the swim bladder and the sacculus might increase the acuteness of hearing.

If that were true, we should find a sense of hearing very well developed in all fishes possessing Weberian ossicles. All five species of Cyprinids which have been trained for sounds in our laboratory up to now have a very well-developed sense of hearing. The same is true for *Amiurus*, which belongs to the Silurids. They have Weberian ossicles too. On the other hand, in families having no connexion between the swim bladder and the inner ear, the sense of hearing is very poorly developed. We tried to train for sounds pike, perch, trout, eels and others. Some of them gave no results at all, others could be trained, but the sounds had to be made much louder than for *Amiurus* or for minnows, and the high sounds were never perceived.

Besides Cyprinids and Silurids there are two other families possessing Weberian ossicles: Characinidæ and Gymnotidæ. We trained a *Gymnotus* and some Characinidæ and found a well-developed sense of hearing in all these fish.

Now I wish to direct attention to a peculiar anatomical fact often mentioned in books of comparative anatomy, but never understood. In the Mormyrids, a family of African fish, there is a gas bladder on each side of the skull connected directly with the sacculus. In early embryological stages it is developed as a double cavity of the swim bladder, growing into the head. Later the connexion with the swim bladder is lost by degeneration and the two small air bladders lie completely separated in the skull. I thought that the function of these little air bladders might be the same as that of the big air bladder in minnows and other fishes possessing Weberian ossicles. Sound vibrations reaching the air bladders should cause vibration of them. In this case the stimulus can be transmitted directly to the sacculus, and therefore Weberian ossicles are not necessary. If that is true, we should expect a very well-developed sense of hearing in Mormyrids, although they do not have Weberian ossicles. It was rather difficult to get living Mormyridæ, and we looked for them for several years without success. But finally we got them. We began to train them for sounds with much interest, and we found with satisfaction that they could hear just as well as our best minnows. The anatomical peculiarities of these interesting labyrinths are now being studied in our laboratory.

It may well be asked for what purpose fishes are able to hear so well in silent water. It is not true that all fish are dumb. We know many species of sound-producing fish. There may be many more species of sound-producing fishes not yet known. Some years ago, Dr. Dykgraaf in our laboratory found out that minnows, too, are sound-producing fishes. If they are excited, a soft piping comes from the aquarium. The noise is very soft, but knowing the acuteness of the sense of hearing, we may be sure that it can be heard by the minnows. It is interesting that the production of sound by so well known a fish should have been overlooked for so long. There may be much to discover in the future about the language of fishes.

Organ Pipes and Edge Tones

By Dr. G. Burniston Brown, University College, London

ORGAN pipes have long been a favourite theme for the musician and for the physicist, but they are very far from being the simple structures idealized in the text-books. One source of complication in the actual organ pipe is the behaviour of the air stream at the mouth, which results, for example, in the note produced by blowing in the normal manner being higher in pitch than the natural note of the pipe considered as a resonator.

Another problem connected with the phenomena at the lip is the variation of pitch with the pressure of the air supply: in fact, one of the most puzzling features of the behaviour of organ pipes is the curious succession of tones which is evoked when they are underblown, that is to say, when the air is admitted with slowly increasing pressure. The subject has been investigated by Rayleigh[1], Lutz[2], Gunnaiya and Subrahmaniam[3] and others, and although it had been suggested that the pipe tones were initiated by edge tones, no observations of their relationship were made. A recent investigation has helped to make the production of these tones clearer by showing that they are intimately connected with the general problem of edge tones.

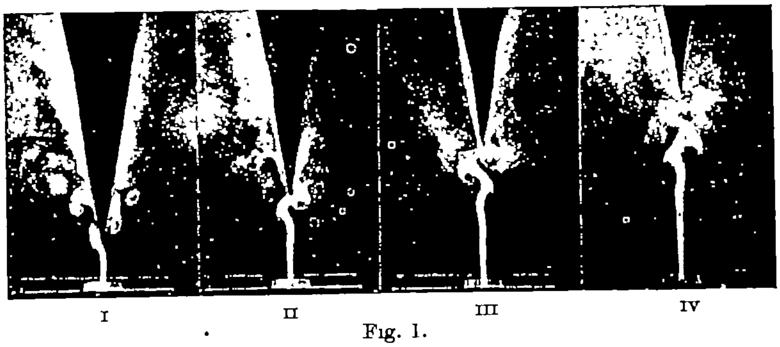
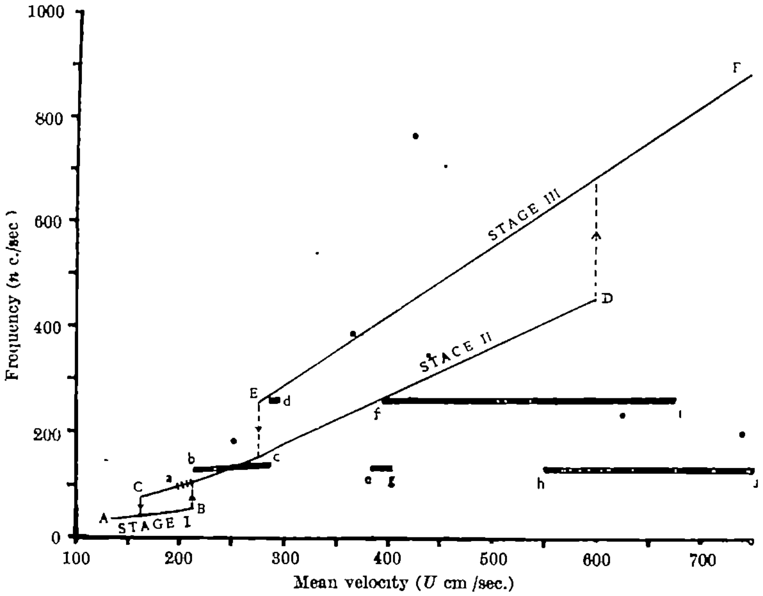

I II III IV

Fig. 1.

STAGES OF VORTEX FORMATION WHEN AIR IMPINGES ON A WEDGE.

An examination of edge tones[4] has shown that, when a jet of air impinges on a wedge, four distinct types or stages of vortex formation may occur. These four stages are illustrated in Fig. 1 for the case where the velocity of the jet is constant and the heights of the wedge are such that the frequency is the same in each stage. The four stages can also be obtained in succession when the height of the wedge is kept constant and the velocity of the jet is increased: the relation between the frequency n and the mean velocity U in such a case is shown by the thin line in Fig. 2. The frequency rises from A to B (Stage 1), then jumps suddenly to Stage II, continuing to rise until the point D, where another jump to Stage III occurs. The jump to Stage IV is not shown. If the velocity is decreased, the jumps to lower frequencies at C and E do not take place at the same velocity as the jumps to higher frequencies at B and D. When the velocity of the jet is above 500 cm./sec., Stage I may continue and occur simultaneously with each of the other stages.



——, Free edge tones; ▬, organ pipe tones; ++++, organ pipe edge tones.

Fig. 2.

OPEN WOOD DIAPASON. FUNDAMENTAL 130 C./SEC.; UNDERBLOWN OCTAVE, 264 C./SEC.

The organ pipe used was an open wood diapason of length 113·5 cm., rectangular in cross-section, 4·7 cm. × 5·8 cm., with a flue of length 4·7 cm. and breadth approximately 0·175 cm. (much nicking), and the cut-up was 1·6 cm., giving a fundamental tone of 130 c./sec. Air impregnated with cigarette smoke was used and the resulting vortex motion examined stroboscopically. The results obtained are shown by the thick lines in Fig. 2.

The free edge tones for a jet of the same width and wedge height as in the pipe were also observed and these produced the thin line *ABCDEF* already described. They are audible when U is above about 500 cm./sec.

The tones emitted by the pipe correspond exactly with those found by Rayleigh. His account of his experiments with an open 2 ft. metal pipe in which the pressure was slowly decreased is reproduced below:

Rayleigh	Diagram
"About this point the octave of the normal note is heard	*i* + *j*
after which the normal note itself disappears	*h*
The normal note reappears, the octave continuing.	*g*
The octave goes	*f*
and then the normal note	*e*
after which there is silence.	*ed*
Octave comes in again,	*d*
and then the normal note, at a pitch which falls from considerably above to a little below the natural pitch.	
At the lowest pressures the normal note is unaccompanied by the octave"	*cb*

In order to explain the mechanism of the production of this sequence, it is more convenient to consider what occurs with increasing velocity. In the pipe used, the construction of the block and lower lip was such that the jet of air is directed outwards and does not encounter the edge until its velocity is 200 cm./sec. Consequently Stage I is unstable and edge tone oscillation commences at a (Stage II): when this reaches a frequency of n = 100 c./sec., oscillation is set up in the pipe and the edge tone changes suddenly to n = 126 c./sec. at b, and this frequency is feebly emitted by the pipe. The combination of the pressure changes in the pipe, and those in the wake of the vortices entering the pipe (which according to my theory are the cause of free edge tone production) result in the frequency of pipe and edge tone rising continually and slowly together to n = 136 c./sec. at c, (U = 290 cm./sec.). The pressure changes in the pipe are not sufficient to affect the edge tone any further and the sound ceases. But it happens that Stage III in the free edge tones at U = 290 cm./sec. has a frequency very close to the octave, and this gives rise, for a short interval, to a very feeble octave note at d.

The construction of the block and lip now causes the jet to pass just *inside* the edge, and silence ensues, together with absence of edge tone oscillation, until the velocity reaches 380 cm./sec. At this velocity a disturbance passing up the jet and striking the edge would produce a frequency of nearly double the fundamental, and pressure variation of this frequency being reinforced by resonance, the note is maintained in spite of the fact that the jet does not strike the edge centrally. If the velocity is increased very slowly, however, the fundamental is elicited first at *e*. This presumably is due to the fact that the fundamental frequency, $n = 130$ c./sec., is *less* than half the octave, $n = 264$ c./sec., so that the edge tone reaches double the fundamental of the pipe before reaching equality with the octave. When the octave sounds at *f*, the pipe takes complete control and the frequency remains constant (Stage II). When the velocity reaches 550 cm./sec. at *h*, the real fundamental of the pipe begins to sound and the jet oscillates as a whole from side to side (Stage I). The octave note can still be heard but disappears at *i*. The occurrence of Stage I at such a high velocity is quite impossible without a resonator.

It seems, then, that edge tones are responsible for the initiation of the vibrations in musical wind instruments of the organ type, and that even the details of the complex initial phenomena can be accounted for adequately.

[1] Rayleigh, Scientific Papers, 2, p. 95

[2] Lutz, P., *Beiträge z. Anat. u. Physiol*, 17, 1 (1921).

[3] Gunnaiya, D., and Subrahmaniam, G., *Proc. Phys. Soc.*, 37, 15 (1924).

[4] Brown, G. Burniston, *Proc. Phys. Soc.*, 49, 493 and 508 (1937).

Scientific Centenaries in 1938

By Engineer Captain Edgar C. Smith, O.B.E., R.N.

THE scientific centenaries which occur this year are of wide and varied interest. They include the tercentenary of the printing at Amsterdam of Galileo's great work, the "Dialogues of the Two Sciences of Mechanics and Motion", and of the birth of the Scottish mathematician James Gregory; the bicentenary of the death of Boerhaave, the famous Dutch physician and chemist, and the bicentenary of the birth of Sir William Herschel; and the centenaries of the death of Dulong, the French chemist and physicist, and of Nathaniel Bowditch, the American mathematician and astronomer, and also the centenaries of the birth of Sir William Perkin, Ernest Solvay, Cleveland Abbe, George James Symons, Pietro Tacchini and of Count Zeppelin. The year 1738 also saw the publication of Daniel Bernoulli's "Hydrodynamics", while the year 1838 witnessed, first the inauguration of trans-Atlantic steam navigation, and secondly, the opening of the whole of the railway line from London to Birmingham, constructed by Robert Stephenson.

James Gregory (1638–75) was the younger brother of David Gregory (1627–1720). Together they founded the scientific fame of a family of men of science. When about twenty-four years of age, James published his "Optica Promota", containing the description of the Gregorian reflecting telescope, and suggestions for utilizing the transits of the minor planets for accurately determining the solar parallax. He studied at Padua, had a controversy with Huygens, corresponded with Newton, and in 1668 was made professor of mathematics in the University of St. Andrews, and in 1674 professor of mathematics at Edinburgh. In October 1675, while showing the satellites of Jupiter to his students, he was struck blind, and he died a few days later. An English contemporary of Gregory was Edward Bernard (1638–97), who was Wren's successor in the Savilian chair of astronomy at Oxford. He held this post from 1673 until 1691, when he was succeeded by David Gregory, the nephew of James. Bernard was a clergyman, having graduated from St. John's College, Oxford. His sole recorded astronomical observation is that of the solar eclipse of July 2, 1684, but he was an indefatigable collector of mathematical manuscripts. The year 1638 also saw the birth of the French botanist Pierre Magnol (1638–1715) of Montpellier. Both botanist and physician, he held the chair of medicine in his native town and was physician to Louis XIV. In 1705 he visited Paris and was admitted to the Academy of Sciences, but his heart was in his botanic garden at Montpellier. The genus *Magnolia* was named after him by his countryman Plumier.

Among the men of science, besides Boerhaave, who died in 1738, were Benedict de Maillet, the French geologist, and Richard Helsham, the Irish natural philosopher. De Maillet, who was born in 1656, came of a noble family of Lorraine. At thirty-three years of age, he was made consul-general in Egypt, and he held this position for fifteen years. He was also consul-general at Leghorn, and travelled in the Near East. He left a description of Egypt and a geological work in which he regarded all the rocks of the earth as marine deposits. The work was written in 1715–16, but was not published until some years after his death, when it appeared under the title "Telliamed", an anagram of de Maillet. It contains six imaginary dialogues between an Indian philosopher, Telliamed, and a French missionary. After reviewing this work, von Zittel concluded that "if we except the concluding chapters, the *Telliamed* far outshines other geological writings of the eighteenth century in its wealth of observed facts, its daring originality and its charm of style". Helsham, who was born about 1682, spent nearly the whole of his life in Dublin. A fellow of Trinity College, he lectured on mathematics and was the first to be appointed to the professorship of natural philosophy founded out of the funds left by the merchant Erasmus Smith. Helsham was a great friend of Dean Swift.

Hermann Boerhaave, who was born on December 21, 1668, and died on September 23, 1738, has been referred to as the most celebrated physician of the eighteenth century. He was equally at home in theology, music, botany and chemistry. He extended the botanic garden at Leyden, and in 1718 became professor of chemistry in the University. His well-known work "Elementa Chemiæ" was translated into several European languages. He was a foreign member of both the Paris Academy of Sciences and of the Royal Society. He is buried in St. Peter's, Leyden.

The bicentenary of the birth of Sir William Herschel, who was born on November 15, 1738, will recall the name of one of the greatest of astronomical discoverers. For fifty years his aim was to obtain "a knowledge of the construction of the heavens". In her "History of Astronomy" Miss Clerke wrote: "The rise of Herschel was the one conspicuous anomaly in the astronomical history of the eighteenth century. It proved decisive of the course of events in the nineteenth. It was unexplained by anything that had gone before; yet all that came after hinged upon it. It gave a new direction to effort; it lent a fresh impulse to thought. It opened a channel for the widespread public interest which was gathering towards astronomical subjects to flow in". The year 1738 also saw the birth of the famous French hydrographer, Charles Pierre Claret, Comte de Fleurieu (1738–1810), who had been entrusted with the testing of the marine chronometers of Berthoud, and who organized the expeditions of La Perouse and D'Entrecasteaux; the French aeronaut Jean-Pierre Blanchard (1738–1809), who with Dr. John Jeffries on January 7, 1785, made the first crossing of the Channel by balloon; the German mineralogist Franz Ludwig von Cancrin (1738–1816), who directed the salt mines of Russia and published a work in thirteen volumes on mining; and also of Christophe-Philippe Oberkampf (1738–1815), who added to the wealth of France by introducing the art of calico printing. Born in Germany, his life's work was done in France, and he received a decoration of the Legion of Honour from Napoleon.

Of the men of science who died a century ago, passing mention may be made of Samuel Woodward (1790–1838), the Norwich bank clerk who published a book containing a list of all British fossils then known; Thomas Andrew Knight (1758–1838), the horticulturist whose efforts were directed to the improvement of fruit trees; Charles Tennant (1768–1838), who in 1799 patented a process for the production of bleaching powder, and in 1800 founded the great chemical works at St. Rollox, Glasgow; Bernard Courtois (1777–1838), the discoverer of iodine; and Pierre-Louis Dulong (1785–1838), a professor at the Paris Ecole Polytechnique and one of the secretaries of the Paris Academy of Sciences, who with Alexis-Thérèse Petit (1791–1820) made important investigations in heat and chemistry. Nathaniel Bowditch, who also died in 1838, began life in a ship-chandler's shop, but rose to be president of the American Academy of Arts and Sciences. His great work was his translation, with a commentary, of Laplace's "Mécanique Céleste", which Simon Newcomb said "made an epoch in American science by bringing the great work of Laplace down to the reach of the best American students of his time". His countryman, Colonel John Stevens (1749–1838), a pioneer of steam transport, constructed the first steam boat driven by a screw propeller, and with his sons did much to further both railways and steam navigation.

The work of this last group of men belongs to the early part of the nineteenth century, just when the value of scientific studies was becoming increasingly appreciated, when technical schools were being opened and physical and chemical laboratories were being established. The seed sown in these laboratories was to bear a fruitful harvest, and no industry benefited more from their establishment than the chemical industry. A century ago, Liebig was making the Giessen laboratory the Mecca of chemical students, and Wöhler had already begun teaching at Göttingen. One of Liebig's students was Hofmann, who came to London in 1845 to teach at the old Royal College of Chemistry, in which Sir William Perkin—whose centenary occurs in March—was studying when he made the discovery which laid the foundation of the coal-tar colour industry. Perkin was only eighteen years of age when he discovered aniline mauve and only nineteen when he started its manufacture at Greenford Green, near Harrow. Fifty years later, he was the central figure of a great international gathering which assembled to celebrate the jubilee of his discovery. The agricultural chemist Robert Warington (1838–1907) also owed something to Hofmann. Warington worked under both Lawes and Frankland, and for many years took part in the work at Rothamsted. Other chemists born a century ago were Wladimir Markownikoff (1838–1904), whose work was of great importance to the Caucasian petroleum industry; Ernest Solvay (1838–1922) whose patent of 1863 led to a revolution in the manufacture of common soda, and François Lecoq de Boisbaudran (1838–1912), who first isolated gallium and received the Davy Medal of the Royal Society.

Passing from the ranks of the chemists to those of the physicists and astronomers, two of the outstanding meteorologists of last century were George James Symons (1838–1900) and Cleveland Abbe (1838–1916). Symons was the founder of the British Rainfall Organisation and of *Symons' Meteorological Magazine*, now the *Meteorological Magazine*. He was twice president of the Royal Meteorological Society, and every two years his name is recalled by the award of the Symons Medal founded to his memory. Abbe at first was an astronomer, but from the passing by the United States Congress of the Weather Bureau Act in 1870 until his death he was the leading meteorologist in his country. Among Abbe's countrymen were James Craig Watson (1838–80), director of the Ann Arbor Observatory, who discovered twenty-two minor planets and wrote a standard text-book on theoretical astronomy, and George William Hill (1838–1914), who in 1909 was awarded the Copley Medal of the Royal Society for his researches on the theory of the moon. Hill's career was bound up with the "American Ephemeris and Nautical Almanac". Two other astronomers born at the same time were Pietro Tacchini (1838–1905), the successor of Secchi at the observatory of the College Romano and the organizer of the Meteorological and Geodynamical Institute of Rome, and Arthur Auwers (1838–1915), whose work was mainly concerned with the fundamental systems of star places and proper motion. His new "Reduction of Bradley's Observations" occupied him from 1866 until 1876. In 1912, the fiftieth anniversary of his doctor's degree, the Berlin Academy of Sciences instituted the Bradley Medal and British astronomers presented Auwers with a copy of the portrait of Bradley by J. Richardson.

To these names may be added those of Ernst Mach (1838–1916) of Prague and Vienna, whose researches in mechanics led him to study by means of photography the motion of a bullet through air; Karl Selim Lemström (1838–1904) of Helsingfors, who made researches on atmospheric electricity, and the effect of electricity on plants; Carl-Louis Schwendler (1838–82), an electrical engineer of German nationality who worked many years with the telegraph department of India; and General Charles Webber (1838–1904), an officer of the Royal Engineers, who was also an expert in telegraphy and assisted the Post Office to organize its telegraph department and with Sir Francis Bolton in 1871 founded the Society of Telegraph Engineers, now the Institution of Electrical Engineers. The geologists, Sir William Boyd Dawkins, Ferdinand Stoliczka and Alfred Elis Törnebohm, were also born in 1838, as was Sir Walter Lawry Buller, the New Zealand ornithologist, to whom there is a tablet in St. Paul's Cathedral.

Of the many inventors and engineers born in 1838 who in one way or another made their mark, Samson Fox (1838–1903) was the inventor of the corrugated flue for boilers which was adopted in all classes of steamships, and a pioneer of the acetylene industry; Peter Brotherhood (1838–1902) was a pioneer in the construction of high-pressure air compressors and of high-speed steam engines; Charles Edward Emery (1838–98) did important work in marine engineering and was responsible for the construction of a central station for house-to-house distribution of steam; Henry Spencer Palmer (1838–1893), a British military engineer, was a geodicist of note and designed the Hong Kong Observatory as well as public works in Japan; William Henry Maw (1838–1924) was president of the Institution of Civil Engineers and of the Royal Astronomical Society and for more than fifty years editor of *Engineering*, while William Cawthorne Unwin (1838–1933) was, in the words of Lord Balfour, "one whose name was honoured wherever engineering was studied in English-speaking lands". Count Zeppelin, who has already been mentioned, was born on July 8, 1838, and died on March 8, 1917, eighteen years after he had built his first airship.

Of all the achievements of engineers in 1838 the place of honour belongs to the men who promoted the plans and built the ships for trans-Atlantic steam navigation. Four steamships, the *Sirius*, *Royal William*, the *Liverpool* and the *Great Western*, made passages between England and New York in 1838, but it was the performances of Brunel's *Great Western*—the *Queen Mary* of her day—that opened men's eyes to the possibilities of steam navigation. The centenary of her first voyage will be commemorated in various ways, and a special exhibition in connexion with the event is being arranged at the Science Museum, South Kensington.

Obituary Notices

Dr. G. A. Boulenger, F.R.S.

GEORGE ALBERT BOULENGER, who died on November 23 at St. Malo at the age of seventy-nine years, was one of the most distinguished of a line of descriptive biologists who have brought fame to the British Museum during the past century.

Born at Brussels on October 19, 1858, the son of Gustave Boulenger, a notary of Mons, Boulenger early exhibited a passion for natural history, and particularly for reptiles and batrachians. While still studying at the University of his native city, he was already engaged in the determination of reptiles, batrachians and fishes in the Natural History Museum at Brussels, and in 1880 he was appointed assistant naturalist in that institution. This appointment he very soon resigned, and came to London at the invitation of Dr. Günther, then keeper of zoology in the British Museum, in order to prepare a new catalogue of the batrachians in the national collection. In the words of Günther, "this proved to be the beginning of a long, most meritorious and beneficial service".

In 1882 Boulenger was appointed a first-class assistant in the Department of Zoology, a position which he held until his retirement in 1920. One of his first duties was the supervision of the removal of the spirit collections from Bloomsbury to South Kensington.

Gifted with tremendous energy, an extremely methodical mind, and a memory that was little short of amazing, Boulenger accomplished a vast amount of scientific work during his forty years at the museum. From 1882 until 1920 a continuous stream of papers flowed from his pen. A list of his herpetological and ichthyological contributions published by the Zoological Society of Belgium in 1921 includes no less than 875 papers in scientific journals and other periodicals, and takes no account of numerous articles of a more popular nature in the *Field*, *Country Life*, etc. His most important contributions to science, however, were the elaborate and detailed monographs, mostly published by the British Museum, which remain to this day the solid foundation of all modern systematic work on the groups of animals concerned. Of these, mention may be made of the "Catalogue of Batrachians . . ." (2 vols., 1882), "Catalogue of Lizards . . ." (3 vols., 1885–87), "Catalogue of the Chelonians, Rhynchocephalians, and Crocodiles . . ." (1889), "Catalogue of the Snakes . . ." (3 vols., 1893–96), "Monograph of the Lacertidæ" (1920), all published by the Museum; the volume on reptiles and batrachians in the Fauna of British India series (1890); and the monograph on the tailless batrachians of Europe, published by the Ray Society (1897–98). The first (and only) volume of a new edition of the "Catalogue of Fishes . . ." (1895), covering several important Percoid families; "Les Poissons du Bassin du Congo" (1901); "Fishes of the Nile" (2 vols., 1907); the systematic section on the Teleostei in the "Cambridge Natural History" (1910); and "Catalogue of the Fresh-water Fishes of Africa . . ." (4 vols., 1909–15); are perhaps the most valuable of his major contributions to systematic ichthyology, and are veritable monuments of painstaking research. The Museum "catalogues" are worthy of special mention, since they represent complete revisions of large groups of animals from all over the world, and, for the most part, they are to-day still the only complete revisions of the groups concerned. That, in addition to this prodigious output of scientific work, Boulenger was able to find time to prepare the sections dealing with reptiles, batrachians and fishes in the *Zoological Record* every year from 1880 to 1904, is a tribute to his amazing and indefatigable energy.

Boulenger's study of the rich collections of freshwater fishes obtained in the Congo basin about 1898, and of those collected during the Egyptian Government's survey of the Nile, directed his special attention to the fishes of the African continent, and these remained his principal interest during the remainder of his museum career. Determined to use every effort to fill the gaps in the national collection, he encouraged travellers and residents in various parts of Africa to send home specimens, with the result that the British Museum now possesses a collection of African freshwater fishes unparalleled in the world. His intensive study of these fishes led him to formulate certain general conclusions concerning the origin and distribution of the African fish-fauna, and his views were ably summarized in his presidential address to Section D (Zoology) of the British Association in 1905. The study of this illuminating address may be recommended to those of the younger school of zoologists to whom systematic zoology is a convenient method of cataloguing, and something quite apart from modern conceptions of science.

On his retirement in 1920, herpetology and ichthyology were almost entirely abandoned in favour of another abiding interest. Long attached to the study of flowers, and particularly of roses, he had spent many of his vacations during his later years at the Museum in visiting various European countries in search of data and specimens. He now became attached to the Botanical Gardens in Brussels, where he undertook the study of the fine series of roses in the herbarium of François Crépin. He was engaged upon a monograph of the European roses at the time of his death, and two volumes had already been published under the title of "Les Roses d'Europe de l'Herbier Crépin".

Boulenger's work was widely recognized by corresponding or honorary membership of many learned societies both at home and abroad. He was elected a fellow of the Royal Society in 1894, and served on the Council. He was also a member of the Council of the Zoological Society nearly continuously from 1893 until 1911, and was for several years a vice-president. He was a doctor *honoris causa* of Louvain, Giessen and St. Andrews, and received a silver medal from the Société d'Acclimatation de France. In 1935, the American Society of Ichthyologists and Herpetologists elected him as its first honorary member, and in 1937 the country of his birth conferred upon him the Order of Leopold, an honour which gave him great pleasure and of which he was justly proud.

The writer of this notice did not come into contact with Boulenger until shortly after his retirement, but he cherishes the memory of several informal talks and discussions. The kindness and courtesy shown to a beginner by one who was the acknowledged master of his subject will always be remembered, and played no small part in the writer's education in systematic ichthyology.

A naturalized Englishman, Boulenger married Emilie, daughter of Charles Heyman of Brussels, who died in 1936. He leaves three sons, two of whom have adopted zoology as a profession. J. R. N.

Prof. A. J. Ewart, F.R.S.

ALFRED JAMES EWART, who died suddenly at his home near Melbourne on September 12, was the first professor of botany to be appointed in any Australasian university. Born at Liverpool on February 12, 1872, he was educated at Liverpool Institute and the University of Liverpool. He afterwards worked in the Universities of Leipzig (Ph.D.) and Oxford (D.Sc.). After a period as science master at the King Edward School, Bromsgrove, he became lecturer in botany at the Municipal Technical School and deputy professor in the University at Birmingham.

In 1906 the Government of Victoria decided that a successor must be appointed to Baron Sir Ferdinand von Mueller as Government botanist, and that the duties could be combined with those of a chair of botany at the University. For fifteen years, Ewart carried the heavy double burden, spending half his day at the University and half in the Herbarium at the Botanic Gardens, South Yarra, two or three miles away across the city. Ewart was further handicapped by lack of laboratories. Botany in the University had been split from the Department of Biology, and still shared the same building. It was not until 1929 that the Department was able to remove to buildings of its own. Ewart was justly proud of the fine Institute which was officially opened in November of that year. He had been elected a fellow of the Royal Society in 1922.

Ewart is best known to British botanists as a plant physiologist, the translator of Pfeffer's "Plant Physiology" and the author of a monograph on protoplasmic streaming published by the Oxford University Press. At about the time of his appointment to Melbourne he was engaged in work upon the ascent of water in trees (*Phil. Trans.*, 1905 and 1908), but after his arrival in Australia systematic and economic botany occupied most of his time. This did not prevent his publishing upon such a wide range of subjects as the longevity of seeds, photosynthesis, the chemistry of chlorophyll and the sensitivity of apples to poisons. This last work led him to hold certain views as to the cause of bitter pit in apples by metallic poisoning. His contributions to the flora of Australia number thirty-six papers. He also published a "Flora of the Northern Territory" in 1918 and in 1930 there appeared his "Flora of Victoria", a book of some 1,000 pages with 400 line drawings. This work is of great value to students in that State. Until its appearance, there was only an incomplete flora by von Mueller and the "Flora Australiensis" for reference.

Ewart's duties as a Government botanist compelled him to pay much attention to weeds and poisonous plants. His services were utilized by the Federal Government in connexion with stock poisoning along the overland route from the Northern Territory to Oodnadatta. In the winter of 1924 he visited Central Australia to examine the problem in the field.

Ewart was a man of robust physique. He delighted in country life and hard physical work. He found much pleasure in the labour of clearing and burning bush around his country cottage near Healsville, close to the heart of the giant eucalyptus forests. He was, however, keenly interested in forestry education and in efforts to develop a forest consciousness in Australia. In 1925 he published a "Handbook of Forest Trees" for use in Victoria, and at the time of his death he was chairman of the Forestry Examinations Board.

For the last two years of his life, Ewart had been far from well. He developed heart trouble. His sudden death, at the comparatively early age of sixty-five years, is a severe loss to his friends and colleagues.

T. G. B. O.

WE regret to record the death of Miss Lilias Armstrong (Mrs. S. Boyanus), which took place unexpectedly in London on December 9. Miss Armstrong was one of the foremost exponents of the science of phonetics, and was well known for her studies of the phonetic systems of the African languages. Lilias Armstrong, the daughter of the Rev. J. W. Armstrong, was a graduate of the University of Leeds. She joined the staff of the Department of Phonetics of University College, London, in 1918. Her abilities as research worker, teacher and organizer won her a world-wide reputation, which was recognized when at the close of the academic year 1936–37 the University of London conferred on her the title of reader. Miss Armstrong was the author of a large number of books dealing with the phonetics of English, French, Burmese, Somali and Kikuyu. It is especially in connexion with the two last named that Miss Armstrong's contributions to the study of languages were of especial note. Her phonetic studies put the grammar of these two languages on a new basis, her most remarkable discovery being the function in them of voice-pitch, by which in both, she discovered, grammar and meaning are determined.

News and Views

British Association: Sectional Presidents

THE annual meeting of the British Association will be held in Cambridge on August 17–24, 1938, under the presidency of the Right Hon. Lord Rayleigh. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Dr. C. G. Darwin; B (Chemistry), Prof. C. S. Gibson; C (Geology), Prof. H. H. Swinnerton; D (Zoology), Dr. S. W. Kemp; E (Geography), Prof. T. Griffith Taylor; F (Economics), Mr. R. F. Harrod; G (Engineering), Prof. R. V. Southwell; H (Anthropology), Prof. V. Gordon Childe; J (Psychology), Dr. R. H. Thouless; K (Botany), Prof. W. Stiles; L (Education), Mr. John Sargent; M (Agriculture), Prof. R. G. Stapledon.

Mr. R. A. Smith

MR. REGINALD ALLENDER SMITH, who retires from the office of keeper of the Department of British and Medieval Antiquities of the British Museum (Bloomsbury) on January 4, has held that appointment since 1928. Mr. Smith had had a long period of previous service in the Department as assistant keeper, entering it when, under the late Mr. (afterwards Sir) Charles Hercules Read, it still included the exhibits in ethnography. Although the whole field of British prehistoric archæology lies within the range of Mr. Smith's expert knowledge, it is more particularly on the palæolithic period and the Iron Age that he is regarded as of the highest authority, and that on certain classes of disputed questions his judgment has been in a sense a court of final appeal. Of the official guides and other publications of the British Museum, of which Mr. Smith is sole or part author, the catalogue of the Sturge collection of stone implements is perhaps of the most enduring value to the student. Mr. Smith is not only the author of a large number of the archæological chapters in the various volumes of the "Victorian History of the Counties of England", but he has also made numerous valuable and authoritative contributions to the literature of archæology in the pages of learned and scientific publications dealing with the subject, more especially those published by the Society of Antiquaries of London, of which society he has acted as secretary and for some years past has been the director.

Mr. T. D. Kendrick

MR. THOMAS DOWNING KENDRICK, who will succeed Mr. R. A. Smith as keeper of the Department of British and Medieval Antiquities of the British Museum, has been an assistant keeper in that department for some years. Since the publication of his first book "The Axe Age", Mr. Kendrick has been recognized as an archæologist whose views are original, but at the same time carefully observant of the limitations of the evidence. Of recent years Mr. Kendrick has made a special study of the form and technique of the Celtic or British decorative art of the Iron Age and the British and Scandinavian art forms of the early historic period, on which he has contributed a number of papers to archæological publications. Among his more important published works are "The Archæology of the Channel Islands", of which one volume only has as yet appeared, "The Druids", "A History of the Vikings" and "Archæology of England and Wales, 1914–1931", the last-named in collaboration with Mr. C. F. C. Hawkes. He is also the editor of that valuable and scholarly series, "The County Archæologies".

Lord Nuffield's New Gift to Oxford

THE endowment of demonstratorships and assistantships in the Oxford Medical School, to be held by graduates from Australia, New Zealand and South Africa, will now be possible thanks to Lord Nuffield's latest gift to the School of £168,000. It is intended with this money to establish three demonstratorships in the pre-clinical departments of anatomy, biochemistry, pathology, pharmacology, and physiology, and three assistantships in the departments of medicine, surgery, obstetrics and gynæcology, anæsthetics, orthopædic surgery, and therapeutics. These posts will be held for a fixed period by graduates eligible for, or already holding, research posts in the universities of Australia, New Zealand and South Africa which grant medical degrees. The holders will be selected in rotation by these universities and appointed to the particular department in Oxford which is theirs. They will thus enjoy all the advantages of membership for a time of the Oxford Medical School. Oxford will benefit by the presence of these additional highly qualified workers; and the Dominions concerned will benefit by their experience on their return.

The Royal Botanic Garden, Calcutta

THE Royal Botanic Garden, Calcutta, is celebrating the completion of its 150th year on January 6, during the jubilee meeting of the Indian Science Congress, and a number of distinguished botanists from Great Britain expect to attend. The Garden was started at the suggestion of Lieut.-Colonel Robert Kyd, and continued as the Honourable East India Company's Botanic Garden until the Company relinquished its control of the government of India in 1857, when it became the Royal Botanic Garden, Calcutta. Colonel Kyd was appointed superintendent of the Garden and continued in that position until his death in 1793. Then it was decided to appoint a special officer, and the East India Company's botanist, Dr. William Roxburgh, held the post from 1793 until 1813. Roxburgh published his "Flora Indica", which became the basis of many subsequent Indian botanical works. In spite of a series of well-known superintendents (F. Buchanan (afterwards Hamilton), N. Wallich, W. Griffith, Hugh Falconer, T. Thomson, T. Anderson, C. B. Clarke, G. King), the Garden suffered vicissitudes of progress and serious set-backs. Cyclones practically devastated the grounds on more than one occasion, and once the Herbarium became seriously depleted through supplying other herbaria too lavishly. Recovery began under the administration of Dr. (afterwards Sir) George King, who retired in 1897; and still further improvements were made under Sir David Prain, who succeeded King and remained superintendent until 1905. Since that date, the Garden has continued performing important functions under the administration of several successive superintendents. The present superintendent is Mr. K. P. Biswas, who, until his recent promotion, was curator of the Garden Herbarium. For several months since relinquishing his curatorship, Mr. Biswas has been working at the Royal Botanic Gardens, Kew. The Garden lies on the right bank of the River Hooghly, at Sibpur, just outside Calcutta; and is now about 270 acres in extent. Apart from work of a 'pure' botanical nature, much work of economic importance —chiefly to India—is being pursued along lines similar to those obtaining at Kew. The authorities are to be congratulated on the Garden attaining its 150th anniversary, and Mr. Biswas on his recent appointment as superintendent.

An Early Text-book of Chemistry

THE small text-book on chemistry, "Tyrocinium Chymicum", of Jean Beguin, a native of Lorraine, was first published anonymously in 1610 and went through a large number of editions. The first issue was intended for the use of Beguin's own pupils in a school of pharmacy he established in Paris, but it was pirated and re-issued in Cologne in 1611. Beguin then re-issued it in 1612. Prof. T. S. Patterson, in a paper on "Jean Beguin and his *Tyrocinium Chymicum*", published in *Annals of Science* (2, 243–298; 1937), has given a very full account of the various editions of the book and a description of its contents. As he says, "it is certain, on account of the large number of editions issued, that Beguin's little book was found to be of great practical value, and it must have done much in unostentatious fashion to guide real chemistry along a sound experimental path. . . . Beguin was much under alchymical influence . . . but his was a common-sense alchymy and he used its philosophy in an entirely reasonable manner. There was little of the fantastic and nothing of the quack or impostor, or even of the willing dupe or self-deceiver, in him." In a preface by Barth in a later edition, it is said: "Beguin, on account of his virtue, opened his school in Paris—that celebrated emporium of all the wits, and compendium of the whole world—and did not burden his pupils and learners (for princes, counts, nobles, councillors and doctors, attracted by its novelty, meanwhile frequented his chemical laboratory) with useless and prolix comments and various descriptions of his remedies, but prepared in their sight candidly and simply, the secret medicaments of Quercetanus and others, of all kinds both solution and coagulation".

Science and Mankind

THE *Manufacturing Chemist* of November includes a further symposium of notes from contemporary scientific workers on "Science and Mankind". Contributions in the October number from Mr. H. G. Wells, Sir Richard Gregory, Prof. L. Hogben, Prof. H. Levy and Sir Daniel Hall are followed by others from Prof. J. B. S. Haldane, who stresses the importance of adequate organization to supply the Press with scientific news, and of thinking rationally about economics and politics, and Mr. C. S. Garland, who directs attention to the vital need for an organization which can speak for science as a whole and of the importance of having representatives in Parliament who are really concerned with the welfare of the profession as a whole. Sir Ernest Graham-Little outlines the contribution which medical science can make to improve social conditions. Dr. W. Cullen, while pointing out that the ultimate effects of a scientific or technical discovery are largely unpredictable, stresses the impossibility of stopping scientific and technical progress and, while condemning the prostitution of science as in warfare, directs attention to the way in which social conditions have been improved by scientific and technical advances. Prof. Alfred Stock expresses the hope that the progress of chemistry and physics has rendered war so terrible that the use of brute force will be renounced by the nations in reality, and that then science will be able to devote itself completely to the welfare, health and enjoyment of existence of mankind.

Research in Canada

THE nineteenth annual report of the National Research Council of the Dominion of Canada, for the year 1935–36, refers to the valuable work of the Division of Chemistry on the utilization of Alberta's natural gas. Optimum conditions have been determined for the production of ethylene, and a method has also been developed giving three to four gallons of benzene from each thousand cubic feet of Turner Valley stabilizer gas. Reference is also made to the synthesis of a number of plant-hormones and to the discovery that alkaloids of the giant larkspur, a plant growing wild in southern Alberta, are powerful insecticides. The Division of Chemistry has also developed an improved method of measuring the hiding power of paints, and the wax mixture previously developed for use in plucking chickens has now come into wide use in preparing poultry for the market. Dry-cleaning research has included the study of non-inflammable cleaning solvents, such as trichloroethylene, the manufacture of which is being undertaken in Canada. The Division of Biology and Agriculture has compiled an extensive review of the literature on weed killers as a guide to experimental work in this field. The extent of insecticide taint in wheat, the requirements of barley suitable for malting, especially for the British market, cold storage of fowls, fruit and other food products have all received attention, and physical conditions necessary for de-chilling boxed poultry have been established which prevent the formation of condensate, a blemish which lowers the market quality.

THE Division of Physics and Engineering has been responsible for a good deal of standardization work in co-operation with the National Bureau of Standards, Washington. A 'reverberation chamber' has been built and used for measurements of the sound-absorbing properties of various kinds, building materials for Government departments and commercial firms. Apparatus completed during the year has enabled the Division to make thermal insulation tests on large samples of insulating materials, partitions and wall sections. An experimental investigation of the heating of railway refrigerator cars in winter has been completed, and in addition to aerial surveys the Division has been concerned with a number of aviation problems, including the development of a new type of aircraft ski. The Division of Research Information is being vigorously developed and the report also refers to conferences on forestry and fish culture and to the work of a number of associate committees, as well as to the assisted researches, for which grants amounting to 158,968 dollars were provided during the year, and to the 685 scholarships awarded to 385 persons, representing total grants of 570,053 dollars.

Cancer Research in Australia

THE report of the eighth Australian Cancer Conference, which was held in Canberra in April last, shows that it was a meeting well attended by representatives from Australasia. The recommendations of the Conference of the previous year appear to have been largely acceptable to the Commonwealth Government for, on September 24, 1936, a National Health and Medical Research Council was instituted by an Order in Council. The recommendation that the Commonwealth Government should appoint an Australian Cancer Commission did not, however, prove acceptable. Among other resolutions of the present year's Conference may be mentioned a recommendation that the Commonwealth Government should make available the sum of £30,000 annually for the purpose of establishing a permanent and reliable system of medical research. There is little doubt that a most lively interest is being taken officially by Australia in the subject of cancer among its population. This is reflected not only in public action but also in the publications which appear from time to time dealing with various aspects of this subject. "Physical Aspects of Radium and Radon Therapy" is a booklet prepared by Dr. C. E. Eddy, physicist-in-charge of the Commonwealth X-ray and Radium Laboratory of the University of Melbourne, and Mr. T. H. Oddie, more especially for the use of radiotherapists and officers of local physical services. The booklet of sixty pages gives an extremely good account of the general physics of the substances and radiations used in radiotherapy together with an account of precautions necessary in using them. The relative advantages and disadvantages of radium and radon are also dealt with in a thoroughly explicit manner.

Edible Birds Nests in the Philippines

The edible nests of swiftlets, valued as a delicacy and as food for convalescents by the people of China, are built in limestone caves along the seashore in many parts of the Philippines. The export of the nests is in the hands of local Chinese merchants, and although accurate statistics are difficult to obtain it has been stated that the Netherlands Indies in 1927 exported 109,310 kilograms of nests valued at 822,913 guilders. In only one of the Philippine Islands, Bacuit, has an attempt been made to derive municipal revenue from the trade, when in 1927 the traditional ownership of the birds nest caves, which had existed for generations, was supplanted by municipal ownership and the annual leasing of the caves to the highest bidder. As a reply to this move, the Chinese dealers formed a ring so that the bidding, which reached 1,700 pesos in 1927, had fallen in 1936 to 500 pesos, and in a footnote to a recent paper on the subject, Canuto G. Manuel states that as no bid at all was offered in 1937, the caves have relapsed to the system of traditional ownership (*Philippine J. Sci.*, 62, 379, March 1937). From Bacuit, approximately 500 kilograms or about 100,000 nests are exported annually, but poaching of nests is common, and attempts to limit the collecting with the view of conserving the stock have met with little success. Nest collecting, however, is a dangerous occupation, and the fact that some inaccessible caves are tenanted by the birds, which belong to the racial form, *Collocalia francica germani*, provides for the survival of the swiftlet.

Literature of Food Investigation

IN its report for 1936, the Food Investigation Board stated that a committee had been appointed to review both the scope and the form of its publication, "The Index to the Literature of Food Investigation". The first number of this journal appeared in 1929 and at present it covers about a hundred scientific and technical periodicals, each number containing upwards of 2,000 references, in the form of elaborated titles that indicate the scope of the papers indexed, but omit all experimental data. The original intention was that the "Index" should deal solely with the transport and storage of foodstuffs; it now tends to cover, however, the wider diverse field that lies between agriculture, or production, and nutrition, or the use of food for the maintenance of health. The first number of volume 7, which covers the literature published in 1934, has been issued ("Index to the

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Science and the Unobservable*

By Prof. Herbert Dingle, Imperial College of Science and Technology

A NEW phenomenon has appeared in modern physics, namely, an attempt to apply with rigour the principle that only that which is observable is significant. This is not intended to be a precise statement of the principle. It is at least vague, and perhaps inaccurate, but on that very account it is the most suitable statement with which to begin our discussion. For the principle itself has not yet been clearly isolated from its applications. Consequently it is manifested here in one form and there in another, appearing to some as an outstanding example of scientific arrogance and even absurdity, while to others it has an authority which raises it above common sense and reason alike. It is therefore important to try to understand the meaning of the principle and to reach a point of view from which its validity may be justly appraised.

It is Einstein who is responsible for the present virility of the principle. Let us hear him speaking of the crux of his theory—the idea of the simultaneity of events occurring at different places.

"The concept" of simultaneity, he says, "does not exist for the physicist until he has the possibility of discovering whether or not it is fulfilled in an actual case. . . . As long as this requirement is not satisfied, I allow myself to be deceived as a physicist (and of course the same applies if I am not a physicist), when I imagine that I am able to attach a meaning to the statement of simultaneity. (I would ask the reader not to proceed farther until he is fully convinced on this point.)"[1]

Here, on the other hand, is a comment by M. Jacques Maritain, the well-known French Catholic philosopher, on this passage:

"Let us, then, obey our author and read no farther, for this little parenthesis, 'the same applies if I am not a physicist', is of direct concern to us who have not the honour to be physicists, and it presumes to introduce us into the most fallacious metaphysics. . . . It is a fault so obvious to the eyes of a philosopher to confuse the *meaning* of a concept . . . with the *use* which may be made of the concept in this or that field of study, . . . that we hesitate to impute such a mistake to anyone, whoever he may be. Everything goes to show, however, that Einstein has made this mistake."[2]

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It is not surprising that a physicist and a philosopher should take opposite views of this question, but the matter cannot be disposed of on simple psychological grounds. Here are the diametrically opposed views of two men of science:

"The general point of view" of relativity, writes Prof. C. G. Darwin, "of questioning the reality of anything unobservable is one of the greatest revolutions in scientific thought that has ever occurred. . . . The great idea which Einstein contributed to scientific philosophy was the principle that if a thing is essentially unobservable then it is not a real thing and our theories must not include it."[3]

This remark has caught the eye of Mr. Albert Eagle, now a mathematician, but in other days an experimental physicist, whose name is known wherever spectroscopy is practised.

"To me," says Mr. Eagle, "this 'great idea' is the most savage example of the application of what is known as the principle of *Occam's Razor* of which I have heard. . . . Einstein's 'great idea' requires us to surrender our common sense for the sake of an arbitrary dictum of his which he and his followers have raised to a fetish. It is preposterous, and to my way of thinking is so inherently idiotic that I cannot understand anyone wasting his breath in giving utterance to such a view."[4]

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* From a Friday evening discourse delivered at the Royal Institution on November 26.

Finally, here is the attitude of another philosopher, Rudolf Carnap—perhaps the leading exponent of the most active of modern schools of philosophy, the so-called "logical positivism". Carnap, the philosopher, not only accepts the principle; he uses it to reduce to nonsense those branches of his own subject known as metaphysics and ethics.

> "I will call *metaphysical*", he writes, "all those propositions which claim to present knowledge about something which is over and above all experience. . . . Metaphysicians . . . are compelled to cut all connection between their propositions and experience; and precisely by this procedure they deprive them of any sense."[5]

Now when men who are neither fools nor liars agree that a certain idea is either the greatest discovery of a generation or the silliest nonsense imaginable, but cannot agree as to which it is, it is clear that there is more than a difference of opinion; there must be some defect of understanding also. It therefore becomes a matter of importance to state this principle precisely, so that we shall at least know what we are doing when we bless or curse it. And in seeking to assess its value we must avoid the error of ascribing greater or less weight to the opinion of a physicist than to that of another. Einstein is perfectly right in saying that if this principle holds for him as a physicist, it holds for him also if he is not a physicist; and M. Maritain offers him a licence which he cannot accept when he allows him to apply the principle in physics but not outside. If we talk nonsense, and plead in extenuation that we are only talking as physicists, we fall short of the ideal of rational speech, distinguished precedent notwithstanding. The question must be considered on general rational grounds. Are we to admit the unobservable into our scheme of things, or are we not?

Let me for a moment adopt the legal method, and state the case for each side independently, as an advocate might state it. Take first the case for the principle. It is necessary, say its supporters, as a safeguard against irresponsible invention. If we allow that an entity might exist and be significant to thought, although it is essentially unobservable, what is there to prevent us from postulating any number of such entities and invoking them to remove any difficulty that might arise? Suppose, for example, I assert that there is a binkum sitting on the table in front of me, and that this tremendous fact, rightly understood, is the final, completely satisfying solution of the problem of evil. If you reject the principle in question, you have no grounds for denying the statement. You may say that you cannot detect my binkum, but I reply that of course you cannot, because he is unobservable. If you want to know how his existence solves the problem of evil, I say that it is its nature to do so, and the definition of him, according to your own contention, is quite independent of any means you adopt to investigate him. If you ask, "What is a binkum, anyway?" I reply that that is immediately evident; I cannot put it into words, but everyone knows what a binkum is. If you retort that you do not know, I shrug my shoulders and say that you must be speaking as a physicist.

Stupid as this example sounds, it contains a precise parallel to the case of simultaneity. M. Maritain and those who agree with him claim that the simultaneity of spatially separated events is something independent of our means of observing it. When asked what it is, they claim that its nature is immediately evident and that everyone knows it. But Einstein says he does not know it, and Einstein is an honourable man. And the only reply is that Einstein and his followers must be speaking as physicists.

We can now press home the point. We agree, let me assume, that science and philosophy are better without the binkum: How, then, can we exclude him? Only, says counsel for the defence of the principle, by refusing to grant existence to anything that is essentially unobservable, and denying any unobservable property to an existent thing. That means that everything whose existence we acknowledge must be definable ultimately in terms of observation. If there is the slightest relaxation of this requirement, in comes the binkum with passport signed and sealed.

The case seems established, but we must hear counsel for the other side. His argument is a *reductio ad absurdum*. Certainly we do not want the binkum, he says, but your device for keeping him out is both presumptuous and absurd; you are throwing out the baby with the bath-water.

Consider for a moment what your principle implies. It asserts that there is nothing in the universe except what you can observe—nothing in the physical world beyond the reach of your senses. How do you know that the universe does not contain things apprehensible only by senses which you do not possess, which perhaps you have lost in the course of evolution or have not yet acquired ? Moreover, what about the past ? You cannot observe that, for it has gone ; therefore, you say, it has no meaning, it must not come into our description of reality. Such nonsense necessarily follows if your principle is granted. Exclude your binkum by all means—we hold no brief for him ; but find some sensible way of doing it, without assuming potential omniscience

The problem, I think, is now set clearly before us. If we admit the unobservable, there is no check on empty speculation ; if we reject the unobservable, we confine the universe within the bounds of human potentialities and make nonsense of history. What are we to do ?

It is evident that we must begin by examining the word 'unobservable'. Both sides wish to exclude the binkum ; both wish to allow the universe a richer content than we can at present perceive. The 'unobservable' that is to be proscribed must therefore include the obviously idle fancies but exclude the legitimately transcendental.

There are reasons of various kinds why we may be prevented from observing a thing; but I think they can all be summarized under four headings. First of all, there is what I will call the *practically* unobservable ; namely, that which is unobservable because of the practical difficulties of observing it. The far side of the moon affords an example. That region is unobservable because we have not solved the problem of interplanetary travel, or performed some equivalent feat of practical ingenuity. It is conceivable that in time this disability will be removed, so that practical unobservability may be merely a temporary characteristic.

Secondly, there is the *humanly* unobservable ; by which I mean the unobservable which is so because we do not possess the necessary faculties for observing it. I cannot, of course, by the nature of the case, give examples of this, but I can give analogies. A great deal of the universe would be humanly unobservable if we had no sense of sight ; and to the musically insensitive the significance of a great composer may be said to be humanly unobservable. If, then, there is in the universe some existence which no creature has the faculty of apprehending, that existence is humanly unobservable.

Thirdly, there is what I will call the *physically* unobservable. A thing may be said to be physically unobservable when we have the faculty for observing it if Nature will co-operate, but Nature gives that faculty no opportunity for exercise. Thus, if somewhere in space there occurred an event from which no signal—light ray or sound wave or anything else—proceeded to other places, and if there were repulsive forces which prevented us from ever reaching the place of occurrence, that event would be physically unobservable.

Lastly, there is the *logically* unobservable ; namely, those things which we cannot claim to have observed without breaking the laws of reason. I doubt if this class is actual, since logic and observation are essentially independent, but it must be included because a great deal has been written about it. An example might be the observation of an object both larger and smaller than a given object ; but I give this example with some hesitation because geometers have an uncanny knack of inventing spaces in which such relations might not be incompatible. Be that as it may, however, if we grant a certain minimum of common agreement—such as the acceptance of Euclidean geometry in the present instance—logical unobservability becomes an intelligible notion, and we will accept it as a candidate for inclusion in our principle.

Now this classification may be simplified ; for, whatever may be the ultimate truth of the matter, it is not necessary for our purpose to put the humanly and the physically unobservable in separate classes. I will therefore group them together and call them jointly the physically unobservable. The justification for this is that we cannot tell, in any given case, with which class we are dealing. If, for example, a certain substance appears tasteless to everyone (that is, its taste is unobservable), it is impossible to say whether that is because it has a taste which our senses are not keen enough to detect, or because it has no taste to be detected. But now our principle is essentially one which, if valid, must be used ; it is not a creed which we are merely called upon to state and may then ignore. The humanly and the physically unobservable, then, become one class so far as our problem is concerned, for if in practice we reject one, we automatically reject the other also.

We have, then, three classes of unobservables, and I think the distinction between them may be expressed most simply in the following way. Let us suppose that we have discovered all the means of observation that exist in the universe, and know all their properties completely. We might then be able to imagine other means of observation which do not exist. Anything which would be observable by such imaginary means, but not by the existing means, would be *physically* unobservable. Anything which would be unobservable by *any* means, existing or imaginable, would be *logically* unobservable. Anything which would be observable by the existing means if we were also omnipotent, but which actually is unobservable because we cannot make full use of the means of observation which exist, would be *practically* unobservable.

We can now proceed a stage further. We have just seen that, for our purpose, the humanly and the physically unobservable become one class because we cannot at present distinguish between them. Let us look, then, at our latest classification, to make sure that the three types of unobservability we have now reached are immediately distinguishable. It is fairly evident, I think, that they are, if we grant the initial supposition that we have discovered all existing means of observation. For brevity, I will call that the assumption of *omniscience*, and you will understand that by this word I do not mean knowledge of everything that exists or that can be observed, but complete knowledge of the existence and properties of every means by which observation is possible. For example, omniscience implies complete knowledge of all the properties of light, but not necessarily of all objects which are visible. Now, clearly, this assumption of omniscience is open to challenge, and it is therefore necessary to see how our classification looks if it is removed. Can we then still recognize the three classes as distinct ?

There is no difficulty, I think, with the logically unobservable. Since this class consists of things which are not even *imaginably* observable, it makes no difference how much we know of *possible* observability. There can be no possible means of observation that is not imaginable. The logically unobservable, then, forms a definitely distinguishable class, independently of our assumption of omniscience.

The case is different, however, with the practically and the physically unobservable, for these classes *cannot* be distinguished if we do not regard ourselves as omniscient. We said that the far side of the moon was practically unobservable, but if we are not omniscient, how do we know that when we have overcome what seem to be the present obstacles, Nature will not face us with some unexpected difficulty like that which she kept in store for our efforts to determine our motion through the ether ? If she does, and persists in doing the same kind of thing, we shall have to call the far side of the moon physically and not only practically unobservable. And, on the other hand, when we say that absolute motion is physically unobservable, we are again assuming omniscience. We cannot observe such motion by optical, acoustical, electro-magnetic or any other means within our present knowledge, but, without the assumption, who can say that there is not some undiscovered physical medium through which it may be detected ? If there is, absolute motion is merely practically, and not physically, unobservable. It is clear, I think, that unless we are omniscient the two classes are indistinguishable.

Our analysis of unobservability, then, finally brings us to this. If we assume that we are omniscient we can distinguish three classes—the *practically*, the *physically* and the *logically* unobservable. If we do not assume that we are omniscient we can distinguish only two classes—the *actually* and the *logically* unobservable, let us call them. The importance of this conclusion for our purpose is this. We are going to look at the actual practice of physics, to see what kinds of unobservable are excluded and what kinds are not. If we find that a distinction is made between the practically and the physically unobservable, then we know that physics is assuming omniscience; but if no distinction is made, then there is no such assumption.

Let me state the result at once, afterwards giving examples to justify the statement before proceeding to consider the validity of the principle we are considering in its definite form. The practice of physics is to recognize three classes—the practically, the physically and the logically unobservable. Of these it excludes the physically and the logically unobservable from its considerations, and aims at describing the universe in terms of the observable and the merely practically unobservable only. It thus assumes omniscience, in the sense in which I have defined the word.

It will not take us long to see that physics includes the practically unobservable. No physicist denies that the moon has a far side in the same sense as it has a near side. We assume without question that the earth has an interior, that there are stars outside the range of our telescopes, and regions beyond the obscuring clouds of the Milky Way. All these things could be observed if known means of observation have precisely the properties we believe them to have and we had the skill to make full use of them. Hence the practically unobservable is admitted to physical theory.

We may deal equally summarily with the logically unobservable. Nasty things have been said about the reasoning of some modern physicists when they step outside the bounds of their equations, but I do not think the bare, unadorned physical theories themselves have been called illogical, either with pride or with shame. If, then, the structure of physical theory allows ontological significance to anything which is logically unobservable, it does so through an oversight, and theory will undoubtedly be reformed as soon as the oversight is discovered. We may say, therefore, that the practice of physics is to reject the logically unobservable.

But now, the unobservables the rejection of which has caused all the controversy belong to neither of these classes. Let us fix our attention on the example of absolute simultaneity, with which the discussion began. This, as we know, is rejected, and that cannot be because it is practically unobservable, for physics reeks of the practically unobservable. Nor is absolute simultaneity logically unobservable. We can conceive that the universe might be such that two events at different places might occur at the same time in an absolute sense, and that this fact might be observable. We cannot, then, escape from the conclusion that absolute simultaneity belongs to a third class of unobservables, which we shall see is what I have called the class of physically unobservables; and the recognition of this class commits physics to the assumption of omniscience.

To see that absolute simultaneity is physically unobservable, let us look at the obstacle that prevents us from observing it. Why can we not say, in an absolute sense, that two events occurring at different places are simultaneous? It comes down to the fact that we can know of the events only through some agency which travels from them to us and takes time to do so. We know of most events when we see them, but we do not see them at the moments at which they occur because the light which makes them visible takes time to travel. We can, of course, allow for this by calculating how long the light has taken to travel, but when we do so, according to standard methods and principles, we find that the results depend on the way in which we happen to be moving with respect to the bodies on which the events occurred. Furthermore, we cannot distinguish in an absolute sense between one state of motion and another. Hence we do not know what allowance to make for the time of travel of the light, and therefore cannot determine absolutely whether the events were simultaneous or not.

The unobservability of absolute simultaneity, then, depends on the fact that we cannot determine unambiguously how long light takes to inform us of an event; or, more generally, how long after an event it is possible for us to know of it. This ignorance, of course, would not be necessary if we could know of an event immediately it occurred—if, this is to say, we could observe it by some messenger which travelled at an infinite speed. This is not pure fancy. Before the time of Römer, in the seventeenth century, it was believed that light might travel at an infinite speed; and before the theory of relativity arose, it was believed that gravitational action was transmitted instantaneously. It is not uncommon, too, to imagine that there might be instantaneous telepathic communication. We can at least, then, *conceive* that an instantaneous messenger might exist, and therefore absolute simultaneity is not *logically* unobservable. It is unobservable simply and solely because, so far as our present survey of the universe has gone, there is no evidence that it is possible to learn of a distant event at the moment at which it occurs. In other words, absolute simultaneity is *physically* unobservable.

We can now, at last, give a rigorous form to the principle which is the subject of our inquiry. It is this: that *only that which is practically observable*—that is, only that which would be observable if we were able to use known means of observation to the known limits of their possibilities—*is significant.*

The next step, clearly, is to examine the credentials of this principle on general rational grounds, but before doing so I want to give another example of its application, in order to emphasize the fact that it is not an unimportant appendage of physical theory, but the very mainspring of the most prominent modern developments. Heisenberg's uncertainty principle is perhaps the best-known example, but I will not deal with that because it is too closely bound up with other factors which there is no time to consider. I choose instead a subject which stresses the point still more forcibly because it is not generally regarded as exemplifying the principle in question, but is attacked or defended on quite other grounds. The principle has taken root so deep in the minds of physicists that they employ it unconsciously, and justify their action by arguments which appear to others either incomprehensible or absurd. I am speaking of the idea that the physical universe is finite but boundless. This idea can be made intelligible in five minutes when presented as an example of the principle of rejection of the physically unobservable, and I believe that those who accept it are convinced of its rationality because they have already accepted that principle. They are not aware of this source of their conviction, however, and therefore have to justify their belief by saying that space is "curved", that it "bends back on itself"—an "idea" which I do not think it is humanly possible to grasp except as a metaphor of the kind one meets with in the "metaphysical" poetry of the seventeenth century. Whether or not that psychological diagnosis is accurate, however, is unimportant; the main point is to see that, in terms of our principle, the idea that space is finite and boundless is intelligible without calling on such unimaginable notions as curvature.

The idea is that if we were free to move about in space eternally, wherever Nature led, we would always find ourselves apparently in the midst of a collection of stars or nebulæ, though we could not for ever be meeting new objects, but would have to endure the tedium of seeing the old familiar faces endlessly, without relief. Like our former example, this idea, in its modern form, originated with Einstein; let us see how it has impressed his contemporaries. Sir Arthur Eddington, who thinks very highly of it, writes thus:

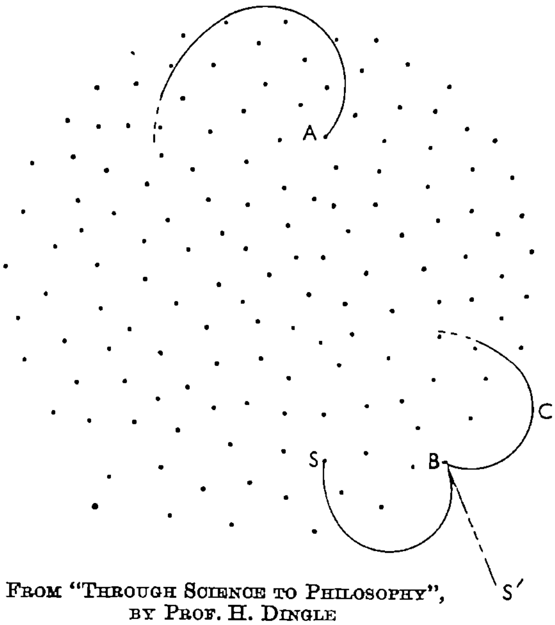
> "Einstein made a slight amendment to his law to meet certain difficulties that he encountered in his theory. There was just one place where the theory did not seem to work properly, and that was—infinity. I think Einstein showed his greatness in the simple and drastic way in which he disposed of difficulties at infinity. He abolished infinity. He slightly altered his equations so as to make space at great distances bend round until it closed up."[6]

On the other hand, here is the stimulating Mr. Eagle again:

> "In pre-Einsteinian days if people had been told that an author's theme in his book had been that external reality only possessed three spatial dimensions, and that therefore to talk of 'curved three dimensional space' was pure nonsense, they would have replied that they thought only lunatics thought otherwise. Now this conception is widely regarded in many circles as a 'probably may be true' one. This to me seems the measure to which both the scientific world and the general public have been bluffed by the theory. Future scientific historians will probably regard the theory as a befitting product of a mad age in the world's history."[7]

Prof. E. A. Milne is scarcely less contemptuous of this manifestation of Einstein's greatness.

> "It is not necessary", he says, "to employ the vague, ill-understood, probably meaningless concept of closed, finite expanding space."[8]



FROM "THROUGH SCIENCE TO PHILOSOPHY", BY PROF. H. DINGLE

Well, the symptoms are familiar. Again we have the alternative estimates of supreme greatness and supreme folly, and we might suspect that the same misunderstanding is at the bottom of the trouble—as, in fact, it is. Let us begin with a finite collection of stars (or nebulæ) in a space which we suppose extends to infinity in all directions; we are somewhere in the midst of the collection—say, at *A* (see accompanying figure). Now suppose we try to get outside into the empty spaces. We cannot, because the gravitation of the system keeps all material bodies inside; the faster we move the greater is the attraction and we find ourselves following some such path as that shown in the diagram. It is the same with light; that also is drawn back, and cannot illuminate whatever external objects there may be. In fact, no physical existence that we know of can escape. All that is perfectly conceivable.

We picture, then, a finite universe from which we cannot escape. The next point is that it is impossible for us to know whether we are at its centre or its boundary; in either case we appear to be surrounded by stars on all sides. Obviously an observer at the centre (or at A) sees stars all round, but so does an observer at B, for the light of the stars inside is bent, so that he sees them whichever way he looks. The light of a star at S, for example, is bent so that the star appears to be at S'. This is a very ordinary phenomenon, exemplified every time we look at a mirror; an object appears in the direction of the light that enters our eye, and not necessarily where it actually is. We are therefore not only confined within the universe, but also necessarily without the possibility of the *experience* of being at the boundary; however we move, and wherever we go, we must always see the same kind of thing—stars more or less uniformly distributed all round.

All that is of the nature of simple, traditional physics: now comes the crucial point. Since the region outside the system is physically inaccessible and unobservable, and the *experience* of being at its frontier is physically unattainable so that it is never possible for us to know whether we are there or not, we leave these things outside our description of the universe. We give the name 'space' to the volume which contains what we can observe, and describe it simply according to our experience as both finite and boundless. We can still, of course, conceive that there is an infinite region outside (wherever 'outside' may be), but that is merely another way of saying that the region is not *logically* unobservable. The rejection of infinite space is, in fact, precisely similar to the rejection of absolute simultaneity: it represents an economy of ideas—we are to introduce no conceptions which are not necessary for the description of the physically observable.

It may be worth while to point out that this account of finite boundlessness differs from the statement that space is curved in the fact that it says nothing about any intrinsic *property* of space. There is no need to try to think of emptiness with a curvature; we have simply to think of possible experience, and keep within its bounds. Of course, for mathematical purposes the conception of curvature is useful because it allows us to employ the technique of Riemannian geometry to solve particular problems, and for the mathematician it may have some æsthetic value, as the poetry of Mr. T. S. Eliot is said to have for those "in the know". But for the purpose of understanding it is worse than superfluous; it is definitely misleading.

What, now, of the validity of this principle, which has taken charge of physics and threatens to direct all future philosophical thought? Let me repeat the principle: it says that *nothing which is logically or physically unobservable is significant.* This statement must be appraised on pre-scientific, general rational grounds, and we can best approach the task by returning to the rival arguments set out earlier and considering them in the light of our rigorous statement.

The essence of the argument for the principle is that it is needed to prevent arbitrary invention of existences or arbitrary dogmas about them; and it meets this requirement by saying, in effect, that everything that exists is observable by known means. The argument against the principle is that we have no right to assume omniscience; that although it may be granted that the logically unobservable cannot exist, it is presumptuous to say the same of the physically unobservable.

We are therefore in this dilemma. If we deny the principle, we have no check on idle invention; it may be that all that we know, and have taken such pains to find out, is trivial, while the great, important facts of the universe are not even suspected and are unattainable. On the other hand, if we accept the principle, we close the door to all experience outside that which our present knowledge allows. Let me repeat that this dilemma is not a domestic affair for physicists. In physics it concerns at present only existences observable by sense perception, but clearly it is equally relevant, in the appropriate forms, to all spheres of thought in which we regard ourselves as apprehending some independent existence by means of human faculties.

This last sentence, I think, gives the clue to the solution of the problem: "all spheres of thought in which we regard ourselves as apprehending some independent existence by means of human faculties". That is the attitude which I have assumed throughout this discussion—the attitude of naïve realism in which we picture an objective universe existing independently of our thought of it and our examination of it. It is the attitude which we always assume in everyday intercourse and in most scientific discussions also. We regard scientific research as an exploration of this independent universe, an attempt to discover what it contains and to understand the pre-established relation of one part with another. It is this conception of science or philosophy that makes possible the dilemma by which we are faced. If the universe exists independently of our experience of it, then clearly it is presumption on our part to deny that it can contain anything inaccessible to experience. On the other hand, if we abstain from this presumption we make all inquiry a mockery, for we have no guarantee that anything that we may discover is more than a triviality, an insignificant part of a universe the essential elements of which are eternally unknowable.

But suppose we take the idealistic view, regarding our experience, our observations, as the primary data, and the universe as a mental construct formed to give rational coherence to those observations. The whole matter then appears in a different light, in which the dilemma is no longer seen. The statement that nothing which is logically or physically unobservable is significant is simply a statement of our aim as scientists or philosophers; it means that we confine ourselves to our purpose of deducing a universe from our observations and do not allow our fancies to intervene. There is no assumption of omniscience because there is no independent universe to know, and the arrogance disappears because we make no claim to know all the possibilities of observation. We set no limit to the possibilities of experience; we simply refuse to assert anything for which we have no (direct or indirect) justification in experience, and as observation grows the universe grows also. The objection to the principle therefore vanishes completely, from the idealistic point of view.

On the other hand, the objection to denying the principle by no means vanishes. If we do not exclude the physically unobservable from our description of the universe, we still have no grounds for not admitting the binkum and so reducing philosophy to a farce. When M. Maritain claims that a thing is independent of our observation of it, he immediately makes it impossible for us to know that we are saying anything of the least importance about it, no matter whether we adopt the realistic or the idealistic point of view. If we are realists the thing may be essentially beyond apprehension; and if we are idealists we may form it equally legitimately from observation or from fancy.

The position, then, is this. If we take the realistic view, we are left with an unresolved dilemma, but if we take the idealistic view, the principle becomes simply a statement of the object at which science has aimed throughout its history. It is not my purpose to comment on the age-old problem of idealism *versus* realism; I am concerned only with the attitude implied in modern scientific developments, and the point I want to emphasize as clearly and unmistakably as possible is that anyone who regards the recent trend of physics in general, and the theory of relativity in particular, as legitimate science or philosophy or intellectual activity bearing whatever name may be thought honourable, must either be an idealist or presume that he is omniscient I do not wish in this place to plead the cause of either of the alternatives open to the humble. I am not anxious to cry, "Vote for realism, and down with relativity!" or "Support idealism and relativity, and throw realism to the dogs!". That is a matter for personal predilection, but it is a matter for pure reason to show that those are the only alternatives open to anyone who is not prepared to assume that he is omniscient.

The striking divergence of opinion with which we opened can now, I think, be understood. Those who, like M. Maritain and Mr. Eagle, see the principle in question as an example of presumption arising from ignorance, are realists—by which I mean that they instinctively think as realists, whether or not they would accept the title. On the other hand, those physicists and philosophers who accept the principle are, by the same criterion, idealists, though most of them speak our ordinary, everyday language which has accommodated itself to the realistic outlook. In terms of that language their utterances necessarily appear arrogant; what they apprehend instinctively as the wisdom of a self-imposed discipline is clothed in sentences which suggest to the realist the idea of arbitrary dogma. The divergence, arising as a difference of philosophical attitude, is accentuated by the necessity of expressing idealistic principles in realistic terms.

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[1] "The Theory of Relativity" (English translation, p. 22) (1920).

[2] "Réflexions sur l'intelligence et sur sa vie propre", pp. 205–6 (1926).

[3] "The New Conceptions of Matter", pp. 23, 81 (1931).

[4] "The Philosophy of Religion versus the Philosophy of Science", pp. 169-70 (1935).

[5] "Philosophy and Logical Syntax", pp. 15, 17–18 (1935).

[6] "The Expanding Universe", p. 21 (1933).

[7] "The Philosophy of Religion versus the Philosophy of Science", pp. 219–20.

[8] *Z. Astrophys.*, 6, 83 (1933).

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Literature of Food Investigation" : 7, No. 1, March 1935. Compiled by Agnes Elisabeth Glennis, assisted by Gwen Davies. Pp. 371+xiii. (London: H.M. Stationery Office, 1937.) 5s. net); but it is hoped during the next twelve months to bring the "Index" up to date and to complete abstracts of the literature published in 1935 and 1936, which will form No. 2 of vol. 7, and vol. 8. Meanwhile the first number of vol. 9, containing abstracts of papers published during 1937, is in preparation. The papers noted in the present number are arranged in fifteen sections, and there is an author index extending to twenty pages. The compiler gives a brief review of developments during 1933–34, selecting the following subjects: gas-storage of meat and fruit, storage of rice, eggs, anti-oxidants for fats and oils, and engineering. Attention is directed to the fact that 1934 was the centenary of the invention of the earliest continuous refrigerating machine, by Jacob Perkin, which used ether as refrigerant, and was the first real landmark in the history of modern refrigeration, so far as technique is concerned.

Studies in Ancient Astronomy

A SMALL collection of papers recently published in *Meddelande Från Lunds Astronomiska Observatorium* makes an interesting contribution to the study of the early history of astronomy. In an article entitled "Greek Cosmogony and Astronomy", Dr. K. Lundmark briefly traces the development of Greek astronomy from the first indications of some primitive astronomical knowledge found in the Homeric poems and in the work of Hesiod to the great work of the Alexandrine astronomers and mathematicians, culminating in the production of the "Almagest" in the second century A.D. A very useful synopsis for rapid reference is included of Greek astronomers and their contributions to astronomical ideas and observation. In another paper, P. Collinder studies the distribution of the birthplaces of the astronomers of antiquity. He remarks that the Hellenic peninsula itself produced but few in contrast with the west coast of Asia Minor, with Alexandria and the coast of southern Italy. It was, in fact, in the great merchant and shipping towns of these latter localities where the Greeks would best receive the importation of astronomical knowledge from the Babylonians, Egyptians and Phœnicians. A further contribution by B. Svenonius describes his examination of certain rock sculptures found in Ostrogothie, Sweden. These engravings, which may date from the bronze age, include amongst the representations of men, animals, ships and primitive weapons, groupings of small cavities, which it is agreed represent groupings of the bright stars into constellations. M. Svenonius identifies the following constellations: the Great Bear, Cassiopeia, Perseus, Cepheus, Auriga, Orion and Leo. An examination by earlier Swedish investigators of similar rocks found in Bohuslän leads to the same general conclusion that the forms of several easily recognizable constellations were copied by some of the prehistoric watchers of the skies. In a supplementary note, A. Ohlmarks contributes remarks on these rock engravings and their relation to the history of early religious beliefs.

Physics Research at Osaka

THE volume of *Collected Papers* for 1936 from the physics section of the Faculty of Science of Osaka University includes 33 papers which have appeared in scientific periodicals between February 1936 and March 1937. The papers are in their covers as issued as reprints and are bound together with wire to constitute the volume, which is 10·1 in. × 7·4 in. × 1 in. Twenty-two of them are from the *Proceedings* of the Physico-Mathematical Society of Japan, five are Reports of Radio Research in Japan and two are from the Institute of Physical and Chemical Research, and five other institutions contribute a paper each. The papers from the Physico-Mathematical Society are nearly equally divided between problems of atomic structure and radiation, hydrodynamics and electricity. A table of contents is provided in which each paper is numbered and the number is printed on the right hand top corner of the cover of each so that reference is easy. The various publications from which the papers are reproduced appear to have very nearly the same size of page, slightly larger than that of the volume, except in one instance in which the page is 0·2 inch less wide. This inexpensive form of issuing collected papers seems to be on the increase.

Films for Promoting International Understanding

IN *Film Progress* of July, the Central Information Bureau for Educational Films, Ltd., announced the impending release of "Living in Wales", the second of its series of talking films designed to help the peoples of the world to gain a clearer insight into each other's lives and thereby to promote sympathetic mutual understanding. The first of the series, "Living in the Netherlands", is reported to have been well received both at The Hague and in London. "Living in Wales" was used at the Congrès Internationale de l'Enseignement Primaire et de l'Education Populaire to illustrate an address by Dr. G. H. Green of Aberystwyth on "The Cinematograph as a Means of Education for International Understanding". The paper emphasizes the fact that the educational film is not merely an additional means of illustrating or confirming what the teacher conveys through the medium of words, but also provides the closest possible approximation to real first-hand experience. It postulates four essentials for the success of films as instruments for promoting international understanding: an adequate supply of suitable trustworthy films, efficient machinery for production, distribution and publicity, comprehensive experiments and investigations into the technique of education by means of the film, and a centre for acquainting teachers not merely with the films and projectors available but also with all matters relating to films. The same issue of *Film Progress* announces the decision of Osaka City authorities to build an "Educational Movie Hall" at a cost of 500,000 yen for the benefit of primary school pupils.

Economic Aspects of the Cotton Trade

"WORLD COTTON PRODUCTION AND TRADE" is the first of a series of studies of the principal agricultural products on the world market to be published by the International Institute of Agriculture, Rome (price 30 lire). This comprehensive monograph, consisting of 480 pages and 20 maps and diagrams, is divided into four main sections. The first deals with the geography of cotton production, describing the agricultural conditions of the humid and sub-humid zones of the rain-grown crop, and the arid or semi-arid zone of irrigated cotton. Part 2 describes the conditions of cotton marketing and movements of cotton prices, while Part 3 is concerned with the evolution of world cotton trade. The fourth part deals with the national and international aspects of the industry, separate sections being devoted to the principal countries concerned. It is evident that the economic problems of the cotton trade are closely linked up with the wider financial and commercial problems of the world. The relatively large expansion of the smaller cotton countries during an economic crisis simultaneously with the general contraction of the world cotton industry, presents one of the most significant aspects of the world economic problem. The position was aggravated by the policy of the United States of maintaining cotton prices at an artificially high level and closing their market to European goods. It is considered that from the point of view of a rational world economic system, the various branches of agriculture should be developed in those parts of the world which are most suitable. Under such a system the United States would regain its position on the world cotton market, which is regarded as its full right, but the conditions of such a recovery would be the abandonment in all countries of the prevailing tendency towards economic isolation and a development of a greater degree of international co-operation.

Progress in the Meteorological Office

THE eighty-second year of the Meteorological Office is referred to in the annual report of the Director for the year ended March 31, 1937, as one of planning and preparation with the object of providing the greatly extended meteorological services required by the expanding Royal Air Force and by the increase of flying on civil air routes. These projected increases of meteorological activity have made it necessary for new staff to be recruited and trained in the special work required of them; in particular, the need for trained forecasters has had to be met in order to staff the principal forecasting centres on the various flying routes. The new Empire Air Mail Scheme led to the formation of a new division of the Meteorological Office in 1935 to organize the meteorological services of the trans-Atlantic and Empire air routes, the duty of advising the Governments of territories traversed by the routes having devolved on the Meteorological Office, and throughout the year under review that division was preparing for the new mail service. The forecast and aviation division has given particular attention to the information required by civil and R.A.F. aircraft in connexion with flying in and through clouds—information about the winds to be expected and warnings of dangerous conditions likely to lead to ice accretion between certain heights in strata where temperature lies between 0° F. and 35° F. and other circumstances are favourable for such accretion. It has now been determined that really dangerous conditions are scarcely ever found when temperature is more than a few degrees above or below the freezing point.

Motor Traffic and Wild Life

IN a discursive and interesting paper read before the Zoological Society of London (*Proc. Zoo. Soc.*, Ser. A, 173; 1937), Surgeon Rear-Admiral Beadnell has given an indication of the destruction of wild creatures caused by motor traffic in Great Britain. In the years 1932–36, in travelling by motor-car and pedal-cycle on roads in England, Wales and Scotland, he counted 2327 dead animals in 10,000 miles, or 23 in every hundred miles. The kill was made up in the following proportions: birds 81 per cent (1885 individuals), rabbits 14 per cent, hedgehogs 4 per cent, rats 0·5 per cent, and the remainder was made up of frogs, toads, moles, snakes, dogs, cats, two sheep and one forest pony. It may be taken that the number counted during a rapid survey falls far short of the total number slain, and indeed were it not that many motorists when driving are highly regardful of wild creatures, the number would be much greater than it is. But the count does not suggest that motor traffic will make appreciable inroads upon the stock of wild animals, for the numbers are insignificant compared with the rate of increase of the common species which usually fall victims. An odd death which came to the notice of the writer was that of a dog fox in beautiful pelage, which during a snowstorm in the north-east of Scotland leapt over a stone wall against the wings of a heavy lorry.

Policy in Pig-Feeding

THE pig and bacon industry in Great Britain is dependent upon imported and home-grown cereals, and during the last twelve months feeding costs have risen by 30 per cent without a compensating rise in the price of bacon. The Bacon Development Board has accordingly completed an inquiry into the possibility of replacing cereals by other foodstuffs, and the report of A. N. Duckham has been published as Bulletin No. 2, "Substitutes for Cereals in Pig-Keeping" (Bacon Development Board, 1937. Price 2*s*.). The general conclusion is that if some sacrifice of growth rates and carcass quality is allowed and adequate facilities for growing and storing substitutes are made available, then cereals may be replaced in part by potatoes, sugar-beet and other home-grown root and fodder crops or by-products either in fresh or processed forms. At present, the use of these cereal substitutes may not be economical in Great Britain, but conditions may arise when cereals, home produced or imported, may be in short supply or at greater cost, and under such conditions it is believed that pig production could be kept up as an economic proposition, making an appreciable contribution to the national supply of meat and animal fat for human consumption.

Water-Power of the World

THE United States Geological Survey has attempted a new estimate of the potential and developed water-power resources of the world. The estimate is based on ordinary medium flow and 100 per cent efficiency. Potential power is based on existing flow and disregards storage except in the case of constructed reservoirs. The estimates for developed power are based on installed capacity of machinery at constructed plants, which averages two or three times the potential power at low flow at the same sites. Thus, for example, the potential power at utilized sites in France amounts to 21 per cent of the total potential power of that country, but in effect amounts to 44 per cent of the theoretical total power resources. With this proviso, it is noted that about ten per cent of the potential water-power of the world is developed. The capacity of the constructed plant in the world at the end of 1936 was 60 million horse-power, or an increase of 160 per cent in sixteen years. The United States show by far the greatest development, but Canada, France, Italy and Japan have high figures, and Norway, Germany, Sweden, Switzerland and the Soviet Union show rising totals.

Biochemistry in India

THE Society of Biological Chemists, India, publishes a useful review each year of the results of investigations in biochemical subjects which have been carried out in India during the previous twelve months. The current number (*Annual Review of Biochemical and Allied Research in India*, 7, 1936. Pp. 165. (Bangalore: Society of Biological Chemists, India, 1937.) 3*s*.) is divided into seventeen sections, of which about two-thirds are devoted to various aspects of agricultural science. Sections are also given to vitamins and hormones, pharmacology and human physiology, pathology and bacteriology. The papers reviewed have, of course, been published in full in other journals, chiefly Indian, but this volume provides a useful summary of work which is not always easily accessible. It is noticeable that the size of the volume has been increased considerably since this review was first published, a tribute to the steady progress research is making in India.

Diseases of Fur Animals

THE United States Department of Agriculture, Washington, D.C., in Farmer's Bulletin No. 1777, gives an account of the diseases attacking fur-animals on the farm, together with methods of control. Descriptions are given of distemper, paratyphoid infection and encephalitis of foxes, of hookworm, tapeworm and fluke affections, and of external parasites such as fleas, lice and sarcoptic mange, as well as of nutritional disturbances. Useful information is also given on farm sites and structure, their sanitation and disinfection. The Bulletin should be of value to those engaged in the fur industry in Great Britain.

Fire at Messrs. Flatters and Garnett, Ltd.

A SERIOUS fire occurred on Sunday morning, December 19, at the laboratories of Messrs. Flatters and Garnett, Ltd., the well-known Manchester firm of microscopists. The chemical and microscopical laboratories were completely burnt out, but a considerable number of mounted slides were saved. The photographic and lantern slide department was only slightly involved and the new instrument workshop, for manufacturing microscopes, micro-projectors, etc., escaped entirely. All the staff is being retained, and work has already been resumed in temporary laboratories. Stocks of most of the firm's chemical specialities are held at the head office, 309 Oxford Road, Manchester, 13, which is two miles from the laboratories.

Awards of the Institution of Naval Architects

THE Council of the Institution of Naval Architects has awarded the premium of the Institution for the year 1937 to Mr. R. W. L. Gawn, for his paper "Results of Experiments on Model Screw Propellers with Wide Blades", the Wakeham Prize (1937) to Mr. H. Lackenby, for his paper "Re-analysis of William Froude's Experiments on Surface Friction and their Extension in the Light of Recent Developments", and the Duke of Northumberland Prize (1937) (awarded by the Council of the Institution in connexion with the award of National Certificates in Naval Architecture) to Mr. D. N. Wallace, of the Royal Technical College, Glasgow.

International Federation of Eugenic Organizations

THE report of the Twelfth Conference of the International Federation of Eugenic Organizations, held at Scheveningen, Holland, in July 1936, has just been issued, and can be obtained from W. P. van Stockum and Zn., N.V., The Hague, Holland, price three Dutch florins. A list of the fifty delegates from twenty countries is followed by twenty-five papers presented at the meetings. The papers range from the classification and inheritance of mental defects to mutations in plants and man, twin studies and the problems of sterilization in Germany, Denmark, Sweden and the United States. The 119 pages end with a report of the Human Heredity Bureau and also reports on the standardization of measurements in anthropometry, physiometry, psychometry and on racial psychiatry.

Fifth International Congress for Experimental Cytology

THE fifth Congress for Experimental Cytology will be held in Zurich on August 7–12, 1938. The sixteenth International Physiological Congress and the International Veterinarian Congress will be held in Zurich too, on August 14–18 and August 21–25 respectively. The proceedings of the Cytological Congress are not to be divided in sections, but will be organized in the following way: Scientific sessions will take up seven half days; two afternoons are reserved for demonstrations, and during one afternoon there will be an excursion. Special subjects are to be treated at each session, opening with a general review to which one or two supplementary reviews may be added. Reprints of these papers will be sent to the members of the Congress at their home addresses, or—at the very latest—will be handed over to the members at the opening sessions of the Congress. Copies of the individual papers are likewise to be distributed before the sessions, the main object of this Congress being the discussion of cytological topics of special interest. The following subjects have been chosen for review: epithelium in culture and in the organism; structure of chromosomes; mechanism of mitosis; cancer cells and normal cells; experimental research on cytology and viruses; ultra-structure of the protoplasm and its products; chemistry of the cell. Further information can be obtained from the honorary secretary for the Congress, Dr. Harald Okkels, Institute for Pathological Anatomy, University of Copenhagen, Denmark.

Congress of Anthropological and Ethnological Sciences

FURTHER arrangements are announced for the second International Congress of Anthropological and Ethnological Sciences, which will be held in Copenhagen on August 1–6, 1938 (see NATURE, July 24, 1937, p. 147). This date has been chosen to meet the convenience of any members who may also attend the International Congress of Geography at Amsterdam on July 18–28. The proceedings at Copenhagen will take place in both general and sectional meetings. There will be eight sections, and a number of subsections, each being devoted to some one branch of anthropological study with a special topic proposed for discussion, though this does not preclude the acceptance of communications dealing with other matters. Among the topics proposed, the following may be mentioned: under Physical Anthropology, in the subsection of Anatomy and Biotypology, meeting under Prof. H. M. Houdensen—interrelation of types of fossil man, methodology, and the conception of 'race' in anthropology; Subsection of Physiological Anthropology, under Prof. Oluf Thomsen, geographical distribution of blood groups in man and their presence in animals; in the Section of Psychology, under Prof. Edgar Rubin, influence of the factors of civilization on character and (with the Section of Sociology and Religion) on cultural changes; in the Section of Ethnology, under Prof. Gudmund Hart, origins of agriculture and the domestication of animals and plants; in the Section of Ethnography, in the subsections of Asia and Africa, of which M. C. G. Feilberg, curator of the Ethnographical Museum and M. Carl Kjersmeier are the respective presidents, the nomad pastorals of Asia and Africa; in the subsection of Arctic Ethnography, under Dr. Therkel Mathiassen, the prehistoric and historic culture-movements of the circumpolar region; and in the Section of Sociology and Religion under Prof. Wilh. Grønbech, the extent to which archæology and prehistory can serve as a basis for the study of intellectual development. Applications for membership should be addressed to the Treasurer of the Congress, Nationalmuseet, 10 Ny Vestergade, Copenhagen, K.

National Parks of the Belgian Congo

THE Institute of the National Parks of the Belgian Congo, Brussels, has decided to publish a collection of photographs of the vegetation of these parks, and has commenced by issuing a very fine series of photographs of the general aspect of the vegetation of the Albert National Park, which comprises some 900,000 hectares in the heart of tropical Africa to the north of Ruwenzori and including several volcanoes. The photographs, taken during the expedition of G. F. de Witte (1933–35), are excellent, and they are beautifully reproduced in the first number of this new production (Vol. 1, Fascicules 1 and 2, Plates 1–12, Brussels, 1937): they include some striking examples of arborescent species of *Senecio* and giant *Lobelia*.

Announcements

PROF. James P. Kendall, professor of chemistry in the University of Edinburgh, has given 1,000 dollars to the American Chemical Society for the 1938 American Chemical Society award in pure chemistry. The award, established in 1931 by A. C. Langmuir to encourage creative work in pure chemistry by men of science at the beginning of their careers, will be made for 1938 at the Society's spring meeting in Dallas, Tex., on April 18–21. The age limit, hitherto thirty, has been raised to thirty-five years. Prof. Kendall was professor at Columbia University from 1913 until 1926, and afterwards head of the department of chemistry at Washington Square College, New York University.

A SERIES of two popular lectures by Prof. C. E. Inglis, entitled "Building Big Bridges", has been arranged by the Engineering Public Relations Committee, primarily for those between the ages of 15 and 20 years. The lectures will be given on January 7 and 10 at 3 p.m., at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. Application for tickets, which are free, should be made to the Public Relations Officer, Engineering Public Relations Committee, 1–7 Great George Street, Westminster, S.W.1.

DR. B. L. BHATIA, formerly assistant professor of zoology at the Government College, Lahore, and later principal of the Government College, Hoshiarpur, and author of works on Ciliophora and Sporozoa in the Fauna of British India series, has established "The Science Press of India" as a science news agency for the daily Press in that country. His address is Hotusingh Road, Lahore.

CATALOGUE 15 B (II) of laboratory balances, issued by Griffin and Tatlock, Ltd., contains particulars of a wide range of analytical balances (ordinary, aperiodic, projection-reading, chainomatic) and a noteworthy selection of micro-analytical balances. The catalogue also includes weights, scales and spring balances. A very cheap silica-gel desiccator to replace calcium chloride in balance cases, which lasts indefinitely, is listed.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 40.

Correspondents are invited to attach similar summaries to their communications.

Fusions between Flexuous Hyphæ and Pycnidiospores in *Puccinia graminis*

In 1933, Craigie[1] discovered that from the mouth of a pycnidium of *Puccinia helianthi* or of *P. graminis* there project not only many straight pointed hair-like cells known as periphyses but also a number of hyphæ which had previously been overlooked and which he called *flexuous hyphæ*; and in *P. helianthi*, some hours after he had mixed the pycnidiospore-bearing nectar of (+) and (−) pycnidial pustules, he observed that some of the flexuous hyphæ had each fused with a pycnidiospore presumably of opposite sex. In 1933, Pierson[2] reported that he had seen similar fusions in *Cronartium ribicola*.

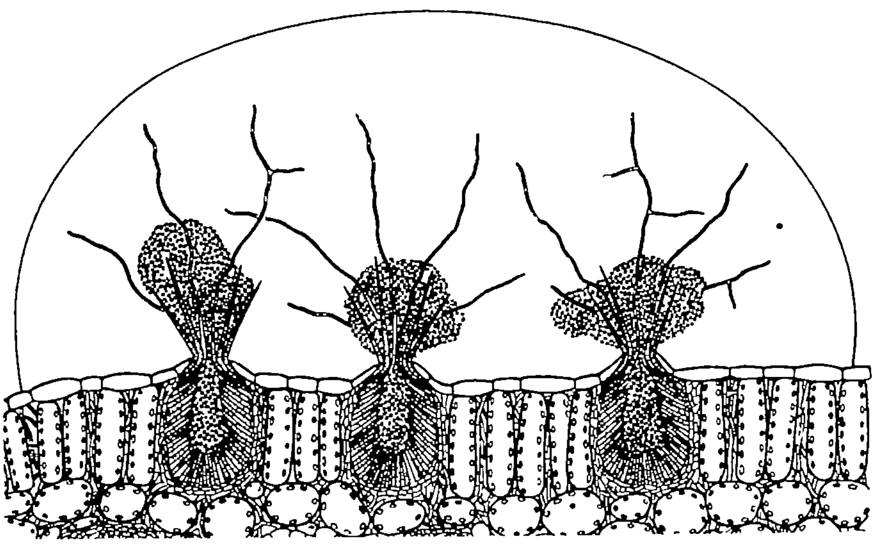

Fig. 1.

Puccinia graminis in a leaf of *Berberis vulgaris*. Vertical section through the upper part of a pycnidial pustule showing: (1) the upper epidermis, the palisade layer, and some spongy parenchymatous cells of the leaf, and (2) some of the intercellular mycelium and three pycnidia of the fungus. The pycnidia are covered by a common drop of nectar into which project from each pycnidium a mass of gelatinous pycnidiospores, pointed periphyses, and several flexuous hyphæ. Highly magnified.

Recently, after mixing the pycnidial nectar of *Puccinia graminis* (the parasite that causes the Black stem rust disease of wheat), I have observed from eighty to a hundred fusions between a flexuous hypha of one sex and a pycnidiospore of opposite sex. No fusions between periphyses and pycnidiospores were seen.

A vertical section through a barberry leaf showing intercellular mycelium and three pycnidia all derived from a single basidiospore of *Puccinia graminis*, and therefore all haploid, is shown in Fig. 1. The main body of a pycnidium is situated beneath the epidermis of the leaf, and consists of a wall bearing pycnidiosporophores from which numerous pycnidiospores are cut off terminally and of a chamber into which the pycnidiospores are set free. The spores have gelatinous walls which swell up and so cause the spores to be extruded at the mouth of the chamber. From the ostiole of each pycnidium is excreted a drop of nectar which, by its scent and sugary contents, is made attractive to insects. In Fig. 1, the three drops of nectar have become confluent. Into the nectar, each pycnidium sends out about 60–70 periphyses (straight pointed red hairs) and a smaller number of flexuous hyphæ, some of which are branched. In Fig. 1 these hyphæ can be seen projecting beyond the clouds of gelatinous spores into the clear part of the nectar.

Several hours after the pycnidial nectar had been mixed, transverse sections of the living leaf and pycnidial pustules were made with a hand-razor, and the sections were at once mounted in water and observed with the microscope. Thus fixing and staining methods were avoided, and the fused hyphæ and pycnidiospores were seen in the living state.

The fusion of a flexuous hypha with a pycnidiospore may take place at the end of a flexuous hypha, as shown in Fig. 2, or at the side of a flexuous hypha, as shown in Fig. 3. In the latter case the flexuous

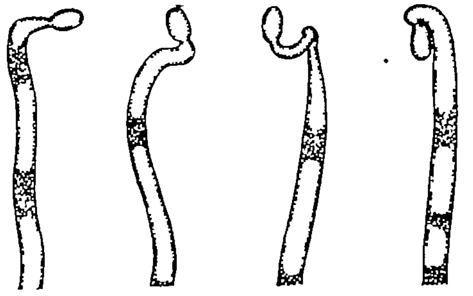

Fig. 2.

The ends of four flexuous hyphæ which have each fused with a pycnidiospore. × about 500.

hypha sends out toward the spore a special branch or fusion peg. Soon after a fusion has taken place (3–6 hours after mixing the nectar), the main protoplasmic contents move out of the pycnidiospore and out of that part of the flexuous hypha which has fused with the spore, thus leaving behind a large vacuole. Presumably the nucleus of the pycnidiospore passes down the flexuous hypha toward the fundaments of the æcidia. This passage is made easier by the fact that the flexuous hyphæ have no septa.

The fundaments of the æcidia or 'rudimentary æcidia' which, after the nectar of (+) and (−) pustules has been mixed, become diploidized and produce æcidiospores, are well-defined haploid organs. They require a special name, and I therefore propose that they should be called *proto-æcidia*[3].

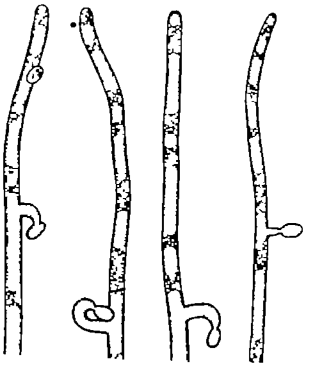

Fig. 3.

FOUR FLEXUOUS HYPHÆ WHICH HAVE EACH SENT OUT A SHORT BRANCH OR PEG WHICH HAS FUSED WITH A PYCNIDIOSPORE. × ABOUT 500.

The experiments here recorded were made early this year at Winnipeg in the Dominion Rust Research Laboratory, and I here wish to acknowledge my indebtedness to Dr. J. H. Craigie for placing the resources of the laboratory at my disposal and to Dr. T. Johnson for supplying me with a series of inoculated barberry bushes.

A. H. REGINALD BULLER.

The Herbarium,
Royal Botanic Gardens,
Kew. Nov. 30.

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[1] Craigie, J. H., NATURE, 131, 25 (1933).

[2] Pierson, R. K., NATURE, 131, 728–9 (1933).

[3] A more detailed account of the sexual process in *Puccinia graminis* and other rust fungi is in preparation for vol. 7 of my "Researches on Fungi".

Nature of the Outer Surface of the Cell Walls of the Mesophyll of the Leaf

IN a recent communication[1], it was recorded that a number of hydrocarbons, including pure paraffin, readily entered the air-spaces of a leaf strip placed vertically in contact with the surface of these liquids, and could also be observed to flow readily over the surface of the exposed mesophyll and cascade down and fill the interspaces. Water, on the contrary, will neither flow over the surface nor fill the interspaces under any conditions, without a pressure gradient.

Since then, working independently, I have found that certain dyes such as janus green, which are also sensitizers of protein monolayers, are strongly adsorbed on the surface of the cells when the leaf is infiltrated under pressure. Under these conditions, it was found that ready infiltration of the air-space could be obtained, but the dye was entirely adsorbed on the cell walls near the point of entry, while the leaf lamina although completely infiltrated by water was entirely free from dye. The dye so adsorbed cannot be liberated by water on exposure of the mesophyll, although it can be extracted by acetone as was described by Ponder[2] for red corpuscles sensitized with brilliant green. The dye cannot be extracted in water by a rise of 15° as recorded by this author for the protein layers of red corpuscles. This possibly may be due to the fact that adsorption took place at a laboratory temperature of 33° instead of 15° as in Ponder's observations on red corpuscles.

Dyes such as methylene blue, neutral red, diamantfuchsin, jodgrun, indigo carmine all give the same results. Other dyes such as orange G, congo red, nigrosin, corallin and magdala red enter the interspaces with the water and show no adsorption.

On using a mixed solution of non-adsorbed and adsorbed dye in approximately equal concentration, the protein adsorbed dye is entirely adsorbed near the point of entry while the other dye enters and fills the interspaces and shows no adsorption. These results are obtained equally well whether the leaf is infiltrated by dye drawn in from the cut edges of the lamina, or whether it is drawn into a complete leaf from the petiole.

If one of the fatty acids such as sodium taurocholate in slight bulk concentration in water be placed on the exposed mesophyll, it begins to spread, and after an interval of one or two minutes the bubbles of air in the interspaces below are displaced and the liquid spreads out and gradually fills the interspaces of the mesophyll. The action is exactly similar to that observed with pure paraffin but the rate is very much slower. Leaf strips placed vertically with the edge in contact with the fatty acid solution are slowly infiltrated, but the process is arrested about 5 mm. from the point of entry, when a brown band of discolouration appears at the limit of infiltration.

The action of the fatty acid on the exposed mesophyll is sensitive to *p*H reactions, as was found by Schulman and Rideal[3] in their observations of the lytic action of fatty acids on protein monolayers in red cells. In this case, the action proceeds readily at a *p*H of 6·2 but very slowly if at all on the alkaline side, while the reverse was recorded for red cells.

The unwettability of these cell walls by water and their great adhesion for hydrocarbons shows that the surface is not covered by liquid water. The strong adsorption of protein sensitizing dyes in general and the non-adsorption shown by other dyes strongly suggest that the outer cell wall–air interface is not a cellulose surface.

The fact that fatty acids which have the power of entering and dispersing protein monolayers cause complete wettability of the walls by water only within certain *p*H values, suggests that the interface may be protein in nature and of molecular thickness.

It is hoped to publish the results shortly.

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Nov. 21.

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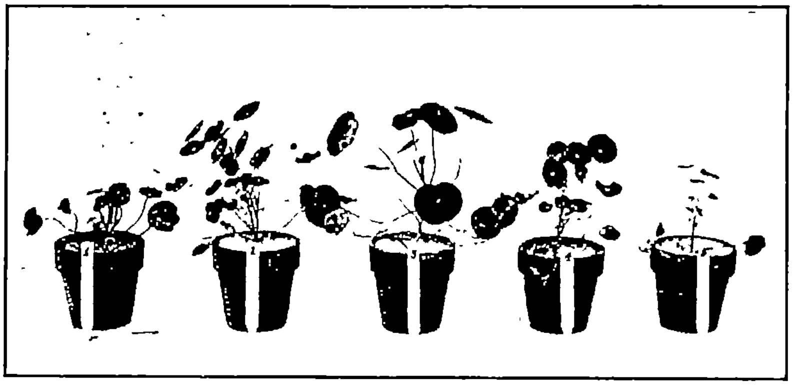
[1] Bangham, D. H., and Lewis, F. J., NATURE, 139, 1107 (1937).

[2] Ponder, E., *Proc. Roy. Soc.*, B, 103, 556 (1928).

[3] Schulman, J. H., and Rideal, E. K., *Proc. Roy. Soc.*, B, 122, 46 (1937).

Physiological Curve of Response to Plant Growth Hormones

The addition of growth hormones to a variety of plant materials results in marked responses over appropriate concentration ranges. The behaviour varies with the particular hormone used, the method of application and the developmental stage of the plant. With graded concentrations of growth hormone the response assumes the form of a physiological curve.



Effect of growth hormone on nasturtiums. Left to right: 50 c.c. daily nutrient solution only; same, containing 1/100, 1/10, 1 and 2·5 p.p.m. 1-naphthylacetic acid respectively.

The accompanying photograph shows the characteristic curve obtained with nasturtiums. After fourteen days growth in soil, these plants were transferred to sand in 4-in. pots and treated for twenty-three days in the manner indicated. Marked stimulation in growth at low concentrations is followed by damage as the amount of growth hormone is increased to excess. A physiological curve of this sort is known to be characteristic of the responses which are obtained with a number of different plants, including certain lower plant forms, such as yeast.

Marked increase in the rate of growth is obtained by the addition to the soil of exceedingly small quantities of the active chemicals. The green weight of tops of 8-weeks old lettuce plants was increased more than 300 per cent by the addition of the equivalent of 150 mgm. of 1-napthylacetic acid to an acre. This particular result was obtained by applying appropriate quantities of 1/100 p.p.m. solution at intervals of three days.

The dusting of seeds with growth hormones incorporated in a suitable diluent carrier caused substantial increases in both top and root development. This method of application is particularly advantageous, as it supplies the active chemicals gradually, and avoids the inhibition of root growth which usually results from a solution method of treatment.

A paper on this subject will appear shortly in the *Canadian Journal of Research*.

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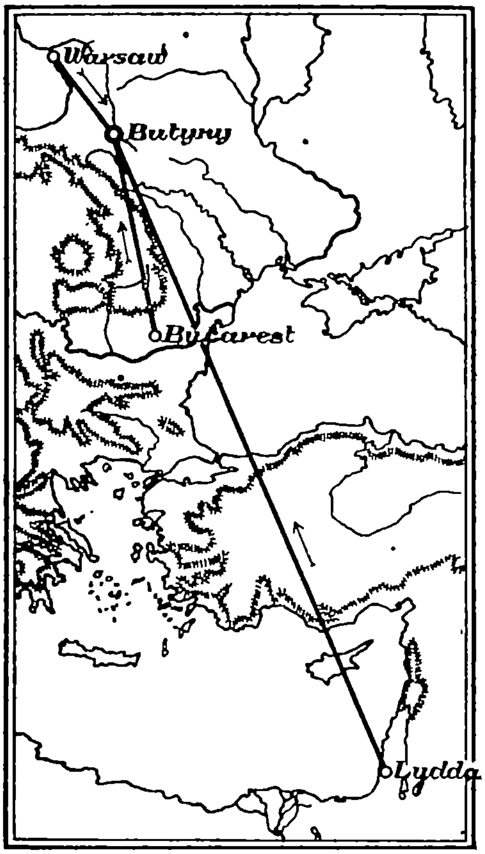
Nov. 19.

Experiments on Homing in Birds

Experiments on homing in birds were made by one of us[1] for the first time in 1933. These showed that wild birds, especially swallows, have more sense of orientation and are better able to find their homes than even carrier pigeons. Later on, Ruppell[2] established as a result of a series of experiments that swallows could find their homes from distances as great as 1,850 km. The same applies to starlings and wrynecks.

This year we experimented on white storks for the first time. In one test they were taken 50 km. and 111 km. away from Butyny, near Lwów; in another series of tests the birds were transported by aeroplanes (Polish Airways "L.D.T.") from Butyny to Warsaw, Bukarest and Lydda in Palestine, 300 km., 660 km. and 2,260 km. respectively. These distances are all along the airline shown in the map below. The birds were specially marked in bright colours and also ringed, so that it was comparatively easy to recognize them after their return to their nests and young.

The results confirmed that 75 per cent of the birds tested came home safely. The average speed of their journey was one third slower than the speed of swallows over small distances, although it equalled



the speed of swallows over big distances, such as 2,260 km. It should be borne in mind that the flight of the stork differs greatly from that of the swallow. The daily rates of progress did not vary to any great extent. The extremes vary: 165 km. for birds released in Bukarest and 188 km. for birds flying from Lydda.

The behaviour of the birds, when given freedom, was much the same and characteristic as a rule. They all took their time in cleaning and putting their feathers in good order, preparing thus for flight. Having taken to the wing, they circulated above the place where they had been set free for a time which varied practically with every bird, and then every bird took a proper direction for home.

As a result of these experiments we may, we think, regard it as a fact that some species of birds possess a special sense of orientation, which enables them to trace their homes from great distances without the help of kinesthetical factors. It is also not to be doubted that 2,260 km. in a straight line does not constitute the limit from which birds are able to find their homes.

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Nov. 15.

[1] *Acta Ornithologica Mus. Zool. Polon.*, 1, 8 (1934).

[2] *J. Ornithologie*, 85, 1 (1937).

Terminology of Sex Hormones

ONE hesitates to advocate the use of new words, even in a rapidly growing subject such as endocrinology, but obvious anomalies are becoming evident in the description of certain activities of the sex hormones, and there is good precedent for supposing that an improvement in terminology would not only be desirable in itself but also would help to clarify the position. One may recall, for example, that the introduction of the words 'œstrogenic' and 'androgenic' has done much to promote clear thinking and precision of expression. The application of the word 'œstrogenic' to the biological activities of œstrone, and 'œstrogen' to substances having œstrogenic properties, was of course due to the best-known property of the hormone, that of causing changes characteristic of œstrus.

These terms serve a very useful purpose, but it is now evident that they are inadequate. Thus the power of œstrogens to cause feminization of the plumage of birds, especially as hen-feathering is rarely cyclic in the female, can scarcely be called œstrogenic activity. I suggest, therefore, that the word *gynæcogenic* be used as a general term to describe activity which results in the production of the attributes of femaleness, and the word *gynæcogen* to describe a substance having such activity, œstrogenic and œstrogen being applied only to the production of œstrous changes. The capacity of many of the androgenic substances to cause growth of the uterus and mucification of the vagina would then indicate gynæcogenic activity, while *trans*androstenediol, which will cause actual cornification of the vagina, would also be œstrogenic.

Certain properties of œstrone, such as its capacity to correct the castration changes in the pituitary of the male rat, to cause fibrous development of the seminal vesicles or to cornify the uterus masculinus of the rhesus monkey, are difficult to include in any terminology, though the first might be called androgenic activity, and the latter œstrogenic activity if the 'uterus masculinus' of the rhesus monkey is actually a vagina masculina.

A further point concerns the terminology of hormones which have both androgenic and gynæcogenic properties. There is a tendency to refer to such hormones as 'bisexual'. This seems unfortunate, because bisexual has a well-established biological meaning which is quite inapplicable to a chemical substance. Two standard works of reference define the word as meaning "having both male and female reproductive organs"[1], and "having the reproductive organs of both sexes; hermaphrodite; also having sexual feeling for both sexes"[2]. In seeking a more suitable word to apply to a hormone, it may be recalled that Champy[3] introduced the word 'ambosexual' in connexion with plumage and other characters to imply "pertaining to both sexes", and Witschi[4] has used the word 'amphisexual' in a somewhat similar way. A more correct form of the word is apparently *ambisexual*, and it would seem that this could be applied with perfect propriety to substances, extracts and organs which exhibit activities pertaining to both sexes. Thus testosterone would be a hormone with ambisexual properties, possibly, though less correctly, an 'ambisexual hormone', while the testis and the ovary, each having potential endocrine activities related to the function of the opposite sex, would be organs with ambisexual activities.

Finally, reference may be made to 'gonadotropic', 'thyrotropic', etc., which have served a useful purpose for some years and now show signs of becoming indispensable. Burn[5] has recently pointed out that the suffix 'tropic', as used to indicate hormones which stimulate the growth of particular organs, is quite incorrect, and he has since suggested that 'trophic' would be much more suitable. It is clear that the alteration would effect a useful improvement in terminology with little or no trouble to writer or reader, and it is therefore desirable from every point of view. *Gonadotrophic* has already been used by certain investigators[6], and I venture to hope that this form, together with *thryotrophic*, *adrenotrophic*, etc., may become customary.

A. S. PARKES.

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Dec. 11.

[1] Henderson and Henderson, "Dictionary of Scientific Terms" (Oliver and Boyd, 1920).

[2] Dorland, "American Illustrated Medical Dictionary" (Saunders, 1935).

[3] Champy, Bulliard, Kritch, and Demay, *Arch d'Anat. micr.*, 27 (1931).

[4] Witschi, *Bull. Soc. Biol. Lett.*, 5, 79 (1936).

[5] Burn, "Biological Standardisation" (Oxford Medical Publications, 1937)

[6] See for example, Tenney and Parker, *Endocrinology*, 21, 687 (1937).

Faraday on Electromagnetic Propagation

THE significance of Faraday's sealed packet of 1832, opened recently at the Royal Society, is not any potential claim for priority which would be quite foreign to his nature, but the remembrance of an episode of ten years earlier which continued to rankle; he was then suspected of having overheard a discussion at the Royal Institution laboratory about how to produce electromagnetic rotations, which put him on the track of his beautiful solution of that problem and thus produced in fact the earliest electric motor. He was resolved that such suspicion should not occur again. See various indications in his carefully prepared additions in vol. 2 of his "Electrical Papers"; also Clerk Maxwell's trenchant remarks in a reference that has escaped my memory. The scientific interest of the note now revealed lies perhaps in the expression of his conviction that the velocity of propagation of magnetic influence would prove to be small enough to be measurable.

JOSEPH LARMOR.

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Dec. 1.

Diffraction of Light by Supersonic Waves in Solids

RECENTLY one of us[1] pointed out that the optical diffraction effects by supersonic waves in solids are to be interpreted on the basis of the Raman-Nath[2] theory, taking due cognisance of the photo-elastic effects arising from the strains caused by the sound waves. A refined further development of this idea enables us now to offer an explanation for a curious effect observed by Hiedemann and Hoesch[3]. Their experiments with glasses show two diffraction patterns of different spacings. With crossed Nicols normal and parallel to the sound-wave, only the pattern with the larger spacing is observed. It consists of the first orders only, with the central one missing. With the crossed Nicols at ± 45° to the sound-wave, only the pattern with the smaller spacing appears, showing many orders, including the central one.

This effect is characteristic for solids. For liquids no diffraction effects appear for crossed Nicols. As Schaefer and Bergmann[4] first pointed out, the existence of two patterns is due to the fact that in solids longitudinal and transversal sound-waves of the same frequency but different wave-lengths can travel simultaneously. Hence the theoretical problem consists in finding the propagation of a light-wave in a medium containing both types of waves.

We can gain an insight into the probable theoretical results by considering first the diffraction effects of either type of waves alone. Since transversal waves travel slower than longitudinal waves, their wave-length λ_T is smaller than λ_L, and the pattern with the larger spacing must be ascribed to the transversal wave. A transversal sound-wave, the directions of oscillation and propagation of which are normal to the light beam, produces a photo-elastic effect characterized by an index ellipse the axes of which are at 45° to the sound-wave. The principle indices of refraction suffer fluctuations μ and $-\mu$ which are equal in magnitude but opposite in phase. If the incident light is polarized parallel to the sound-waves, the two light-components parallel to the axes travel independently and their nth order has components of magnitudes $J_n(2\pi\mu L/\lambda)$ and $J_n(-2\pi\mu L/\lambda)$, where J_n is the Bessel function of nth order, L the width of the supersonic field and λ the wave-length of the incident light. These components are in phase or in opposite phase as n is even or odd. Hence it is easily seen that all even orders, including the central one, have the same polarization as the incident light and are therefore not visible through crossed Nicols. Only the odd orders can appear, in conformity with the observation of Hiedemann and Hoesch. If the crossed Nicols are at 45° to the sound-wave, that is, parallel to an optical axis, the diffraction effect by transversal waves must vanish.

For a longitudinal sound-wave the axes of the index ellipse are normal and parallel to the wave and the index fluctuations μ_1 and μ_2 are in phase but of different magnitude. With crossed Nicols parallel or normal to the sound-wave, the diffraction effects due to the longitudinal wave vanish. If the polarizing Nicol is at 45° to the sound-wave, all diffracted orders are plane polarized, but with a plane of polarization different from that of the incident light. Hence all orders are visible through crossed Nicols, but each order can be made to vanish by rotating the analysing Nicol. In the case of standing sound-waves, the intensity of the various orders passes through a minimum which is different from zero.

These are, of course, preliminary considerations for the development of a more complete theory considering the simultaneous existence of both types of waves. Work along this line has already shown that the diffraction angles φ are generally given by $\sin\varphi = n\lambda/\lambda_L + m\lambda/\lambda_T$, where n and m are integers, but if the light is polarized parallel to the sound-waves, only even m's enter for parallel, and only odd m's enter for crossed Nicols.

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HANS MUELLER.

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Nov. 23.

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[1] Mueller, H., *Phys. Rev.*, **52**, 223 (1937).

[2] Raman, C. V., and Nagendra Nath, N. S., *Proc. Ind. Acad. Sci.*, **2**, 406, 413 and **3**, 75, 119, 459 (1936).

[3] Hiedemann, E., and Hoesch, K. H., *Naturwiss.*, **24**, 60 (1936).

[4] Schaefer, Cl., and Bergmann, L., *Naturwiss.*, **22**, 685 (1934) and *Sitzgsber. preuss. Akad. Wiss.*, **14** (1935).

Magnetic Moments of the Proton and the Neutron

IT is well known that the magnetic moment of the proton and the neutron cannot be explained by Dirac's relativistic wave equation. It was first suggested by Wick[1] that the surplus moment of the proton may be explained by Fermi's β-theory, according to which the proton spends a certain fraction of its life in a virtual state as a neutron plus a free positive electron and neutrino. Since the electron has a large magnetic moment, this state will contribute considerably to the magnetic moment of the proton. Since, however, the β-decay constant is exceedingly small in nuclear dimensions, it has not been possible to account for the observed momenta in this way.

A new hope for such an 'exchange theory' of the magnetic moments is perhaps offered by the probable existence of a hitherto unknown type of particle constituting the hard component of cosmic radiation. It has been suggested that they are 'heavy electrons' with a mass somewhere between that of the electron and the proton. Since these particles are certainly not stable, it might be plausible to assume that they can be emitted and absorbed by nuclear particles in a similar way as in the β-decay. We therefore assume that, in suitable circumstances, a proton (or neutron) can emit a positive (or negative) heavy electron, transforming itself into a neutron (or proton). Hence it would follow that heavy electrons have no spin and satisfy Bose statistics. In order to account for the magnetic moment of the proton and neutron, it is necessary to choose an interaction between the heavy particles and the heavy electrons depending on the relative directions between the spin of the proton (neutron) and the angular momentum of the emitted heavy electron. Such an interaction can easily be found and has the property that a proton (neutron) with spin in the $+z$-direction can only emit a heavy positive (negative) electron with angular momentum $+1\hbar$ about the z-direction transforming itself into a neutron (proton) with spin in the $-z$-direction. Thus angular momentum is conserved.

The details of this 'interaction *Ansatz*' and their bearing on the nuclear forces will be discussed elsewhere. Without reference to the special type of the interaction chosen, it is possible to calculate the *mass of the heavy electron* from the observed data. Let α be the fraction of time which a proton (neutron) spends in a virtual state as a neutron (proton) + heavy electron and let us assume that the proton satisfies—apart from the above interaction—Dirac's equation; and let M be the mass of the proton, m that of the heavy electron. If we measure all magnetic moments in units of the Bohr nuclear magneton, the magnetic moments of the proton μ_P and neutron μ_N will then be

$$\mu_P = 1 - \alpha + \alpha\frac{M}{m},$$

$$\mu_N = -\alpha - \alpha\frac{M}{m}.$$

Hence we obtain

$$\frac{M}{m} = \frac{\mu_P + |\mu_N| - 1}{1 - \mu_P + |\mu_N|}.$$

Inserting the observed values $\mu_P = 2\cdot 6$, $\mu_N = -1\cdot 75$, we obtain $M/m = 22$ or $m = 80$ electron masses.

This value of m depends sensitively on the departure of the value of the magnetic moment of the deuteron $\mu_P - |\mu_N|$ from 1. But the order of magnitude of ~ 100 electron masses will probably be right. This seems to be quite in accord with cosmic ray data.

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Nov. 24.

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[1] Wick, R. C., *Accad. Lincei*, 21, 170 (1935). Cf. also Kahn, *Physica*, 3, 495 (1936).

Orientation Habit of Martensite

FOR many years, metallurgists have believed that martensite, the hardening constituent in iron-carbon alloys, forms along the octahedral {111} planes of austenite. In 1933, Mehl, Barrett, and Smith[1] reported experimental results which they interpreted as verification of this assumption.

Recently, we have succeeded in demonstrating conclusively that martensite in quenched plain high-carbon steels is *not* parallel to the octahedral {111} planes of the austenite lattice; in fact, the martensite plates are parallel to no low-indices plane of austenite. Actually, the poles of planes delineated by martensite midribs deviate about 2° or 3° from {421} of the austenite lattice; thus, they are not far from the mean cementite-plate orientation determined by Mehl, Barrett, and Smith[1]. Our experimental procedure was, briefly, as follows: Specimens containing large (1–3 mm.) austenite grains saturated with carbon at 1130° C. were prepared (by a suitable annealing treatment) and rapidly quenched from that temperature in a solution of 10 per cent caustic soda. The orientations (to within ½°) of the austenite grains were determined by means of the back-reflection Laue X-ray method; and from a microscopic measurement (and pairing) of martensite midribs on two prepared surfaces, the poles of martensite plates were located stereographically with respect to the orientation of the austenite lattice. Poles of twin bands in the austenite grains, located for check purposes, were found to deviate less than ½° from {111} poles located from the X-ray data.

These austenite grains, which at 1130° C. were saturated with carbon, were found to have, after quenching, a perfect lattice structure with no indication of any distortion, and the martensite midribs in these austenite grains could be measured (that is, were parallel) to within ½°. In specimens having carbon contents appreciably less than the above saturation value, the retained austenite grains have a distorted structure, manifested in a symmetrical broadening of the Laue spots on the X-ray patterns. For all carbon contents investigated so far, the martensite orientation habit is essentially the same. Thus, the martensite transformation in iron-carbon alloys, far from producing a simple octahedral pattern in austenite, actually shows an irrationality in orientation habit comparable to that of the "martensitic transformation" in brass[2].

It is expected that when the complete results of this and collateral work now being conducted at our laboratory become available, it should be possible to give a more comprehensive picture of the interrelation of the various 'constituents' in steel than has been presented heretofore.

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ALEXANDER R. TROIANO.

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Cambridge, Massachusetts.
Nov. 23.

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[1] Mehl, Barrett, and Smith, *Trans. Am. Inst. Min. and Met. Eng.*, 105, 215–258 (1933).

[2] Greninger and Mooradian, *Metals Technology* (*A.I.M.E.*), December 1937.

The Surface Slit Viscosimeter and the Viscosity of Monolayers

PERHAPS the greatest advantages of the surface viscosimeter which makes use of the flow of a film through a rectangular slit are (1) that the theory is relatively simple, and (2) since there are no moving parts, the substrate, usually water, is not set in motion by the apparatus, but only by the film. In a recent letter in NATURE[1], Harkins and Myers show that the flux of the film through a narrow slit varies inversely as the cube (a^3) of the diameter of the slit. Since this neglects the effect due to the viscosity of the substrate, η_0, it seems to be essential to develop the complete theory, and this has been done by one of us (Kirkwood). For a slit of length l, depth h, and width a, the area flux A, is given by

$$A = \frac{8\alpha a^3}{\pi^4}\sum_{n=1,3,5,\ldots}^{\infty} \frac{1}{n^4\left[\eta + \frac{a\eta_0}{\pi n}\coth\frac{\pi n h}{a}\right]} \qquad (1)$$

where $\alpha = (f_2 - f_1)/l$ is the pressure gradient in the slit. If h/a is large relative to unity, this may be represented by a practically adequate approximation as

$$\eta = \frac{\alpha a^3}{12A} - \frac{a\eta_0}{\pi} \tag{2}$$

The slit viscosimeter is an extremely delicate instrument, when used with small diameters. Expanded films, such as those of oleic, myristic or pentadecylic acid, have very low viscosities, and for their measurement the value of *a* should be 0·1 mm. or less. For 0·1 mm. the correction term is only − 0·00003 surface poises.

The substrate correction, $-a\eta_0/\pi$, is added to the earlier equation. While the highest viscosity (0·0018 surface poises for arachidic acid) given by Harkins and Myers is essentially correct, the lower values are too large by more than the experimental error. The correction applicable to their slit of negligible depth is *smaller* than the term given above, so to insure accurate results the work is being repeated by the use of a slit which meets the demands of the theory.

In the earlier letter, a ring viscosimeter, which vibrates as a torsion pendulum, was described. In addition, there is now in use a surface ring which rotates at a constant rate, either without or with a guard ring, the latter being used to simplify the theory. While theories may be developed for these instruments for the calculation of the absolute viscosity, the theories are somewhat doubtful, so it seems better to calibrate these instruments by the use of the slit viscosimeter.

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Nov. 16.

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[1] NATURE, 140, 465 (1937).

Sorption of Carbon Dioxide by Chlorophyll

THE interaction of chlorophyll with carbon dioxide is of obvious interest in connexion with the problem of photosynthesis. The formation of an addition product of chlorophyll and carbonic acid has been often assumed to be the first stage in the reduction process.

We performed some experiments to see if solid chlorophyll has any affinity for carbon dioxide. The preparation used was crystalline ethyl chlorophyllide ($a+b$ mixture, 0·3 gm. kindly supplied by Prof. A. Stoll of Basle). It was degassed in high vacuum at 70–80° C. and brought into contact with pure carbon dioxide gas under different pressures. A considerable sorbing capacity was found. The sorption is perfectly reversible, and the equilibrium is established in a few seconds. The sorption isothermals for 0° C. and −80° C were measured out, point by point, in the interval $p=$ 0 to 700 mm. They are perfectly reproducible smooth curves, and can be represented by the sorption formula derived previously[1] for the sorption of gases by crystalline lattices ('zeolithic' sorption). The heat of sorption is 2·6 kcal. per mol, and the saturation corresponds to 2 mols carbon dioxide per mol of ethyl chlorophyllide. The maximum sorption actually observed (−80° C., $p=600$ mm.), was 1·1 mols/mol; at 0° and $p=\frac{1}{4}$ mm. (partial pressure of carbon dioxide in the air), about 1 ethyl chlorophyllide molecule in 15,000 is carrying a carbon dioxide molecule.

The relation of these results to the experiments of Willstätter and Stoll[2] on sorption of carbon dioxide by colloidal chlorophyll solutions will be discussed elsewhere, together with the details of our experiments.

I wish to thank Mr. K. W. Jones for his help in carrying out the experiments.

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London.
Dec. 5.

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[1] Rabinowitch, E., and Wood, W. C., *Trans. Faraday Soc.*, 32, 947 (1936). In formulæ (4) and (6) of this paper, $R^{3/2}$ is a misprint for $R^{2/3}$.

[2] Willstatter, R., and Stoll, A., "Untersuchungen über die Assimilation der Kohlensaure", pp. 227–314 (Berlin, 1918).

Mechanism of the Biological Synthesis of Acetylcholine

THE well-known work of Prof. O. Loewi and of Sir Henry Dale and their collaborators has established the widespread function of acetylcholine as a chemical transmitter of nervous action. It has further been established that there exists in the animal organism a specific enzyme, choline-esterase, which effects the rapid destruction of this ester. Interest, therefore, now centres round the mechanism whereby acetylcholine is produced in the body.

Making the assumption that the synthesis in question occurs in nervous tissue, we recently[1] succeeded in demonstrating conclusively that acetylcholine is produced in minced brain from the ox when this tissue is incubated under certain specified conditions. We further obtained some evidence which suggested that acetoacetic acid or one of its derivatives could act as a precursor of the acetyl moiety of the acetylcholine molecule, but the magnitude of the increase in the yield of acetylcholine produced by the addition of sodium acetoacetate to the incubating material was not sufficiently great to justify us in concluding with certainty that this substance acted as an immediate precursor.

Further progress has now been made in the elucidation of this problem. An examination of different portions of the brain by the technique previously described has shown that the synthesis of acetylcholine *in vitro* occurs to a preponderating extent, although not exclusively, in the grey matter, and that rather more is produced by the basal ganglia than by the grey cortical tissue. In view of this result and of the ease with which the basal ganglia can be removed from the remainder of the brain, we have now used this material in place of whole brain for ascertaining the influence of sodium acetoacetate on the synthesis of acetylcholine. The effect of the addition to this tissue has proved to be much greater than was previously observed with whole brain. In experiments which have been repeatedly carried out, the addition of 20 mgm. of sodium acetoacetate to 10 gm. of basal ganglia has increased the yield of acetylcholine, as determined by its action on the dorsal muscle of the leech, by 100 per cent. Further, although smaller, increases are produced by the addition of 10 mgm. of choline chloride.

These results appear to us to demonstrate that acetylcholine is synthesized biologically from choline and acetoacetic acid essentially according to the hypothetical scheme which we previously outlined, although they do not exclude the possibility that minor details of the process still require elucidation. The synthesis is presumably of an enzymic nature, and we are now commencing experiments designed to separate the enzyme concerned from the nervous tissue.

We hope later to give a more detailed account of our work and also to discuss some of the implications of our findings.

EDGAR STEDMAN.
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University, Edinburgh.
Nov. 26.

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[1] *Biochem J.*, 31, 817 (1937).

A Clay Adjunct to Potato Dietary

IN the course of an expedition to Lake Titicaca, South America, financed by the Percy Slade Trustees in which one of us (H. P. M.) took part, an interesting observation was made in regard to the diet of the Quetchua Indians on the Capachica Peninsula near Puno. These people are almost certainly descendants of the Incas and at the present time live very primitively. They exist largely on a vegetable diet of which potatoes form an important part. Immediately before being eaten, the potatoes are dipped into an aqueous suspension of clay, a procedure which is said to prevent 'souring of the stomach'.

We have examined this clay and found it to consist of kaolin containing a trace of organic material, possibly coumarin, and presumably a decomposition product of the grass from underneath which the clay is dug. The local name for the clay is Chacco, and the Indians distinguish between good and bad qualities. This dietetic procedure is universal among the Indians of the Puno district, and is probably of very ancient origin.

Such a practice by a primitive people would appear rather remarkable in view of the comparatively recent introduction[1] of kaolin into modern medicine as a protective agent for the gastric and intestinal mucosa and as a remedy for bacterial infections of the gut.

ALEXANDER LAWSON.
H. P. MOON.
University College,
Southampton.
Dec. 14.

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[1] "British Pharmaceutical Codex", 1923.

Points from Foregoing Letters

A description and diagrams submitted by Prof. A. H. R. Buller show the thread-like flexuous hyphæ of *Puccinia graminis* (which causes the black stem rust in wheat) in the process of fusion with the gelatinous spores of opposite sex (produced in the pycnidia).

Prof. F. J. Lewis finds that the outer surfaces of the mesophyll cells in the leaf, which are unwettable by water but wettable by hydrocarbons, show strong adsorption of protein sensitizing dyes such as janus green. Within certain *p*H limits, protein dispersing fatty acids such as sodium taurocholate render the surfaces readily wettable with water. The author suggests that they are protein in nature and of molecular thickness.

Photographs showing the effect of small amounts of the 'growth-hormone', 1-naphthylacetic acid on 'nasturtiums' are submitted by N. H. Grace. Optimum results were obtained with a solution containing one part in ten millions. Green tops of lettuce plants increased threefold on addition of 150 mgm. per acre.

Experiments made by Prof. K. Wodzicki and his collaborators on the homing of storks have shown that these birds can return to their nests from distances of no less than 2,260 km. in a straight line. It is concluded that there exists a special sense of orientation in some species of birds.

The term 'gynæcogenic' is suggested by Dr. A. S. Parkes as of more general application than 'œstrogenic' in connexion with substances which induce female characteristics, for example, in the plumage of birds. He also recommends 'ambisexual' in place of 'bisexual' and 'gonadotrophic' instead of 'gonadotropic'.

The curious diffraction effects due to supersonic waves in glasses, as observed by Hiedemann and Hoesch, are explained by N. S. Nagendra Nath and Prof. Hans Mueller on the basis of the Raman-Nath theory by taking into account the phase relations of the index variations. New results are predicted concerning the polarization of the light diffracted by the longitudinal sound waves and the existence of new diffraction lines.

In order to explain the magnetic moment of the proton and of the neutron, Dr. H. Frohlich and Dr. W. Heitler postulate the existence of a hitherto unknown particle with a mass somewhere between that of the electron and the proton. From theoretical considerations they calculate for the new particle a mass about eighty times that of the electron. Such particles, the authors state, may constitute the hard component of cosmic radiation.

A. B. Greninger and A. R. Troiano find that in quenched plain high-carbon steels the hardening constituent, martensite, is not oriented parallel to the octahedral planes of the austenite lattice but more nearly parallel to the direction of the mean cementite-plate orientation.

A formula for determining the viscosity of surface films (monolayers) flowing through a narrow slit, developed by J. C. Kirkwood, is submitted by Prof. W. D. Harkins and Prof. J. G. Kirkwood, who indicate the conditions which have to be satisfied.

Solid chlorophyll (crystalline ethyl chlorophyllide) is found by Dr. E. Rabinowitch to have a maximum sorption for carbon dioxide of 1·1 mols/mol at −80° C., under a pressure of 600 mm. At 0° C. and usual concentration of carbon dioxide in the air ($\frac{1}{4}$ mm. partial pressure) the author found about one molecule of carbon dioxide to 15,000 molecules of ethyl chlorophyllide.

Dr. and Mrs. Stedman find that the formation of acetylcholine occurs mainly in the grey matter and the basal ganglia of the brain. They consider that this substance is formed biologically from acetoacetic acid and choline, since the addition of sodium acetoacetate to the basal ganglia doubles the yield of acetylcholine, while a further, although smaller, increase results from the addition of choline.

Research Items

Archaic Culture of the Northern Andes

MM. A. Métraux and H. Lehmann figure and describe (*J. Soc. des Américanistes*, N.S. 29, 1) archaic objects sculptured in stone which were acquired in the course of an expedition to the plateau lands of Bolivia in 1931. Some time was spent at Oruro, where they were advised of the existence of a collection of these objects. They traced them to the village of Belén in the province of Cercado, forty-five kilometres from Oruro. Here similar examples were found sparsely scattered among miscellaneous rubbish, derived from buildings, in a mound in the centre of the village. The mound was about fifteen metres high and about thirty metres long. Other sculptures were found in the walls of adjacent enclosures and buildings, as well as a number of inscribed plaques, some built into the structure of the church. Excavation of the mound was impossible. Much potsherd material was scattered about the mound, but of modern origin. The objects collected, archaic in style, consisted of a number of heads of Felidæ of a varying degree of realism, heads with conventional representations of the human features, a llama, in which the natural form of the stone is merely elaborated, and a number of stones and plaques with geometrical ornament. There is also a figure of a demon. A small number of such archaic sculptures had been recorded previously; but nothing was known of their origin and affinities, beyond that they showed no relation to any known form of Andine prehistoric art. They were evidently intended for affixing to the walls of a building, and with this as a clue a relation with the earliest phase of the Tiahuanaco culture is established. It is therefore concluded on a basis of comparative study that these sculptures represent the most southerly extension of an archaic north Andean culture, and the most archaic phase of Andean sculpture and art.

Economics of Retail Milk Distribution

RETAIL milk distribution has been the object of much criticism on the grounds that it is unnecessarily costly, that the number of retailers is excessive and that wasteful expenditure is involved in competitive advertising and canvassing. Competition, moreover, compels distributors to provide expensive facilities, such as deliveries in half-pint bottles, two deliveries a day and deliveries at special times. Various aspects of the problem are discussed in a useful report by the Food Council on its inquiry into "Costs and Profits of Retail Milk Distribution in Great Britain" (H.M. Stationery Office. 9*d*.). This report examines variations in costs of distribution, profit margins and the possibilities of effecting savings through a more rational organization of the trade. It emphasizes the fact that the overlapping which is inherent in the retail milk distributive industry is responsible for much duplication of effort and in consequence for much expenditure that is uneconomic. Costs are shown to vary considerably owing to differences in 'rounds', dairy costs, advertising and other circumstances and they range, for example, in the case of pasteurized milk from 5¾*d*. to 9½*d*. per gallon among eight provincial co-operative societies and from 9⅝*d*. to 12½*d*. per gallon among seven proprietary businesses in the provinces. The evidence, it is stated, does not suggest that, taking the trade as a whole, profits are substantially in excess of what is reasonable, though a certain proportion of undertakings are making a liberal rate of profit on turnover. It is concluded that to reduce working costs and thus to lower the retail price of milk, it is essential to reduce the number of distributors and to rearrange trade as between one distributor and another, including a concentration of processing and distributing depots.

A Specific Phosphatase in the Nervous System

AN interesting observation recently made by J. Reis (*Enzymologia*, 2, 110; 1937) indicates that the nervous system has a marked ability to break down adenylic acid and its deaminated product inosinic acid. Under conditions where the α- and β-phosphoric esters of glycerol were hydrolysed to the extent of 1 per cent or less, an extract of the white matter of brain hydrolysed inosinic and adenylic acids to the extent of about 40 per cent. This phosphatase is termed 5-nucleotidase, and its action appears to be specific to adenylic and inosinic acids. It occurs both in the white and in the grey matter of brain, in the spinal cord, in peripheral nerve and, to the greatest extent, in retina. A kidney extract proved to be very much less active than an extract of nervous tissue. Magnesium ions have only a small activating action on the enzyme, the optimal activity of which lies between *p*H 7·0 and 7·5. It is probable that so active an enzyme will play an important part in the metabolism of the nervous system.

Adaptive and Constitutive Enzymes

IT is now well known that the formation of enzymes of bacteria may depend greatly on nutritional conditions. A study of these conditions has given rise to the view that bacterial enzymes may be classified as adaptive when they are formed as a response to the presence in the nutritional medium of the specific substrates upon which they act, or as constitutive when they are formed independently of the composition of the nutritional medium. Experiments by J. H. Quastel (*Enzymologia*, 2, 37; 1937) make it clear that this classification may need modification. Working with suspensions of *M. Lysodeikticus*, it was shown that the urease content of the organism increased, not when urea was present in the nutritional medium, but when glucose was present. On the other hand, the catalase content of the organism decreased when glucose was present in the nutritional medium. It appears, therefore, that the enzymes of the cell may be considerably affected by substances, other than their specific substrates, in the nutritional medium. It is pointed out that the enzyme content at any time in the cell must be a function of the rate of its formation and of the rate of its destruction in the cell, and nutritional conditions may affect these rates differently.

Classification of Marsupials

THE division of the Marsupialia into Polyprotodontia and Diprotodontia was originally suggested by Owen and has been widely followed by zoologists. Another classification, based upon the presence or absence of syndactyly, that is, the union of the second and third digits of the foot save for their claws, has been put forward by Wood Jones. Taking both the dental arrangement and syndactyly into account two equivocal families are discovered, the Peramelidæ and the Coenolestidæ. A. A. Abbie (*J. Anat.*, July 1937) has shown that it is possible to use another criterion, and that is the presence or absence of a fasciculus aberrans, an additional, easily recognizable tract in the anterior commissure of the brain. It is found in Diprotodontia but not in Polyprotodontia, and as it is absent in the two equivocal families they are both referable to the Polyprotodontia. The syndactyly of *Perameles* and diprotodontism of *Coenolestes* are regarded as the results of convergence

Goose Hybrids

Two crosses which do not seem to have been noted previously have been described by Einar Lönnberg (*Arkiv f. Zoologi*, 29 B, No. 8; 1937). One is a hybrid between two species belonging to different genera *Branta canadensis* × *Anser anser*; the other between species grouped in different subgenera, *Anser* (*Eulabeia*) *indicus* male × *Anser albifrous gambelli* female. An account is given of the plumage and colour characteristics of the hybrids. The hybrids were raised at Bokenäs on the coast of Kalmar Sound, where the grey lag-geese stock was raised from eggs imported from Sweden and Denmark. The grey lags were allowed to fly freely and some of them migrated and later returned to the place of hatching and upbringing. That the migration journeys were quite extensive was shown by the shooting of one of the marked migrants on the Lower Guadalquivir in Spain, while others were shot in France, Germany and Denmark.

A Land Nemertean in Britain

AN unusual record has been made of the occurrence of a land nemertean (*Geonemertes dendyi*) living in open-air conditions near Swansea, the first known case of the establishment of a land nemertean in the temperate climate of Europe (*Proc. Roy. Soc. Edinburgh*, 57, 379). A. R. Waterston and H. E. Quick describe the external and internal characters of the species, and record the habits they have observed in specimens at large and in captivity. In Nature eggs were laid in March, and in captivity in October, November and April, and hatching took place after about three weeks. The localities inhabited were all damp places, and the worms were most numerous where there seemed to be least interference by man. The species now found in Wales was originally described by Dakin from West Australia, but since then it has turned up in glass-houses in the Botanic Gardens at Breslau in Germany. Like others of its kind, it has suffered unintentional transportation with vegetation or soil carried by man.

Neuropteroid Insects from Formosa

MR. N. BANKS, of the Harvard University Zoological Museum, has recently described a number of new species and identifies others belonging to the orders Psocoptera, Plecoptera and Neuroptera (*Philippine J. Sci.*, 62, 255–291; 1937). It is apparently at once noticeable with these insects, as with others, that the Formosan fauna shows great affinity with the species found on the Asiatic mainland, particularly the highlands. In general the species, and many of the genera, are different from those occurring in the Philippines. The numerous Panorpidæ, the large Sialids, the Raphidias as well as most of the Plecoptera are wholly foreign to the Philippines. These insects show much more affinity with those of Japan, yet Formosa is about three times the distance from Japan that it is from the Philippines. Most of the genera and many of the species are the same as those which occur in Japan.

The Genus *Bathychordæus*

THE genus *Bathychordæus* is one of the most remarkable among the Appendicularia, and hitherto our knowledge of the genus has been limited to the accounts of four specimens from the deep water of the South Atlantic and the Indian Oceans. The fortunate capture of two specimens at Bermuda in a very good state of preservation has enabled W. Garstang (*J. Linn. Soc.*, Zool., 1937) to add considerably to that knowledge. There seems little doubt that these specimens are congeneric with those previously recorded, but they are regarded as belonging to a new species, for which the name *B. styguis* is proposed. They have no Eisen's oikoplasts, no oral glands and no sub-chordal cells in the tail. They do possess Fol's oikoplasts, contrary to what was previously believed. The totality of the structure leads to the suggestion that the type is somewhat archaic, and while showing some affinities with the *Oikopleura fusiformis* group, also shows others with the *Fritillaria* group.

Control of White Plaster Mould

THE fungus *Oospora fimicola* often makes its appearance upon the surface of mushroom beds, where it excludes the more welcome fungus crop. Large white patches are formed, and give to the invader its name of white plaster mould. Messrs. W. F. Bewley, J. Harnett and P. H. Williams have investigated methods for control of this unwanted competitor (*Gard. Chron.*, Aug., 1937). It has been shown that *O. fimicola* does not grow when the acidity of the medium is below *p*H 4·6, and control of its activities has been obtained by removal of infected casing soil, and its replacement by peat saturated with dilute acetic acid. The question as to whether peat alone might be sufficiently acid to control the fungus arises from a consideration of the paper, for many samples of peat have an acidity of *p*H 4·5 or less.

Atomic Weight of Lutecium

HONIGSCHMID (*Naturwiss.*, 25, 748; 1937) has carried out a redetermination of the atomic weight of lutecium by analysing lutecium chloride and finding the ratios $LuCl_3 : 3Ag : 3AgCl$. The sample of the chloride used was found by X-ray spectrographic methods to contain 1·18 per cent of ytterbium, but no other rare earths in measurable quantity. Allowing for this impurity, the atomic weight of lutecium was found to be 174·98. A difference between this value and that obtained by Aston (174·91) by the mass-spectrograph was expected owing to the announcement by Gollnow (*Z. Phys.*, 103, 443; 1936) of the existence of a new isotope of mass-number either 173 or 177 in lutecium. The amount of this isotope, according to more recent work by Gollnow, might be as great as 2·5 per cent. Honigschmid points out that if the isotope has mass-number 177 and is present to the extent of 2·5 per cent, the mass-spectrographic value for the atomic weight of lutecium becomes 174·96, which is close to the chemical value now reported.

Isotopic Composition of Ordinary and Uranium-Lead

THE isotopic composition of uranium-lead is of importance in the determination of the mass numbers of the radioactive elements of the actinium series, the atomic weight of protactinium, the half-life period of actinium-uranium, and the age of the earth. A new determination of this isotopic composition is reported by J. Mattauch and V. Hauk (*Naturwiss.*, 25, 763 ; 1937). Lead chloride prepared from Katanga curite was used for the investigation, and the percentages of isotopes of mass-numbers 204, 206, 207 and 208 were $1 \cdot 1_5$, $24 \cdot 5_5$, $21 \cdot 3_5$ and $52 \cdot 9_5$, respectively. These values are a little different from those obtained by Aston. Assuming a packing-fraction of 1×10^{-4}, and using the correction factors of Smythe, and Mecke and Childs for the ratios $^{16}O/^{18}O$, and $^{17}O/^{18}O$, respectively, the value for the atomic weight of uranium-lead on the chemical scale ($O = 16$) is 207·21. This is identical with the value given in the International Atomic Weight Table for 1937. The isotopic composition of ordinary lead was found to be 95·1 per cent of ^{206}Pb, and 4·9 per cent of ^{207}Pb, giving an atomic weight of 206·01 ($O = 16$).

Illumination of Buildings

FROM the Engineering Experiment Station of the University of Illinois there have recently been issued two papers by Prof. John O. Kraehenbuehl, giving the results of investigations in lighting and illumination. "Problems in Building Illumination" (Circular No. 29) treats of the general principles underlying the necessity for good lighting and the problems met with in obtaining it. The author first discusses the factors involved in 'seeing', a term used to indicate the fundamental relationships between vision and lighting. The human eye was adapted by evolution for long-distance vision and high illumination, but now works under low illumination at close range. Ordinary conditions are 18 in. distance, 3–10 foot-candles and usually considerable glare, and the effect is strain on the muscles of convergence and of accommodation, the symptoms of which are local—such as smarting and watering of the eyes—and reflex—such as headaches and indigestion. From these conditions, the author proceeds to consider illumination requirements and the systems of lighting in use and, in order to show the relationship between the theoretical and the practical aspects of the problem, makes an analysis of several specific examples. In "An Investigation of Student Study Lighting" (Circular No. 28) he gives an account of a survey made of a large number of students' studies. A supplementary investigation of the different types of lighting equipment used in these was made in the Electrical Engineering Laboratory, where a specially equipped room was provided. The methods and material in use were found in most cases to be conducive to eye irritation and unfavourable to concentrated thought. The results, which should be applicable to analogous cases, showed that the most suitable arrangement was a standard indirect lighting fixture placed 30 in. from the ceiling and above the centre of the right-hand edge of the table. Equipped with a 500-watt lamp, this furnished the correct amount of illumination free from glare or shadow on the work surface, and gave, at the same time, the proper illumination to the surrounding walls, this latter being an essential condition for proper eye relaxation.

Babylonian Algebra

IT is now well known that some Babylonian cuneiform texts contain quadratic equations with correct solutions. According to S. Gandz, the word *algebra* is not really Arabic, as generally supposed, but an Arabic form of the Babylonian term *gabru-maharu*, meaning to confront, compare, or set up an equation. Mr. Gandz (*Scientia*, 52, 249 ; 1937) gives further details of Babylonian methods. They did not deal with quadratic equations directly, but approached them by problems concerning rectangles. The first type of problem sought to determine the sides when their sum was known and also the area. A second type replaced the sum by the difference. There were four other types, in which were given the diagonal and the sum or difference of the sides, or one side and the sum or difference of the diagonal and the other side. Mr. Gandz points out that Euclid and Diophantus were influenced by this Babylonian work, and four of Euclid's problems were merely the geometrical form of four of these types. After a time, it was discovered that the six traditional Babylonian types were not exhaustive. Quadratic equations with two positive roots became known, but they were regarded as absurdities, since they gave two values for one and the same quantity. All kinds of devices were employed to avoid them and to keep to the traditional problems of the rectangle, where this difficulty did not arise. It was the great merit of the Arabic School, who taught Europe algebra by the famous treatise of Muhammad ibn Musa al-Khuwarizmi (*c.* 820), that it had the courage to throw over the traditional methods and to replace the six Babylonian types, and all the ingenious devices necessary to employ them, by the three simple and standardized Arabic types. A later age, by the recognition of negative numbers, was able to reduce these to one.

Studies of the Remote Nebulæ

INVESTIGATIONS into the distribution of the distant nebulæ, which are beyond our galactic system, have shown from 'small-scale' sampling that there is a tendency for those nebulæ towards clustering. This observed tendency is believed to be intrinsic ; there appears to be, in fact, an unbroken sequence from double galaxies and multiple galaxies to the meta-galactic clusters and the superclusters. The "Whirlpool" nebula (Messier 51) is an example of a double system ; the great Andromeda nebula with its two satellites (*M.* 32 and *N.G.C.* 205) is an example of a triple system. Such systems provide unique data for studying the relative dimensions of the nebulæ at various stages of the sequence classification, and in certain cases may provide the data for a statistical determination of the relative masses of these star systems. With this end in view, Mr. Erik Holmberg, in *Annals of the Observatory of Lund*, No. 6, has published a catalogue of 827 double and multiple systems, of which only a very small proportion are believed to be merely optical double or multiple systems. The material for the catalogue has come from the author's examination of the important collection of photographs taken by the late Dr. Max Wolf and his successors at the Heidelberg Observatory, Königstuhl. In a preface to the catalogue, Mr. Holmberg discusses some general problems relating to the extra-galactic nebulæ (termed by the Swedish astronomers "anagalactic" nebulæ), as well as describing his procedure in dealing statistically with his data obtained from the Heidelberg plates.

Early Stone Age Cultures of the Great Salt Lake Region, Utah

NO traces of the Folsom culture, the earliest known Stone Age culture of North America, have been found as yet west of the Rocky Mountains. It has been suggested that climatic conditions on the eastern side of the range in early times, possibly so early as the late phases of the Ice Age, were more favourable to human occupation; but the discovery of a primitive culture in caves of the Great Salt Lake region of Utah demonstrates the existence of early man west of the Rockies at a period for which the geological evidence would warrant a very considerable antiquity, possibly in comparative terms not far removed from the close of the Ice Age.

The evidence for this primitive culture is derived from the investigation of caves above the shores of the Great Salt Lake by a joint expedition of the University of Utah and the Bureau of American Ethnology in 1930 and 1931, upon which a report by Julian H. Steward, field director, has been published recently*.

The largest group of caves investigated is situated on Promontory Point on the northern shores of the Great Salt Lake. Another cave at Black Rock on the southern shore was also examined. These caves were once submerged by Lake Bonneville, which at its greatest depth, during the last phase of the Ice Age, stood at a level of one thousand feet above the present level of the Great Salt Lake. A rapid fall in level from the shore-line of this period left its first well-defined terrace, Provo, at no less than three hundred and seventy-five feet below. Further desiccation left only one well-marked terrace, Stansbury, halfway between Provo and the Great Salt Lake, at a point three hundred feet above the latter.

It is with this later terrace, Stansbury, that the earliest of the cultures discovered in the caves is brought into relation. On the assumption that the high-level shore-line dates from the close of the maximum of the final Pleistocene glacial period at about 25,000 years ago, and the Provo terrace from 20,000 years, the Stansbury terrace is assigned a provisional and approximate dating of 10,000 years.

Several caves on the northern shore were examined by members of the expedition, but two only were excavated, and that in part. Of these two, No. 1 yielded artefacts belonging to a single culture of a relatively recent period—1000 A.D. or later. This culture is new and is to be designated "the Promontory culture".

Cave No. 2 is situated much closer than No. 1 to the Great Salt Lake, and in 1931 was sixty-six feet only above water-level. Charcoal and split bones resting on the bedded gravels indicate that it was occupied by man, when the recession of waters first left it habitable, at a date which its position would indicate to have been somewhere between one thousand and five thousand years B.C. It is possible, therefore, that the earliest occupation of the cave may have been contemporary with the Basket-maker I period. The objects of flint and bone found, however, cannot be equated to any known culture; but the paucity of specimens and the limited variety of artefacts make it difficult to define the culture, which at best is impoverished.

The Black Rock cave on the southern shore is 364 ft. above lake-level and 60 ft. above the Stansbury terrace. It must therefore have been habitable some ten to fifteen thousand years ago. No interval appears between the lacustrine gravels and the culture-bearing strata, so that it may be assumed that it was occupied soon after the waters had receded. Evidence of human occupation in the form of charcoal is, in fact, mingled with the gravels. Three more or less distinct periods are represented. The earliest culture, which is associated with an infant burial, lay in the lowest two feet of refuse. Its most significant feature is a complete absence of dart points of quartzite, which are common at higher levels, and the use in their stead of a dart point so minute as to resemble modern arrow points. Other artefacts include knives, scrapers and bone-splinter awls. There is nothing specific to link this cave culture with Signal Butte, Nebraska, Lindenmeier Folsom or Clovis. The greater part of the deposits contains a single culture, the 'Black Rock culture', of which the most conspicuous feature is a distinctive style of corner notched projectile point of grey or reddish quartzite. The leaf-like flint knife appears to be shared by this and the overlying Promontory culture, which constitutes the third distinct element found in this cave.

The paucity of artefacts from the earliest of the cave cultures makes it difficult to attempt, even tentatively, to reconstruct anything like a cultural sequence. Two negative points are to be noted. No single artefact is associated with post-Caucasian objects, and there is little, if any, suggestion of the Basket-maker or Pueblo cultures. Nor is there any great similarity between the Black Rock culture and the early culture of Promontory 2, despite the reasonable assurance that the two were contemporaneous.

It may be stated with certainty that the latest occupants of these caves all belonged to the stage of the Promontory culture. This culture is characterized by the self- and the sinew-backed bow, the reed arrow with hardwood foreshaft, the longitudinally grooved arrow-polisher, "fingernail" and rim-decorated pottery, cedarwood pottery-rests, three- and four-piece mocassins, single rod or rod-and-bundle coiled basketry, triangular flint knives set in wooden handles, and incised slate slabs. It possesses a curious combination of traits of both northern and southern origin; and it is quite distinct from modern Shoshoni, though it may be a form of early Shoshonean. Possibly it is a relic of an Athapascan-speaking people from the north in the course of its migration southward.

Prior to this Promontory culture in the Black Rock cave come the people of the so-called Black Rock culture, characterized most typically by the quartzite dart point, which may or may not be contemporary with Basket-maker and Pueblo, and of uncertain correlation with the early culture of Promontory Cave 2.

The oldest culture of all, preceding the Black Rock culture in the Black Rock cave, has yielded little to characterize it, though its high antiquity appears to be beyond question.

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* Ancient Caves of the Great Salt Lake Region. By Julian H Steward. Smithsonian Institution: Bureau of American Ethnology, Bull, 116 (1937)

Effects of Impulse Voltages on Transformer Windings

In a paper by Dr. T. E. Allibone, D. B. Mackenzie and F. R. Perry (*J. Inst. Elec. Eng.*, 80, 118; 1937), the results obtained in a very thorough research on the effects of impulse voltages are given.

To understand what is meant by 'impulse voltage' we have to consider the experiments that have been made during the past seventy years. In 1860 Lord Kelvin wrote a paper describing researches that had been made in his laboratory on the voltage required to produce a spark between spherical electrodes. He used primary batteries in series, and obtained some evidence that the spark occurred when the maximum stress between the electrodes attained a definite value depending on the barometric pressure. If higher voltages had been obtainable, he would have found that except when the electrodes were close together and when they were so far apart that brush discharges appeared on them, there was a certain stress at which the discharge occurred. This is definitely proved by the results obtained by several experimenters some fifty years ago. Knowing, therefore, how to compute the sparking voltages between the electrodes in air in certain cases, attempts were made by electrical engineers to determine experimentally the electric stresses that would produce sparking voltages in materials like glass, ebonite, porcelain and even in non-homogeneous substances like the insulating wrappings of cables. Owing to the very high voltages required, alternating current pressures obtained from a transformer were used. This made a very large high-tension laboratory necessary and greatly increased the cost of research at high pressures.

Instead of using a very high pressure transformer, experimenters sometimes employed batteries of condensers. If there were ten such batteries and they were charged to a potential V in parallel, then in series they would give a potential difference of 10 V. But as Kelvin had shown in 1853, this discharge might be oscillatory, obtaining a maximum voltage which is generally taken to measure the maximum stress and then trailing off in a series of smaller oscillations. The effect of the rush of this oscillating quantity of electricity is sometimes deleterious to the transformer windings. As Duddell pointed out many years ago, when a transformer broke down after a rush of electricity through it, the place of breakdown was generally in the windings first subjected to the effects of the rush. Apart from testing, this problem is of vital importance in power transmission lines where we often have inductance and capacity in series, and a neighbouring lightning stroke or a short circuit may start a travelling 'impulse voltage'.

Messrs. Allibone, Mackenzie and Perry have analysed the effects of the applications of impulse voltages of varied wave shapes to transformers. They have considered both single and multiple 'transients'. They have also experimented on model transformers of different winding characteristics and on both single-phase and three-phase transformers. The constants of these transformers must be known as they determine the voltage distribution within the windings due to the impact of a surge. They have been calculated and measured, and the effect of altering them has been examined. The agreement obtained between theory and experiment is good. The transference of surges from one winding to another is considered. They also discuss the testing of transformers with impulse voltages.

In Germany and Switzerland, surge voltages have been used for transformer testing for several years, and this has improved the quality of the transformers. Recently, test schedules have been suggested both in the United States and in Great Britain with the same object in view. The authors conclude that a knowledge of the behaviour of transients in transformer windings is essential if the most efficient use is to be made of the insulation employed. The problem is made more complex owing to the wide diversity of connexions possible between the windings and by the influence which externally connected circuits may have on the transient within the winding. At the same time, as the designer makes research on the impulse voltages within the windings, he must ascertain the behaviour of the insulation employed under a variety of applied impulses, so that by combining the knowledge of voltage distribution with a knowledge of the electric strength of materials, a forecast of the breakdown voltage of the transformer under test conditions can be obtained.

Alloys of Magnesium

MAGNESIUM, the sixth most abundant element in the world, was first made commercially in 1857, and in the last twenty years its price has dropped from 25*s*. to 1*s*. 3*d*. a pound. The recent demand for lightness in construction has led to a great deal of research being undertaken in many countries on the possibility of using magnesium alloys in place of the heavier aluminium alloys as engineering materials, and the results obtained are scattered in many scientific and technical journals. The Metallurgy Research Board of the Department of Scientific and Industrial Research arranged for the results to be summarized by Dr. J. L. Haughton and W. E. Prytherch*.

One of the great limitations to the use of magnesium alloys at the present time is that they tend to corrode very readily in certain types of water, although the corrosion is not always so severe as was originally believed. Much work has been done to find some metal which would notably reduce this trouble, and 0·5–2·5 per cent manganese has an appreciable influence in this direction. Failing further progress in this field, magnesium alloys will probably have to be protected against severe corrosive conditions by paints applied over some chemically produced film, without which paints will not adhere satisfactorily. Special reference is made to the selenium and to the chromate treatment for the production of protective films as a basis for painting, and it is pointed out that the choice of paint to put on the films is important, as many pigments suitable for iron and steel actually stimulate corrosion on magnesium alloys. Reference is also made to the corrosive action of 'leaded' motor and aviation fuels on magnesium cylinders. It is stated that work at the Chemical Research Laboratory has shown that the addition of 1 per cent of quinoline to the fuel inhibits this action and exerts no harmful effect in its anti-knock properties.

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* Department of Scientific and Industrial Research. "Magnesium and Its Alloys". By Dr. J. L. Haughton and W. E. Prytherch. Pp. viii+100+5 plates. (London: H.M. Stationery Office, 1937.) 2*s*. 6*d*. net.

Owing to the ease with which molten magnesium and its alloys combine with oxygen, special methods have to be employed for melting and casting. With the methods described in the monograph, however, it is stated that there is no difficulty in producing castings in magnesium alloys either in sand or permanent moulds.

The monograph summarizes the mechanical properties at room temperatures of the magnesium alloys at present used in industry. These are almost entirely confined to alloys with aluminium and zinc, often containing a small amount of manganese introduced to improve the corrosion-resisting properties. With alloys containing 8 per cent or more of aluminium, it is usually possible to produce increased hardness and a general improvement in properties by suitable heat treatment. This takes the form of exposure to a temperature of 420° C. for a few hours, sometimes followed by tempering for 4–7 days at about 150° C. Increased ductility can be produced by adding cadmium, and reference is made to an alloy consisting of aluminium, silver, manganese and calcium, which has been found suitable for use in stressed parts at room temperature.

A number of possible uses of magnesium alloys involve the exposure of the metal to elevated temperatures, and for this reason their mechanical properties when hot become important. The results of tests up to 300° C. are given for various alloys. Silver, it has been found, increases the ultimate strength of magnesium up to 290° C. but its effect when used alone is not so marked as that of aluminium. Recently cerium has been added, which is stated to have a pronounced effect in increasing the strength of magnesium at elevated temperatures. Even small quantities, of the order of 1 per cent, have a remarkable effect in increasing the hardness at 300° C. The addition of a small amount of calcium to the cerium-magnesium alloys is beneficial in preventing oxidation during melting and heat treatment as well as in improving the age-hardening properties. The increased hardness due to heat treatment is, however, relatively small, even when calcium is present.

A harder alloy can be produced by adding nickel to the cerium-magnesium alloys, but such alloys were found to be very liable to corrosion. This can be reduced slightly by replacing nickel by cobalt and manganese.

The final chapter of the monograph contains reproductions of all known constitution-temperature diagrams for the alloys of magnesium in the form considered by the authors to be most nearly correct.

F. C. T.

Conditions in the Special Areas of Great Britain

SIR GEORGE GILLETT'S admirable first report as Commissioner for the Special Areas of England and Wales, covering the year ended September 30, 1937, shows no departure from the example of frankness and independence of judgment that was set by Sir Malcolm Stewart. The report is indeed in striking contrast to the evidence tendered by the Board of Trade to the Royal Commission on the Geographical Distribution of the Industrial Population. Like Sir Malcolm Stewart, Sir George Gillett stoutly upholds the principle that the State should control the location of industry, asserting that the introduction of tariffs and quotas has enhanced the Government's responsibility in this matter, and that social and strategic as well as economic causes are driving the Government to abandon the old *laissez-faire* attitude. The recommendations in the recent report of the Import Duties Advisory Committee on the present position and future development of the iron and steel industry, no less than the appointment of the Royal Commission, illustrate this tendency.

The first recommendation is that the conclusions of the British Iron and Steel Federation in regard to all schemes of development of the industry should, whether favourable or not, be reported to an independent body looking to the general public interest. This independent body is to be the Import Duties Advisory Committee itself, and Sir George Gillett points out that this recognition that matters which concern the welfare of thousands of our fellow citizens are properly to be considered in relation to their social and broad economic consequences, as well as in relation to the profit and loss account of the individual concern, marks a great advance.

The second recommendation to which Sir George directs attention relates to the need for dealing with the problem of restoration on a systematic and comprehensive scale to avoid the serious risk of creating extensive areas of broken and barren land by quarrying ironstone over large new areas. Sir George Gillett considers that this touches on one of the vital problems of the Special Areas, and that the recommendations should be extended to apply to all industries, such as the coal, chemical and brick industries, which are apt to leave scars on the landscape, and he suggests that the tragic relics of the past should be avoided by a system of compulsory insurance or by putting responsibility for clearance on the industry as a whole.

As Sir George Gillett points out, the ideal solution is for new industries to be established on sites which have already been scarred and spoilt for any but industrial purposes, as in the huge new steel works being erected by Richard Thomas and Co. on the site of the old works at Ebbw Vale and the new steel works to be erected on the site of the old works at Palmer's Yard in Jarrow. These examples in themselves sufficiently indicate one way in which the problems of the Special Areas are linked up with those of the preservation of amenities generally, but the North Eastern Trading Estate at Team Valley provides a conspicuous example of the way in which industrial development in a new area can be planned so as to add to, rather than detract from, the amenities of the district. Already it appears that proper facilities for manufacture, pleasant conditions for labour and the high advertising value of a well-planned estate weigh quite as heavily with industrialists as economic considerations. Even if the proximity of a fine type of labour has been a further factor, there is still evidence of a real desire on the part of many industrialists to assist in the solution of the problems of this particular Area.

The Commissioner in his report does not hide the difficulties that remain to be overcome or the seriousness of the present situation, but the keynote of the present report is a definite but restrained optimism. During the twelve months, unemployment in the Areas has fallen by 25·6 per cent., of which only a comparatively small part was due to transference out of the Areas, the corresponding figure for the rest of England and Wales being 12·0 per cent. National and international causes have undoubtedly been responsible for most of this improvement, but it has been largely independent of armament work. Another encouraging sign of progress in the Durham and Tyneside Special Area, for example, is the extent to which much of the work necessary for the recuperation of the Area is now in the hands of bodies locally administered and having a lease of life which is independent of Special Area legislation. Further reduction in the volume of unemployment depends upon the success of the measures now being adopted to induce new industries to establish themselves, the further development of those measures and the policy of the Royal Commission.

As regards particular measures, the report refers once more to the question of establishing a calcium carbide factory in South Wales, the investigation of schemes for low-temperature carbonization or hydrogenation of coal, the improvement of communications, and the research carried out by the Technical Advisory Committee of the North East Development Board, while the Commissioner for the Special Areas in Scotland lays a good deal of stress upon the utilization of coke-oven gas as well as the establishment in the Area of one or other processes for the extraction of oil from coal, if any impression is to be made on the most intractable problem—that of continuing unemployment in the coal industry.

For the future, Sir George Gillett insists that it is not so much new organizations that are wanted as twelve months of steady work to see if, with the powers already granted, any impression can be made on the 200,000 unemployed men and women still left in these Areas, of whom about 80,000 are men of forty-five years of age and upwards, many suffering from diseases contracted through working in the coal mines. This is the most significant problem of the Areas, and is being tackled in various ways, apart from insisting on the employment of older men in wage-paid schemes, such as group holdings, subsistence production, voluntary (local amenities) schemes and allotments.

The problem of the Scottish Special Areas is essentially different in the greater difficulty of transference, in the absence of an expanding industrial centre in Scotland, and in the lesser severity of unemployment statistically. There are, however, many towns and communities with every local service, labour suitable for training and employment, attractive amenities, and a robust civic and social sense. Measures to deal with the unemployment in the coal industry have already been mentioned. Among indirect measures, the Commissioner lays stress on housing, land settlement and assistance to schemes for improving water supplies, sewerage and sewage disposal, drainage and the like.

In conclusion, in view of significant omissions in a recent book on the Special Areas, it is pertinent to point out that the present reports indicate that, up to September 30, 1937, estimated commitments, including expenditure on the Special Areas Fund, amount to £12,900,000 in England and Wales and £2,488,584 in Scotland.

Science News a Century Ago

Progress of British Railways

IN the January number of the *Civil Engineer and Architects' Journal*, under the heading "Progress of Railways", were given extracts from various newspapers referring to the state of construction, growth of traffic, etc., on some fifteen railways. Of the Eastern Counties Railway, it was said: "The works of this railway are now pushed as far as Ilford and it is confidently expected that it will be opened to that town (seven miles) next summer." As regards the Grand Junction Railway, it was remarked: "It is said that the Post Office Department have concluded a valid agreement with the Directors, which will enable the inhabitants of Liverpool after the first of May next, to receive their London letters, dispatched on the preceding evening, at eight on the following morning"; and also that "Notice has been given, that it is intended to dispatch a train from the station at Lime street, for the conveyance of pigs to Birmingham". Similar trains were to be dispatched each Tuesday, Wednesday and Thursday. On the Whitby and Pickering line, "A great increase has taken place in the tonnage amount of traffic and numbers of passengers conveyed, the increase in the number of passengers during the half-year had been 8,000, and the increase in goods traffic 6,000 tons". Another notice said, "On the 1st of January, the London and Birmingham Railway will be open as far as Stony Stratford, and also the Birmingham end as far as Rugby, making in the whole 77 miles of this great undertaking completed." The Bolton and Preston Railway had been decided upon, while at a meeting at Penrith of the promoters of the Lancaster and Glasgow Railway, one speaker, when alluding to the western line over Morecambe Bay to Whitehaven, declared that Mr. Stephenson had made a mistake of fourteen miles in computing the length of the line!

Visions of the Extension of the Electric Telegraph

ON January 5, 1838, a correspondent "Inquisitivus" wrote to the editor of the *Mechanics' Magazine* about the electric telegraph, which was then engaging much attention. "It is too often the case", he said, "that the ingenuity and valuable time of talented men are wasted upon what has, unknown to them, been invented before; and of this we have instances in the electric telegraph." After referring to the telegraphs of Alexander, Ritchie, Gauss, Cooke, Wheatstone and Davy, he went on: "Now, Mr. Editor. What shall hereafter prevent our globe from having sets of wire laid down branching in all directions over its surface like the nervous system of the human body, and thus having as it were but one pervading soul?" A patient, in India, he said, could then obtain advice from a doctor in London; the *Sydney Gazette* might contain the proceedings of the House of Commons the day before. "From New York to Pekin, from Pole to Pole, man will be enabled to converse with man, as though he were in the same house, in the same chamber; it will be one step towards making all nations as one family."

Hooker's "Icones Plantarum"

SIR WILLIAM JACKSON HOOKER (1785–1865), the celebrated botanist, had among other works published "Musci Exotici", "Flora Scotica", "Icones Filicum" and his "British Flora", when in 1837 he began the publication of his "Icones Plantarum" containing figures and descriptions of rare plants in his herbarium. Speaking of the last of these, the *Athenæum* of January 6, 1838, said: "This work appears occasionally in parts, each containing fifty plates of new and rare plants, drawn on stone with singular taste and fidelity. Two volumes have appeared, and a third is announced, although it is known to the friends of the author that each volume leaves him a considerable loser. Such a fact . . . is not very creditable to the science of this country. Nothing can be more interesting to a man of science than the plants represented in these volumes; nothing can be in better taste or more faithful than the figures; and it is difficult to conceive how anything can be cheaper (fifty plates for fifty shillings): yet while the most miserable trash that the press produces under the name of Botany sells in hundreds and thousands of copies, such a sterling work as this is only enabled to maintain its ground by aid of the purse of its author. We do trust that the friends of Botany will bestir themselves on this occasion, and come forward with such a demand for copies as will, we do not say encourage, but enable, the learned author to produce many volumes in addition to those which have hitherto appeared."

The Society of Arts

THE *Mechanics' Magazine* of January 6, 1838, said: "The Society of Arts, in years gone by, took a prominent part in the scientific world, and effected considerable good in promoting that spirit of invention and discovery which is now so general among the manufacturing community. It has not, however, kept pace with the times, and has of late fallen into obscurity. It has also fallen into debt, and an appeal has been lately made to its members, urging them to procure donations and annual subscriptions from noble and wealthy patrons of the arts, manufactures and commerce of the country, and to obtain an increase in numbers so as to renovate the funds and extend the useful powers of the Society."

The appeal was issued by the secretary, Arthur Aiken (1773–1854), a chemist and mineralogist who in 1807–14 had published a "Dictionary" of those sciences.

Societies and Academies

Dublin

Royal Irish Academy, November 30.

ARTHUR E. J. WENT: The salmon of the River Shannon. An account is given of the analysis of the stocks of salmon in the River Shannon during the year 1927. The phenomenon of growth in fresh water in the year of migration as a smolt is discussed, and it is suggested that a minimum size is necessary before the physiological condition is attained which causes the assumption of the smolt livery and the smolt migration. Examination of the scales and data from smolts confirmed the results obtained from the examination of the scales of adult fish.

Paris

Academy of Sciences, November 15 (*C.R.*, 205, 885–939).

ROBERT ESNAULT-PELTERIE: The coefficient of self-inductance of a solenoid.

A. PFLUGER: The growth and distribution of the zeros of certain integral functions of positive finite order.

GEORGES VALIRON: A criterion of normal family.

JOHN ELLSWORTH: Photometric study of the variable star *BD*–1° 1004. This star is probably not a variable with eclipses. The photometric period found has no relation with the spectroscopic period.

BERNARD LYOT: The passage of Mercury across the corona.

MIRCEA DRĂGANU: The passage of very rapid protons through matter.

THÉODORE KAHAN: The phenomenon of quantum exchange and nuclear isomerism. A new method of determining this.

GUSTAVE RIBAUD: Improvements in the technique of measuring the temperatures of flames. Modifications of the Kurlbaum optical method.

J. BETHENOD: A method for testing high-power circuit breakers for high-tension systems.

MME. IRÈNE MIHUL and CONSTANTIN MIHUL: The reflection in the atmosphere of waves of radio-diffusion.

MAURICE PARODI: The transmission of some oxides in the extreme infra-red.

ANDRÉ POIROT and MAURICE AUCLAIR: The anode rays of some heavy metals, especially lead. Lead bromide placed in the discharge tube gives satisfactory results and is more convenient than the lead tetramethyl hitherto employed.

ALFRED SILBERSTEIN: Some bromocupric complex compounds.

JACQUES BÉNARD: The parameter of pure ferrous oxide.

C. F. GOODEVE and F. D. RICHARDSON: The existence of chlorous anhydride. Criticism of a recent paper on this subject by Kantzer. This author's method gives an oxide with a spectrum identical with that of chlorine dioxide.

ALEXANDRE TRAVERS and ROBERT DIEBOLD: The mechanism of the decomposition of pure cementite by acids. From a discussion of this reaction it is concluded that it is impossible to determine cementite chemically in a ferrous metal by selective solution of the iron: the carbide is always attacked, liberating carbon, and giving gaseous hydrocarbons.

PAUL CORDIER: The condensation of acetone with phenylpyruvic acid.

Maxence Meyer : The synthesis of a derivative of oxyhydroquinone.

René Hazard, Jean Comandon and Pierre de Fonbrune : The crystallization of ecgonine silicotungstate. Cinematographic registration.

Alexis Lambert : Discovery of the Rhetian with *Avicula contorta* in the Djurdjura chain.

Jean Sagatzky and Rostislav Goloubinow : The origin of the gold on the Guinea-Sudanese border and in the old Haute-Volta.

Emile Miège : Chemical composition of *Triticum*, of *Ægilops* and their hybrids.

Marc Simonet : New pentaploid hybrids in the garden *Iris* (*I. germanica*).

Paul Chabanoud : A new teleostean of the Solidae family, *Pseudaustroglossus annectens*.

Roger Netter and Mlle. Simone Roche : The action of hydrochloric acid upon insulin.

Marc de Larambergue : Genetic study of *aphallie* in *Bulinus* (*Isodora*) *contortus*.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, Nos. 8–9, 1937).

G. Goethals : The synthesis of Δ 2–6 octadiene-1-al. This aldehyde was prepared from pentenyl chloride by converting it into pentenyl vinyl carbinol and acting on the latter with phosphorus tribromide. Octadienyl benzoate was prepared from the bromide and then saponified. The octadienol so produced gave the octadienal on oxidation with chromic acid. The Raman spectra of the primary and secondary bromides formed in the above reactions were examined as a means of identifying the products.

B. Ruyssen and E. Verstraete : Complex coacervation of the system gelatine-saponin. Determinations of the viscosities of mixtures of these colloids as a contribution to the study of complex coacervation, an intermediate stage in the flocculation of hydrophilic colloids in which the initial desolvation is caused by the opposition of the electrical charges on the two components of the mixture.

J. D. H. Donnay : Morphology of apophyllite. A discussion of the true crystallographic symmetry of this mineral and its representation.

Cracow

Polish Academy of Science and Letters, November 8.

S. Dobinski : The adsorption of the components of a solid phase at the surface. The examination, by means of electron diffraction, of the surface structure of certain metallic alloys, shows that the concentration of the components in the neighbourhood of the surface is not identical with that corresponding to the deeper layers. This is possibly due to the effect of surface tension.

J. Wesolowski : The dielectric polarization of liquid selenium. From experimental results obtained with an apparatus capable of measuring the dielectric constant with an accuracy of ±0·5 per cent, between temperatures ranging from 237° C. and 300° C., it is shown that the atomic polarization is 12·0, is independent of the temperature, and satisfies the rule established by Cuthbertson and Doborzynski.

Mlle. L. Stankiewicz : The arithmetical operations in the calculation of determinants according to Cracovian methods.

A. Chrominski : The application of Cracovians to the rapid solution of various problems of practical analysis.

M. Centnerszwer and Mlle. J. Borowicz : Study of the electrolysis of colloidal solutions of silver.

K. Dziewonski and P. Trzesinski : Study on pyrene (II). The preparation and properties of propionylpyrene.

W. Friedberg : Catalogue of the collection of Miocene molluscs of Poland.

W. Friedberg : An attempt at a stratigraphy of the Miocene of Poland, based on the molluscan fauna.

J. Zacwilichowski : The second filial generation (F_2) descendant of *Lymantria dispar*, made artificially darker.

Mlle. H. Gajewska : The microscopic structure of the middle intestine of *Mesidothea entomon*.

P. Pautsch : Researches on the autoplastic transplantation of the tails of tadpoles of *Rana temporaria* with inversion of the dorso-ventral and cephalo-caudal axis.

Moscow

Academy of Sciences (*C.R.*, 16, No. 5, 1937).

G. Ambarzumian : Distribution curves of probabilities which reproduce at their limit the Pearson distribution curves.

S. I. Wawilow (Vavilov) : A method for the determination of the true fluorescence polarization of solutions at high concentrations.

S. I. Wawilow (Vavilov), P. G. Gluchow and I. A. Khwostikow : Fluorescence depolarization of solutions at high concentrations.

V. Fabrikant and I. Cirg : Probability of a step-wise excitation of mercury atoms.

S. N. Rževkin : The problem of the wave-field of a piezo-quartz radiator.

P. P. Lazareff and E. V. Dobrovolskaya : Influence of singing on adaptation in peripheral vision.

D. I. Mirlis : Kinetics of wetting and linear corrosion of metals in polyphase systems : metal-liquid-liquid and metal-liquid-gas (4).

V. G. Tronev and C. M. Bondin : Solubility of noble metals at high pressure. (2) Solution of gold in cyanides at atmospheric pressure.

L. P. Breslavec and E. Zaurov : Hermaphrodite hemp found in field crops.

(*C.R.*, 16, No. 6, 1937.)

N. Moisseiev : Stability and anti-stability of the third generalized type.

Natalie Rein : Method of evaluation of the period of solution of a problem restricted to three bodies.

S. Bellustin : Influence of space charge on a current in vacuum.

W. W. Shouleikin : Theory of monsoons. (2) Vertical distribution of velocities.

S. A. Borovik and T. A. Burova : Quantitative spectroscopic determination of neodymium and praseodymium in minerals.

V. G. Tronev and S. M. Bondin : Solubility of noble metals at high pressure. (3) Influence of temperature and of the potassium cyanide concentration on the rate of solution of gold at high pressure.

V. G. Tronev : Displacement of gold in chloride solutions by hydrogen at high pressure.

B. K. Klimov and E. I. Kazakov : Carotene (provitamin A) in sapropel.

M. G. Tumanian : Occurrence in Nature of polyploid mutations in wild monococcal wheat.

J. W. R. Rakitin: Flower-bud drop in some varieties of the cotton plant under the influence of different lengths of day.

K. Arnoldi: Life forms in ants.

L. N. Zhinkin: Experiments on the reversion of polarity during regeneration in *Lumbriculus variegatus* Müll.

Vera Gromova: New finds of Late Pleistocene fauna in North Caucasus.

(*C.R.*, 16, No. 7, 1937.)

V. V. Čelincev: Furfurylidene- and benzylidene-phenol systems and their fusibility diagrams.

A. D. Gelman: Compounds of platinum with unsaturated hydrocarbons of the ethylene series.

D. P. Serdiučenko: The isomorphic series kerolite-beidellite in argillaceous silicates.

A. N. Adowa and I. A. Smorodinzew: Oxido-reduction potential during the pepsin digestion of proteins.

N. I. Makovnik: A new tungsten-bearing region in the U.S.S.R.

T. N. Agafonova: Quantitative mineralogical X-ray analysis.

G. N. Vertuškov: Alpine type veins in the Urals.

A. Nikonov: Stratigraphy of the sources of the Katun River in the Altai Mountains.

I. N. Konovalov: An experiment in vernalizing the embryos of wheat seeds without endosperm.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 535–559, Oct. 15, 1937).

C. C. Little and A. M. Cloudman: Occurrence of a dominant spotting mutation in the house mouse. A new mutation has been found, probably an allele of the dominant spotting already known and more viable in the homozygous condition.

E. W. Berry: Succession of fossil floras in Patagonia. Following the Late Jurassic cosmopolitan floras, conditions during Lower and Upper Cretaceous did not prevent colonization by elements representing Upper Cretaceous flowering plants. Early in the Tertiary, a change occurred which allowed a flora of small-leafed and largely beech forest (Eogene) to extend down to Antarctica.

B. H. Willier, Mary E. Rawles and E. Hadorn: Skin transplants between embryos of different breeds of fowl. Skin ectoderm (0·5 mm. × 1 mm.) was taken from the dorso-lateral surface of the head, freed from mesoderm, and inserted, through a window cut in the shell of another egg, at the base of the right wing or the leg bud; both donor and host were incubated for about 75 hours. The embryos were examined when 15 days old, when they have well-developed down feathers. Black skin grafts give a patch of black feathers, but white skin grafts on a black breed have no apparent effect. It seems that skin ectoderm is dependent on the position on the host for the form of feathers produced, but as regards colour, the feathers are dependent on the genic constitution of the graft.

A. D. Michal: General projective differential geometry.

G. A. Miller: Groups in which every sub-group of composite order is invariant.

H. S. Vandiver: (1) The concept of co-sets in a semi-group. (2) Generalizations on the numbers of Bernoulli and Euler.

Forthcoming Events

Friday, January 7

Engineering Public Relations Committee (at the Institution of Electrical Engineers), at 3.—Prof. C. E. Inglis, F.R.S.: "Building Big Bridges" (Christmas Lectures for Young People. Succeeding lecture on January 10).

Conference of Educational Associations, January 3–10. To be held in University College, London.

The Right Hon. Sir Kingsley Wood, M.P.: "Education and Health" (Presidential Address).

Geographical Association, January 4–6. Annual Conference to be held in the London School of Economics.

January 4, Prof. Patrick Abercrombie: "Geography, the Basis of Planning" (Presidential Address).

Annual Exhibition of Scientific Apparatus by the Physical Society, January 4–6. To be held at the Imperial College of Science and Technology, London.

Discourses:

January 4, Capt. G. C. C. Damant: "Diving in Deep Water and Shallow".

January 5, Prof. A. F. C. Pollard: "Mechanisms for Measuring Small Changes".

Science Masters Association, January 4–7. To be held in the Chemistry Department of the Imperial College of Science and Technology, South Kensington, S.W.7.

January 4, Sir Cyril Ashford: "Past and Future Aims of School Science" (Presidential Address).

January 5, Sir Richard Gregory, Bt., F.R.S.: "Science and Citizenship".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Lecturer in Aeronautics in the Imperial College of Science and Technology, Prince Consort Road, S.W.7—The Secretar (January 7).

Research Chemist (subsidiary subjects physics or metallurgy) fo the Northern Coke Research Committee—Secretary, Northern Cok Research Committee, King's College, Newcastle-on-Tyne.

Official Publications Received

Great Britain and Ireland

Edinburgh Geological Society. Geological Excursion Guide to th Assynt District of Sutherland. By Dr. M. Macgregor and Dr. Phemister. Pp. 62+4 plates. (Edinburgh: Edinburgh Geologic Society.) 2*s*. [101

Air Ministry: Aeronautical Research Committee: Reports an Memoranda. No. 1741 (2361): Full Scale Lift, Drag and Landin Measurements of a Monoplane fitted with a Zap Flap. By E. T. Jone J. Cohen and P. A. Hufton. Pp. 27. 4*s*. net. No. 1758 (2499): Th Vibration of Airscrew Blades with particular reference to their R sponse to Harmonic Torque Impulses in the Drive. By B. C. Carte Pp. 37. 5*s*. 6*d*. net. No. 1770 (2589): The Behaviour of a Pitot Tu in a Transverse Total-Pressure Gradient. By A. D. Young and J. Maas. Pp. 16. 2*s*. 6*d*. net. No. 1775 (2724): The Experimental Dete mination of the Bending Actions induced by Axial End Constraints a Rectangular Tube in Torsion. By D. Williams and C. B. Smith. P 19. 3*s*. net. No. 1776 (2552): Note on the Directional Stability Seaplanes on the Water. By Dr. J. P. Gott. Pp. 14. 2*s*. net. No. 17 (2664): Effect of Differences of Form on the Porpoising Characterist of Two Flying Boats. By L. Johnston and W. D. Tye. Pp. 10. 1*s*. net. No. 1778 (2806). Note on the Standardisation of Pitot-Sta Head Position of Monoplanes. By S. B. Gates and J. Cohen. Pp. 2*s*. net. No. 1780 (2956): Diffusion of Concentrated Loads in Monocoque Structures. By H. L. Cox, H. E. Smith and C. G. Conwa Pp. 16. 2*s*. 6*d*. net. (London: H.M. Stationery Office.) [19

Other Countries

J. E. Purkinje. Commentatio de examine physiologico organi vi et systematis cutanei, Vratislaviae 1823. Quam pro loco in Grati Medicorum Ordine. By Gulielmo Kraus. Pp. 58. ('s-Gravenha Dr. W. Junk.) 8 guilders. [1

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Training and Employment of University Graduates

IF happily unemployment of graduates is less serious in Great Britain than in some other European countries, it has been sufficiently widespread to offer obstacles to the work of the Society for the Protection of Science and Learning in finding occupation for displaced men of science from abroad, apart from the existence of a by no means negligible amount of wastage and misplacement of young graduates of our own universities. Indeed, the position led the University Grants Committee in its last report to suggest that the universities themselves should consider not merely the question of the appropriate number of university students in relation to the population of the country as a whole, but also that of the appropriate number for any particular university. Granting that a university should not be too preoccupied with problems of purely professional vocations for its students, it should none the less face the question whether the time has arrived, or is approaching, when additions to its numbers will tend to impair the quality of the instruction and the value of the training for life it sought to give.

For these reasons, the inquiry on unemployment among graduates, and the study of the proposals for diminishing unemployment in intellectual professions, which has already been initiated by the Committee on Intellectual Co-operation of the League of Nations, is of no less interest in Great Britain than elsewhere; while W. M. Kotschnig's recent study of unemployment in the learned professions* is also a valuable contribution. The case he presents for real educational and occupational planning in our changing society as the only solution of this difficult problem deserves careful consideration, reinforced as it is from other quarters of the industrial world by the suggestion that industry should consider more closely not merely qualitative but also quantitative requirements in regard to recruitment generally.

It can scarcely be denied that neither the universities nor professional associations of scientific workers, despite serious warnings, have given anything like the attention to this question that it demands. The report on graduate employment recently issued by the National Union of Students, to which reference was made in discussions at the British Association meetings at Nottingham, brings together in this field a number of suggestions or proposals which require attention and action by professional associations as well as by university authorities.

This report, which brings out the fact that in Great Britain the question of misemployment among graduates is as important, if not more important, than that of actual unemployment, reveals the meagreness and inadequacy of existing statistics and the complete absence of planning or control over the numbers entering various branches of study, as well as the ignorance on the part of students proceeding to a university of conditions in the employment market. The most serious criticism in the report is, in fact, that of the lack of guidance and help available at the universities for placing students in careers. Even where appointment boards or officers are to be found, their organization often leaves much to be desired. Contact with students is imperfect, and with industry, commerce and the professions is often poor.

Many who have attempted to recruit university graduates, particularly for any of the less usual openings, will agree that much of this criticism is well founded. It is no uncommon experience to find that after approaches to the universities appointments boards or advertisements in the appropriate scientific or technical journals have drawn blank, promising candidates have been encountered accidentally, who, like the professors of their particular faculty, were quite unaware of the existence of the vacancy. Quite apart from the fact that the outlook of graduates on the sphere of employment is often unnecessarily narrow, such experiences are common enough to indicate not merely the failure of graduates to look round them intelligently but also an amazing lack of contact between the appointments boards and the different faculties or departments the students of which it is their function to place.

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* London: Oxford University Press, 1937. 12s. 6d. net.

There can, of course, be no question of value of the appointments board when well organized and properly run. An efficient board rapidly builds up a reputation for supplying candidates of the right type; and this is as valuable to the employer as to the graduates it places. Accordingly, the highly constructive suggestions in this matter, which are outlined in an appendix to the report referred to, merit close attention by all concerned with the placing of graduates in employment; for the establishment of efficient appointment boards must inevitably precede the consideration of the quantitative aspect of the question. These suggestions show clearly that at the present time the problem is not so much one of finding posts for graduates but of finding graduates to fill the existing vacancies.

One of the first results of a really efficient appointments organization would be not only to co-ordinate the spasmodic and often haphazard recommendations and efforts of individual professors and teachers, and to promote the supply of candidates in whom due weight was given to the other qualities besides the academic which they possess, but also to facilitate the collection of accurate and comprehensive information. The functions of the organization should, in fact, include a survey of the whole field of potential employment for university graduates, and the establishment and maintenance of contact with employers' associations, professional institutions and organizations and the like.

Information regarding the qualifications and personnel required for different careers, as well as of the nature and conditions of the work, salary scales and prospects, is frequently readily obtainable, but corresponding information regarding the overcrowding of a particular occupation, new developments and tendencies is often deficient and inaccurate, and in many places the means of making even the existing information really available to students early in their university career appear to be in need of improvement. It is suggested, accordingly, that a handbook on the lines of the "Handbook on Careers for Graduates and Students", which is published by the University of London Appointments Board, might be issued by each appointments board.

Obviously there is room in this particular field for effective co-operation between the appointments boards of different universities. Even if certain universities desired to expand the information regarding the particular occupations for which they specially prepare students, there would appear to be no reason why such a handbook should not be prepared on behalf of all the universities. Not only should a mere comprehensive handbook be obtainable in this way, but also co-operation should offer substantial financial savings.

Whether there is need for the different sub-committees suggested in the report to deal with technical appointments, teaching, professional, Government appointments and commerce, etc., may well be a matter of opinion. Much depends on obtaining men of the right type of personality, mature experience and with something of a flare for establishing contacts to serve the board. Appointments officers of the right type could probably be relied upon to take care of the requisite internal as well as external contacts, though it may sometimes be advisable for the university to institute some means of stimulating the use of the machinery provided in the boards' organizations, so as to bring together all those interested in placing graduates whether of a special faculty or not.

As to the wisdom of the further suggestions regarding contact between students, and between the appointments officers of different universities, there can scarcely be any difference of opinion, though there are other ways of securing contact with students than by representation on the boards. Such co-ordination and organization are essential if statistical information is to be collected in standardized form on the numbers of students in each faculty, the potential output of the university for different careers and the numbers of students leaving or who have left the university, and the nature and extent of unemployment among them.

Valuable, however, as are such statistics as a preliminary to planning the wiser use of university education on the community, we must guard against the mistake of allowing the university authorities or the students themselves to be preoccupied excessively with the professional prospects of later life. The effective employment of university graduates is a matter of much moment to the community as a whole as well as to the individuals concerned, since the appropriate use of talent to a large extent governs the pace of social progress. This is one reason for regarding with concern the comparative neglect of university graduates in the local government service of the country. None the less, we must be at pains to reconcile the objective of the best training for a vocation in life with that of the best training for life itself.

Once again, therefore, we are brought back to the question of the true purpose of a university, and even here it seems that a university appointments officer might well make a valuable contribution. His contacts with the industrial and commercial world should enable him to supply timely warning about the evils of premature or excessive specialization, and to insist on the need for men and women with a wide outlook, sense of values and cultural interests so strongly stressed in recent discussions. It should enable him too, perhaps, in his contact with students, to inspire them with a sense of responsibility for service which, by bringing out the fundamental meaning of vocation, may rob vocational training of its dangers. Nor should he lack the opportunity to give timely warnings as to the importance of cultivating human interests and utilizing to the full the opportunities which the social and athletic activities of college life afford of developing initiative, personality and the capacity to cooperate, upon which, as much as on intellectual attainment, depend alike individual success and the fullest meed of service to the community.

Growth-Regulating Substances in Plants

Phytohormones
By F. W. Went and Kenneth V. Thimann. (Experimental Biology Monographs.) Pp. xi+294. (New York: The Macmillan Co.) 17*s*. net.

THIS book will prove very valuable as it reviews admirably a field in which the contributions have recently been so numerous that it is difficult to follow them all. (The authors give references to seventy-four papers on plant hormones for 1936 alone.) This rapid output is no doubt due to the discovery by Kögl and Kostermans (*Z. physiol. Chem.*, 235, 201) in 1934 that indole-3-acetic acid, sometimes called 'heteroauxin', a substance which can be synthesized, acts on plant growth in very nearly the same way as the natural growth-hormone or 'auxin': for this has provided wonderful opportunities for experimenting. But unfortunately, as the authors point out, the quality of some of this recent work has not been so good as that of the earlier work on the growth-hormone: indeed, some recent contributions have shown that the investigators responsible for them neither know what has been done already nor understand what are the problems at issue. The book should, therefore, be very useful, since it reviews critically the subject of the hormones of higher plants and shows up the main problems clearly: indeed it is one of the chief attractions of the book that it looks to the future as much as to the past. The authors include also summary statements of many interesting unpublished results, and although an excellent historical survey of the same field by Boysen Jensen entitled "Die Wuchsstofftheorie" appeared in 1935, progress has been so rapid that they have been able to include a great deal that was not in the earlier book.

Boysen Jensen has claimed ("Die Wuchsstofftheorie", p. 12) that in his well-known experiments of 1910, 1911 and 1913, from which the modern study of the growth-hormone has mainly developed, he proved that there exists a growth-promoting substance in the oat coleoptile during the phototropic excitation, and that it is by the movement of this substance that the phototropic stimulus can be transmitted (as he showed) from the tip across a watery gap below. In the reviewer's opinion, this claim is justified, except that, as Went and Thimann point out, he did not show that he was dealing with a single growth-promoting substance rather than with several substances. But neither did the later experiments of Paál (*Ber. bot. Ges.*, 32, 499; 1914; *Jahrb. wiss. Bot.*, 58, 406; 1919) show that the growth-hormone is a single substance, in spite of what Went and Thimann say (p. 11). The important point which was missed by Boysen Jensen but established by Paál and by Söding (*Ber. bot. Ges.*, 41, 396; 1923) is that even the tips of *unstimulated* coleoptiles form growth-promoting substance (or substances), and it was not generally agreed that it is a single growth-substance which they form, until this substance, now called 'auxin', was extracted and studied by Went himself (*Rec. trav. bot. Néerl.*, 25, 1; 1928). Later work has shown that this auxin is the same growth-substance which was demonstrated by Boysen Jensen, and it has been found that auxin regulates a surprising number of other growth processes also.

The authors are a little misleading in saying that Dostál (*Acta Soc. Sci. Nat. Moravicae*, 3, 83; 1926) interpreted his experiments on the correlative inhibition of axillary buds "in terms of nutrition and water relations, like his predecessors": for this gives the impression that he interpreted them in terms of a withdrawal of nutriment or water. But actually he attributed the inhibition to an effect upon the buds of metabolic products coming *from* the leaves, an opinion not very different from the recent discovery that it is the auxin secreted by the young leaves which somehow brings about the inhibition of axillary buds.

The investigations reviewed in this book have progressed quite along the lines advocated by Roux for animal embryology. First came the recognition of various 'complex components' in plant growth, and the discoveries that they depended on transmitted influences of unknown nature; among such 'complex components' were the growth-reactions of the tropisms, the initiation of cambial growth and of root-formation, and the promotion of the growth of coleoptiles and shoots. Next came the evidence that the influences on which these processes depended could cross watery gaps and were due to the movements of a soluble substance or substances. Later again came the extraction of the substance concerned and its identification as auxin. The next step must be to discover more in detail the manner in which the auxin acts, and thus to continue the analysis in the hope of reaching finally the basic molecular or ionic reactions. But when, or if, these are discovered, a knowledge of the foregoing analysis will still be necessary for anyone who wishes to understand plant growth.

R. SNOW.

West African Plant Lore and Uses

The Useful Plants of West Tropical Africa

By Dr. J. M. Dalziel. Being an Appendix to the "Flora of West Tropical Africa" by J. Hutchinson and J. M. Dalziel. (Published under the authority of the Secretary of State for the Colonies.) Pp. xii + 612. (London: The Crown Agents for the Colonies, 1937.) 18*s*.

THE series of Colonial floras issued from the Royal Botanic Gardens, Kew, are highly technical works of great value to the systematic botanist and to the trained worker in the countries in question. But there is much information of economic and human interest which lack of precise information and consideration of space has perforce to be omitted. Dr. Dalziel's volume is an attempt to fill this gap in our knowledge of the West African flora as a supplement to the "Flora of West Tropical Africa" recently completed by Dr. Hutchinson and himself.

Dr. Dalziel was especially well qualified for the task. His long service as a medical man in the British West African Colonies, his knowledge of the flora and his interest in native customs and languages—he is the author of "A Hausa Botanical Vocabulary"—have yielded a mass of information collected personally. This has been supplemented from notes on herbarium specimens and from literature, especially the published work of Dr. A. Chevalier and his colleagues on French West Africa, which covers the greater part of the area dealt with.

Care has been exercised in the selection of vernacular names, which are notoriously difficult to collate with certainty. These are classified geographically and according to local dialects, and though in some cases open to revision may, as the author points out, become important where a Colonial administration seeks to fix official names for commercial timbers or noxious weeds.

Obvious characters of the species included are described as well as their domestic, medicinal and commercial uses, but it is assumed that the volume will be used in conjunction with the "Flora", the arrangement of which it follows as regards the families, under which genera and species are arranged alphabetically. The numerous references to relevant literature in the text are supplemented by a general bibliography which is additional to that included in volume 1 of the "Flora".

A detailed index of the vernacular names covers forty-three closely printed pages, and there are also indexes of common English and scientific names.

Dr. Dalziel's volume is an invaluable contribution not only to our knowledge of the economic botany of West Africa but also to its ethnology.

A. B. R.

Recent Developments in Probability Theory

(1) Généralités sur les probabilités; variables aléatoires

Par Prof. Maurice Fréchet. (Traité du calcul des probabilités et de ses applications, par Émile Borel, Tome 1 : Les principes de la théorie des probabilités, Fascicule 3 : Recherches théoriques modernes sur la théorie des probabilités, Livre 1.) Pp. xvi + 308. (Paris : Gauthier-Villars, 1937.) 90 francs.

(2) Théorie de l'addition des variables aléatoires

Par Prof. Paul Lévy. (Monographies des probabilités, Fascicule 1.) Pp. xvii + 332. (Paris : Gauthier-Villars, 1937.) 120 francs.

(3) Random Variables and Probability Distributions

By Prof. Harald Cramer. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 36.) Pp. viii + 121. (Cambridge : At the University Press, 1937.) 6*s*. 6*d*. net.

(4) Les lois des grands nombres du calcul des probabilités

Par Prof. Louis Bachelier. Pp. vii + 38. (Paris : Gauthier-Villars, 1937.) 18 francs.

(1) PROF. FRÉCHET'S "Généralités" represents the first volume only of a treatise which, as a whole, is to form part of the very important "Traité du calcul des probabilités" edited by Prof. Borel. The present volume is chiefly dedicated to an examination of the theory of random variables which has both simplified and re-modelled the classical theory of probability.

The volume is divided into two parts, the first of which consists of a general introduction to the theory of probability and a short chapter on various extensions of the principle of total probabilities. In the second part, Prof. Fréchet considers the mean values of random variables and proceeds to an examination of the inequality of Bienayme and its generalizations. But perhaps the most interesting work is contained in sections III, IV, and V of his chapter on different methods of convergence for a series of random variables. For here, the connexion between Prof. Fréchet's brilliant work in general analysis, including the theory of abstract spaces for which he is justly famous, and his contributions to probability theory, is clearly exhibited. In these sections of Chapter v, Prof. Fréchet considers all those random variables x which are definable in a given category of tests as the same number of points in a certain abstract space. He then proceeds to examine the various definitions of the limit of a series of random variables, to find that each of them completes the definition of a 'space' containing such random variables, and that the spaces thus defined are not identical. The whole work shows the close connexion of these developments with the order of ideas dominating general analysis.

(2) Prof. Paul Lévy's book is the first of a series of monographs destined to supplement the "Traité" of which Prof. Fréchet's work forms a part. Prof. Lévy is the author of an earlier work on the calculus of probabilities, and in this monograph he includes original work of his own as well as a survey of the most important problems and their solutions, where these have been forthcoming. He observes that, during the last fifteen years, research in the calculus of probabilities has made tremendous advances, and that problems born of the theory of probabilities of denumerable order have been discovered, for which, in a number of cases, solutions have been found. His own work during recent years has been principally concerned with the study of asymptotic problems relative to probabilities, a branch which owes much to the work of Kolmogoroff and Khintchine, who are also responsible for the fundamental results obtained from the study of series of which the terms are independent random variables. The latter are examined in Chapter vi of the present volume. Prof. Lévy further attributes to the work of Khintchine and his pupils the completion of his own study of integrals, the elements of which are independent random variables.

After a short general exposition of the foundations of the calculus of probabilities, Prof. Lévy devotes two further introductory chapters of a mathematical character to the examination of the theory of random variables and the law of probability, in close connexion with the theories of measurement and the Lebesque-Stieltjes integral. Throughout the whole work, Prof. Lévy is really concerned with the translation of the theorems of general analysis into the language of probability. He advocates practice in this exercise, so that the enunciation of a theorem in one language should automatically evoke the parallel enunciation in the other.

(3) Prof. Cramer's little book published in English as a Cambridge Tract has many points of contact with Prof. Lévy's larger work. He treats the subject, mathematically, as a branch of the theory of completely additive set functions and thus chooses his axiomatic foundations in agreement with those of Kolmogoroff. For the most part, Prof. Cramer avails himself of the method of

characteristic functions, a method which Prof. Lévy had once hoped to be able to reject in favour of the utilization, wherever possible, of more elementary arguments. Although he is apparently still of the opinion that it may some day be possible to dispense with this method, Prof. Lévy considers that for the advanced part of the theory, a familiarity with Fourier transformations and the properties of characteristic functions is essential.

Although in Part II of this brochure Prof. Cramer shows how many of the results for distributions in a one-dimensional space R_1 can be extended to spaces of any number of (finite) dimensions, he is unable here, for lack of space, to consider probability distributions in spaces of an infinite number of dimensions. This is naturally a restriction in the proper treatment of modes of 'convergence in probability'. Again, in the advanced part of the theory, Prof. Cramer finds it expedient to confine himself to the treatment of problems connected with the central limit theorem for sums of independent variables.

(4) Prof. Bachelier's brochure on the laws of large numbers has for its object the study of these laws in a more complete form than has been usual in the majority of treatises, in which they have been considered only in the simplest cases. In Prof. Bachelier's own larger work on the calculus of probabilities, these laws were treated as consequences of a more general theory, but here he deems it useful to isolate them from all analytical apparatus.

One of the principles of the more general theory to which he alludes is the supposition of the continuity of all variables, and in particular of that variable which expresses a series of exceedingly numerous tests. By means of this assumption, this variable permits of being assimilated to time; in consequence, the transformation of the probabilities in a series of tests appears as a continuous phenomenon. The whole content of this work is rigorously exact in accordance with the hypothesis of continuity, and the main object is the application of the results to problems which are, in reality, related to discontinuous variables. A. v. Z.

Practice and Principles

Belief and Action:
an Everyday Philosophy. By Viscount Samuel. Pp. 366. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1937.) 7*s*. 6*d*. net.

THIS ably and attractively written book is wholly in accord with much that has recently appeared in the columns of NATURE. For while the author is convinced that we must find "a way out from the intellectual anarchy of our time", he is equally definite as to the contribution which science can offer towards this end. Neither mysticism nor intuition, merely as such, can solve our problems; rather must both be criticized, and often corrected, by reason. This, however, involves neither "intellectual pessimism" nor crude materialism; on the contrary, "Science makes a spiritual view of the universe more tenable" and is, indeed, perfectly compatible with worship.

Still more significant is the application of this point of view to practical affairs. Although he advocates no extremist measures which may worsen the disease, Lord Samuel insists that economic injustice is widespread and destructive. But machinery is not the cause of this; for man's slavery to the merely material aspects of life could be removed by its further expansion, were this but properly directed, though this ideal involves "testing the very foundations on which civilization rests". But here again "history must be handled scientifically", exactly as with politics, economic and eugenics.

Discussion of more abstract themes has wisely been relegated to appendixes dealing with reality and value, matter and mind, causation, indeterminism and freedom. The treatment of the implications of the uncertainty principle is exceptionally clear; Viscount Samuel follows Planck, Einstein and Rutherford in their rejection of indeterminism, inherent in Nature, as distinct from that which is but the inevitable result of limited knowledge. This is no purely theoretical question; if "at the heart of Nature hazard rules", then all large-scale planning may prove quite futile.

Such a determinism, still further, forms the only reliable basis for any sound ethics. Well-being is indissolubly linked with good; pain and penalty with evil. But equally essential to morality are genuine choice and personal freedom, attainable only when the individual becomes a cause and is therefore determined, no longer from without, but more and more from within himself.

The presentation of purely scientific issues is neither too technical for the general reader nor too simple for the professional. The author's advocacy of the expansion of the League of Nations from a judiciary to a legislature is more controversial. It merits, nevertheless, serious consideration, while there must be few who would refuse to endorse Lord Samuel's vigorous indictment of militarist philosophy. J. E. T.

The Physiological Basis of Medical Practice

a University of Toronto Text in Applied Physiology. By Prof. Charles Herbert Best and Prof. Norman Burke Taylor. Pp. xxi+1684. (London: Baillière, Tindall and Cox, 1937.) 45*s*.

MEDICINE and physiology owe much to one another and neither can advance far without the other. Many of the greatest physicians have been physiologists as well and have spent years of their lives on physiological problems, but of recent years, and particularly in Great Britain, a generation of physicians has grown up with no real training in scientific research.

A gap has no doubt formed between medicine and physiology, and the new book by Best and Taylor will help to fill it. The authors are both physiologists, and they believe that physiology is a science in its own right, but that it is the duty of those who teach it to medical students to emphasize those facts which are most clearly relevant to medical practice. The book covers the whole field of physiology with particular emphasis on human physiology, and without much physics or mathematics. In each section, the anatomy is discussed first, then the physiology, and then the applications in medicine. Pathological conditions such as nephritis, bronchiectasis, the leucæmias, Ménière's syndrome, syringomyelia and epilepsy are discussed from the physiological point of view. The discoveries of clinical science are more fully and sympathetically discussed than in previous volumes of this kind.

It might have been supposed that two authors who had set out to cover so wide a field would necessarily have acquired much of their information at third hand. The present book bears much evidence that its authors have not been content to put forward generally accepted conclusions without full consideration of the experimental evidence. The book is not a rehash of *Physiological Reviews*. In spite of much diligent reading, few errors have been noticed.

The chief defect of the book lies in the arrangement of the references, which are collected together at the end of the book, but grouped under chapters. Seekers after references must first discover what chapter they are reading, and then hunt through a lot of pages, many of which contain no indication of the number of the chapter to which they refer. J. H. G.

Gmelins Handbuch der anorganischen Chemie

Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. (1) System-Nummer 22: Kalium. Lief. 1: Element, Verbindungen bis Kalium und Sauerstoff. Pp. 246. 28.50 gold marks. (2) Lief. 2: Verbindungen bis Kalium and Chlor. Pp. 247–514. 3.50 gold marks. (Berlin: Verlag Chemie, G.m.b.H., 1936 and 1937.)

IN the volume on potassium considerable space is devoted to a discussion of the geological origin, distribution and character of the European potash deposits, with maps and a geological section reproduced from E. Fulda's book "Das Kali". The only compounds included in this part are those with hydrogen and oxygen.

The second part of the volume on potassium includes compounds containing the elements nitrogen, fluorine and chlorine. There is a general survey of the conditions which lead to the natural formation of potassium nitrate, the preparation of which from Chile saltpetre is relatively unimportant nowadays, since it has been largely replaced by other salts in the manufacture of explosives; but its properties are fully recorded. The peculiar behaviour of the system potassium fluoride – hydrogen fluoride is illustrated by a phase rule diagram which indicates the existence of no fewer than five complex compounds.

A very useful feature of this part is the compilation of references to the enormous mass of data about the physical properties of potassium chloride in the crystalline state and in aqueous solution. Thus numerous attempts have been made to link up the classical views of Arrhenius on electrolytic dissociation with the modern ideas of Debye. The technical production of this salt is being described in a later part. References to original memoirs and patent specifications relating to the manufacture of potassium chlorate by electrolysis of solutions of the chloride are very numerous. On the other hand, the electrolytic production of the perchlorate is rendered difficult by the low solubility of this salt, which leads to incrustation of the anodes, so that in practice it has generally to be made from the sodium salt.

Mathematische Methoden der Biologie:

insbesondere der Vererbungslehre und der Rassenforschung. Von Dr. Friedrich Ringleb. Pp. vii + 181. (Leipzig und Berlin: B. G. Teubner, 1937.) 8.80 gold marks.

THIS is essentially another text-book on elementary statistical methods written to assist scientific workers with a limited mathematical background to gain an understanding of the nature and usefulness of tools they are finding it necessary to use. A special group of workers is aimed at, as is indicated by the title; the plentiful illustrations are drawn from biological and botanical material and considerable space is given to the elementary algebraic description of the workings of Mendel's law and some of the simpler applications of the theory of probability to it.

The selection of topics is from definitely classical material, and it is to be hoped that readers of this book will also become acquainted with others at the same mathematical level which give an account of the present resources statistical methods offer. The exposition is good and the examples are clearly explained. Though sampling and correlation are treated in almost too brief and antiquated a fashion in view of the developments of the last twenty years, the author has done on the whole a good job within the limits of his material.

A few slips were noted. Thus we find it stated without qualification that $m(xy) = m(x)m(y)$ and that $\sigma^2(x+y) = \sigma^2(x) + \sigma^2(y)$. Hardy's summation method is attributed to H. Gunther. Class marks for distributions of continuous variables are incorrectly located, and the derivation of the Poisson law will confuse the student. CECIL C. CRAIG.

Transmutation of Matter

[Shortly before his death on October 19 last year, Lord Rutherford completed the presidential address which he proposed to deliver at the meeting of the Indian Science Congress Association on January 3–9. The latter part of the address is here reproduced and represents Lord Rutherford's last pronouncement on a subject with which his name will always be associated. Other matters discussed by him in the address were referred to in last week's leading article.—Editor, NATURE.]

TOWARDS the close of the nineteenth century, when it seemed certain that the atoms of the elements were unchangeable by the forces then at our command, a discovery was made which has revolutionized our conception of the nature and relations of the elements. I refer to the discovery in 1896 of the radioactivity of the two heaviest elements, uranium and thorium. It was soon made clear that this radioactivity is a sign that the atoms of these elements are undergoing spontaneous transmutation. At any moment, a small fraction of the atoms concerned become unstable and break up with explosive violence, hurling out either a charged atom of helium, known as an α-particle, or a swift electron of light mass called a β-particle. As a result of these explosions, a new radioactive element is formed, and the process of transmutation once started continues through a number of stages. Each of the radioactive elements formed in this way breaks up according to a simple universal law but at very different rates. In a surprisingly short time, these successive transformations were disentangled and more than thirty new types of elements brought to light, while the simple chemical relations between them were soon made clear.

We had thus been given a vision of a new and startling sub-atomic world where atoms break up spontaneously with an enormous release of energy quite uninfluenced by the most powerful agencies at our disposal. Apart from uranium and thorium and the elements derived from them, only a few other elements showed even a feeble trace of radioactivity. The great majority of our ordinary elements appeared to be permanently stable under ordinary conditions on our earth. Science was then faced with the problem whether artificial methods could be found to transmute the atoms of the ordinary elements. Before this problem could be attacked with any hope of success, it was necessary to know more of the actual constitution of atoms. This information was provided by the rise of the nuclear theory of atomic structure, which I first suggested in 1911 The essential controlling feature of all atoms was found to reside in a very minute central nucleus which carried a positive charge and contained most of the mass of the atom. A relation of unexpected simplicity was found to connect the atoms of all the elements. The ordinary properties of an atom are defined by a whole number, which represents the number of units of resultant positive charge carried by the nucleus. This varies from 1 for hydrogen to 92 for the heaviest element uranium, and, with few exceptions, all the intervening numbers correspond to known elements.

On this view of atomic structure it was evident that, to bring about the transmutation of an atom, it was necessary in some way to alter the charge or mass of the nucleus or both together. Since the nucleus of an atom must be held together by very powerful forces of some kind, this could only be effected by bringing a concentrated source of energy of some kind to bear on the individual nucleus The most energetic projectile available at that time was the swift α-particle spontaneously ejected from radioactive substances. If a large number of α-particles were fired at random at a sheet of matter, it was to be expected that one of them must occasionally approach very closely to the nucleus of any light atom in its path. In such a close encounter, the nucleus must be violently disturbed, and possibly under favourable conditions the α-particle might actually enter the nuclear structure.

This mode of attack upon the nucleus at once proved successful. I found in 1919 that nitrogen could be transformed by bombardment with fast α-particles. The process of transmutation is now clear. Occasionally an α-particle actually enters the nitrogen nucleus and forms with it a new unstable nucleus which instantly breaks up with the emission of a fast proton (hydrogen nucleus) and the formation of a stable isotope of oxygen of mass 17. About a dozen of the light elements were found to be transformed in a similar way. The protons liberated in the nuclear explosions were at first counted by observing the flashes of light (scintillations) produced in phosphorescent zinc sulphide. This method was slow and very trying to the eyes of the observers. Progress, however, became more rapid and definite when electrical methods of counting individual fast particles were developed. These electrical counters, mainly depending on the use of electron tubes for magnifying small currents, have now reached such a stage of perfection that we are able to count automatically individual fast particles like α-particles and protons even though they enter the detecting chamber at a rate as fast as ten thousand per minute. By other special devices, we are in like manner able to count individual β-particles. In this connexion, I must not omit to mention that wonderful instrument, the Wilson expansion chamber, which makes visible to us the actual tracks of flying fragments of atoms resulting from an atomic explosion. These remarkable devices have played an indispensable part in the rapid growth of knowledge during the last few years. It is to be emphasized that progress in scientific discovery is greatly influenced by the development of new technical methods and of new devices for measurement. With the growing complexity of science, the development of special techniques is of ever-increasing importance for the advance of knowledge.

Up to the year 1932, experiments on transmutation were confined to the use of α-particles for bombarding purposes. It became clear that the process of transformation was in most cases complex, since groups of protons with different but characteristic energies were observed when a single element was bombarded. This led to the conception that discrete energy levels existed within a nucleus, and that under some conditions part of the excess energy was sometimes released in the form of a quantum of high-frequency radiation.

The stage was now set for a great advance, and four new discoveries of outstanding importance were made in rapid succession in the period 1931–33. I refer to the discovery of the positive electron by Anderson in 1931, of the neutron by Chadwick in 1932, of artificial radioactivity by M. and Mme. Curie-Joliot in 1933 and of the transmutation of the elements by purely artificial methods first shown by Cockcroft and Walton in 1932.

The discovery of the neutron—that uncharged particle of mass nearly 1—was the result of a close study of the effects produced in the light element beryllium when bombarded by α-particles. It is noteworthy that the proton and neutron, which are now believed to be the essential units with which all atomic nuclei are built up, owe their recognition to a study of the transmutation of matter by α-particles.

Before the discovery of the neutron, it had been perforce assumed that nuclei must in some way be built up of massive protons and light negative electrons. Theories of nuclear structure became much more amenable to calculation when the nucleus was considered to be an aggregate of parts like the proton and neutron which have nearly the same mass. There was no longer any need to assume that either the positive or the negative electron has an independent existence in the nuclear structure. We are still uncertain of the exact relation, if any, between the neutron and the proton. The neutron appears to be slightly more massive than the proton, but it is generally believed, although no definite proof is available, that the proton and neutron within a nucleus are mutually convertible under certain conditions. For example, the change of a proton into a neutron within the nucleus should lead to the appearance of a free positive electron, while conversely the change of a neutron into a proton gives rise to a free negative electron. In this way it appears possible to account for the observed fact that either positive or negative electrons are emitted by a large group of radioactive elements to which I will now refer.

In the early experiments on transmutation by α-particles, it was supposed that a stable nucleus was always formed after the emission of a fast proton. The investigations of M. and Mme. Curie-Joliot showed that in some cases elements were formed which, while momentarily stable, ultimately broke up slowly, exactly like the natural radioactive bodies. Most of these radioactive bodies formed by artificial methods break up with the expulsion of fast negative electrons, but in a few cases positive electrons are emitted. Since the presence of these radioactive bodies can be easily detected, and their chemical properties readily determined, this new method of attack on the problem of transmutation has proved of great value. Nearly a hundred of these radioactive bodies are now known, produced in a great variety of ways. Some arise from the bombardment by fast α-particles, others by bombardment with protons or deuterons. As Fermi and his colleagues have shown, neutrons, and particularly slow neutrons, are extraordinarily effective in the formation of such radioactive bodies. On account of its absence of charge, the neutron enters freely into the nuclear structure of even the heaviest element, and in many cases causes its transmutation. For example, a number of these radioactive bodies are produced when the two heaviest elements, uranium and thorium, are bombarded by slow neutrons. In the case of uranium, as Hahn and Meitner have shown, the radioactive bodies so formed break up in a succession of stages like the natural radioactive bodies, and give rise to a number of trans-uranic elements of higher atomic number than uranium (92). These radioactive elements have the chemical properties to be expected from the higher homologues of rhenium, osmium and iridium of atomic numbers 93, 94 and 95.

These artificial radioactive bodies in general represent unstable varieties of the isotopes of known elements which have a limited life. No doubt such transient radioactive elements are still produced by transmutation in the furnace of our sun, where the thermal motions of the atoms must be very great. These radioactive elements would rapidly disappear as soon as the earth cooled down after separation from the sun. On this view, uranium and thorium are to be regarded as practically the sole survivors in our earth of a large group of radioactive elements, owing to the fact that their time of transformation is long compared with the age of our planet.

It is of interest to note what an important part the α-particle, which is itself a product of transformation of the natural radioactive bodies, has played in the growth of our knowledge of artificial transmutation. It is to be remembered, too, that our main source of neutrons for experimental purposes is provided by the bombardment of beryllium with α-particles. The amount of radium available in our laboratories is, however, limited, and it was early recognized that if our knowledge of transmutation was to be extended, it was necessary to have a copious supply of fast particles of all kinds for bombarding purposes. It is well known that enormous numbers of protons and deuterons, for example, can be easily produced by the passage of the electric discharge through hydrogen and deuterium (heavy hydrogen). To be effective for transmutation purposes, however, these charged particles must be given a high speed by accelerating them in a strong electric field. This has involved the use of apparatus on an engineering scale to provide voltages as high as one million volts or more, and the use of fast pumps to maintain a good vacuum.

A large amount of difficult technical work has been necessary to produce such high D.C. voltages and to find the best methods of applying them to the accelerating system. In Cambridge, these high voltages are produced by multiplying the voltage of a transformer by a system of condensers and rectifiers; in the United States of America by the use of a novel type of electrostatic generator, first developed by van der Graaf. Prof. Lawrence, of the University of California, has devised an ingenious instrument called a 'cyclotron' in which the charged particles are automatically accelerated in multiple stages. This involves the use of huge electromagnets and very powerful electric oscillators. By this method he has succeeded in producing streams of fast particles which have energies as high as the α-particle ejected from radioactive substances. Undoubtedly this type of apparatus will prove of great importance in giving us a supply of much faster particles than we can hope to produce by the more direct methods.

It was at first thought that very high potentials of the order of several million volts would be required to obtain particles to study the transmutation of elements. Here, however, the development of the theory of wave-mechanics came to the aid of the experimenter, for Gamow showed that there was a small chance that comparatively slow bombarding particles might enter a nucleus. This theoretical conclusion has been completely verified by experiment. In the case of a light element like lithium, transformation effects can be readily observed with protons of energy as low as 20,000 volts. Of course, the amount of transformation increases rapidly with rise of voltage.

The study of the transmutation of elements by using accelerated protons and deuterons as bombarding particles has given us a wealth of new information. The capture of the proton or deuteron by a nucleus leads in many cases to types of transmutation of unusual interest. For example, the bombardment of the isotope of lithium of mass 7 by protons leads to the formation of a beryllium nucleus of mass 8 with a great excess of energy. This immediately breaks up into two α-particles shot out in nearly opposite directions. When boron 11 is bombarded by protons, a carbon nucleus of mass 12 is formed which breaks up in most cases into three α-particles. The deuteron is in some respects even more effective than the proton as a transmuting agent. When deuterons are used to bombard a compound of deuterium, previously unknown isotopes of hydrogen and of helium of mass 3 are formed, while fast protons and neutrons are liberated. The bombardment of beryllium by very fast deuterons gives rise to a plentiful supply of neutrons. Lawrence has shown that the bombardment of bismuth by very fast deuterons leads to the production of a radioactive bismuth isotope which is identical with the well-known natural radioactive product radium E. Many artificial radioactive elements can be produced, often in great intensity. For example, the bombardment of common salt by fast deuterons gives rise to a radioactive isotope of sodium. This breaks up with a half period of 15 hours, emitting not only fast β-particles but also γ-rays at least as penetrating as those from radium.

It may well be that in course of time such artificial radioactive elements may prove a useful substitute for radium in therapeutic work. By these methods also, such intense sources of neutrons can be produced that special precautions have to be taken for the safety of the operators of the apparatus.

Sufficient I think has been said to illustrate the variety and interest of the transmutations produced by these bombardment methods. It should, however, be pointed out that transmutation in some cases can be effected by transferring energy to a nucleus by means of γ-rays of high quantum energy instead of by a material particle. For example, the deuteron can be broken up into its components, the proton and neutron, by the action of the γ-rays from radium or thorium. As a result of the bombardment of lithium by protons, γ-rays of extraordinarily great quantum energy as high as 17 million volts are strongly emitted. Bothe has recently shown that these high-energy rays are able to transmute a number of atoms, neutrons usually being emitted in the process.

Some simple laws appear to hold in all individual transformations so far examined. Nuclear charge is always conserved, and where heavy particles are emitted, so also is energy when account is taken of the equivalence of mass and energy. Certain difficulties arise with regard to the conservation of energy in cases where light positive and negative electrons are emitted during transmutation, and there is still much discussion on this important question.

The study of the transmutation of matter has been extraordinarily fruitful in results of fundamental importance. In addition to the α-particle, it has disclosed to us the existence of those two building units of nuclei, the proton and neutron. It has greatly widened our conception of the varieties of atomic nuclei which can exist in Nature. Not only has it led to the discovery of about one hundred new radioactive elements, but also of several stable isotopes of known elements, like ^{3}H, ^{3}He, ^{8}Be, which had previously been unsuspected. It has greatly extended our knowledge of the ways in which nuclei can be built up and broken down, and has brought to our attention the extraordinary violence of some of the nuclear explosions which occur. The great majority of our elements have been transmuted by the bombardment method, and in the case of the light elements which have been most carefully studied, a great variety of modes of transmutation has been established.

Rapid progress has been made, but much still remains to be done before we can hope to understand the detailed structure and stability of different forms of atomic nuclei and the origin of the elements. I cannot but reflect on the amazing contrast between my first experiment on the transmutation of nitrogen in the University of Manchester in 1919 and the large-scale experiments on transmutation which are now in progress in many parts of the world. In the one case, imagine an observer in a dark room with very simple apparatus painfully counting with a microscope a few faint scintillations originating from the bombardment of nitrogen by a source of α-particles. Contrast this with the large-scale apparatus now in use for experiments on transmutation in Cambridge. A great hall contains massive and elaborate machinery, rising tier on tier, to give a steady potential of about two million volts. Nearby is the tall accelerating column with a power station on top, protected by great corona shields—reminding one of a photograph in the film of Wells's "The Shape of Things to Come". The intense stream of accelerated particles falls on the target in the room below, with thick walls to protect the workers from stray radiation. Here is a band of investigators using complicated electrical devices for counting automatically the multitude of fast particles arising from the transformation of the target element, or photographing with an expansion chamber, automatically controlled, the actual tracks of particles from exploding atoms.

To examine the effect of still faster particles, a cyclotron is installed in another large room. The large electromagnet and accessories are surrounded with great water tanks containing boron in solution to protect the workers from the effect of neutrons released in the apparatus. A power station nearby is needed to provide current to excite the electromagnet and the powerful electric oscillators.

Such a comparison illustrates the remarkable changes in the scale of research that have taken place in certain branches of pure science within the last twenty years. Such a development is inevitable, for, as science progresses, important problems arise which can only be solved by the use of large powers and complicated apparatus, requiring the attention of a team of research workers. If rapid progress is to be made, such team work is likely to be a feature of the more elaborate researches in the future. Fortunately there is still plenty of scope for the individual research worker in many experiments of a simpler kind.

The science of physics now covers such a vast field that it is impossible for any laboratory to provide up-to-date facilities for research in more than a few of its branches. There is a growing tendency in our research laboratories to-day to specialize in those particular branches of physics in which they are most interested or specially equipped. Such a division of the field of research amongst a number of universities has certain advantages, provided that this subdivision is not carried too far. In general, the universities should be left free so far as possible to develop their own lines of research and encouraged to train young investigators, for it cannot be doubted that vigorous schools of research in pure science are vital to any nation if it wishes to develop effectively the application of science, whether to agriculture, industry or medicine. Since investigations in modern science are sometimes costly, and often require the use of expensive apparatus and large-scale collaboration, it is obviously essential that adequate funds should be available to the universities to cover the cost of such researches.

Progress in Chemotherapy

PEOPLE in settled and civilized countries, such as Great Britain, are familiar with the beneficent results of the application of the methods of preventive medicine, but these methods are not easy to apply among primitive populations, and in the tropical parts of the Empire the effects of preventive methods are apt to be much less apparent than those brought about by curative medicine, making use of the products of chemotherapeutical investigation, in the treatment of endemic plagues such as malaria, sleeping sickness, bilharzia, hookworm disease and kala-azar. It is fitting that the value of such work should be recognized, and the decision of His Majesty's Government to spend £30,000 per annum in promoting chemotherapeutical investigations is a welcome move in the right direction. Although work of this kind has not so far been undertaken in Great Britain on so large a scale as in some Continental countries, the amount done is by no means negligible, as was evident from the partial survey of recent work made in the course of a discussion on "The Influence of Structure on the Action of Parasiticidal Drugs" held under the auspices of the Chemical Society on Thursday December 2, in which both biologists and chemists took part.

In his opening remarks, Dr. T. A. Henry suggested that such investigations are usually conducted in one of two ways. The method by which most of the practical successes of chemotherapy have been achieved depends upon the discovery of a clue in the form of a drug to which the pathogenic organism associated with a disease is more or less vulnerable. The course of such an investigation was illustrated by a brief account of work on kala-azar, which, starting with the observation in 1915 that this disease could be successfully treated by tartar emetic, resulted in the replacement of that unpleasant drug by derivatives of *p*-aminophenylstibonic acid, made possible by Dr. Hans Schmidt's discovery in 1911 of a method of preparing arylstibonic acids[1]. The second method depends upon the idea that toxicity to a range of parasites may be associated with a particular type of chemical structure, and that pharmacological investigation of a series of drugs in which the structural type is maintained may afford useful information as to the mode of action of such drugs—a difficult subject upon which there has been much speculation, but little real progress. At present such investigations are in progress on the influence of chemical modification on the action of cinchona alkaloids in bird malaria and auricular fibrillation[2] and on their pneumococcicidal activity[3]. It has been found that modification of the vinyl side-chain in quinine and quinidine makes little difference to anti-malarial action, but that any interference with the central –CHOH– group reduces or extinguishes activity, even when there is only a change in spatial distribution, as in the conversion of quinine into Rabe's *epi*–C^9–quinine. In a homologous series of *apo*quinine or dihydrocupreine alkyl ethers, anti-malarial action does not rise to a maximum and then fall as the series is ascended, but shows this behaviour in an alternating form, the members with odd and even numbers of carbon atoms forming two sub-series, each giving an independent maximum.

Discussing the biological side of such investigations, Dr. J. W. Trevan said that even when allowance is made for the crudity of the pharmacological methods available and the variability of the test object, there is no doubt that small structural changes do profoundly modify the pharmacological action of many substances, which is not surprising in view of the narrow limits of tolerance for environmental change shown by living cells. Mere methylation of an amino-group may reduce the anæsthetic action of a compound by reducing the concentration of base free at the hydrogen ion concentration of the body. The difference in effect between the chains of odd and even numbers of carbon atoms referred to by Dr. Henry may be due to differences in spatial arrangement. Müller has shown that the normal paraffins have the carbon atoms arranged in a zig-zag form. It is not unlikely that these drugs act on a surface film of the cell composed of protein, possibly containing some such substance as cholesterol, possessing a recurrent pattern. If the drug is anchored by the characteristic group of the alkaloid and the plane of the zig-zag is at right angles to the surface with its axis parallel with the surface, the distance of the terminal methyl group will not be the same for the odd and even numbered chain, and it would be interesting to construct a model of the molecule and to determine whether such an explanation is feasible

Prof. F. L. Pyman summarized briefly the results of his work on *n*-alkylphenols and on amœbicides, of which an account has been published recently in NATURE (140, 409, 832; 1937). The results are of special interest as showing that amœbicidal action *in vitro* is exhibited by compounds wholly different in structure from emetine, the most active substance found being $\alpha\ \varkappa$-tetra-*n*-amyldiamino-*n*-decane, which, however, proved not to be of clinical value.

Sir Gilbert Morgan then gave an account of work done on homologous series of derivatives of *p*-aminophenylarsonic acids of the general formula $(HO)_2.AsO.C_6H_4.NH.CO(CH_2)_n.CO.NR_1R_2$, which may be regarded as combining the desirable features of the well-known arsenical drugs, acetyl-*p*-arsanilic acid and tryparsone, $(NaO)(OH).AsO\ C_6H_4.NH.CH_2.CONH_2$, the latter being probably the most widely used drug of this type for the treatment of sleeping sickness and late syphilis. Among the new drugs, sodium succinanilomethylamide-*p*-arsonate ($n = 2$; $R_1 = H$; $R_2 = CH_3$) has been selected and has already given promising results in clinical trials in sleeping sickness in Nigeria. In connexion with the same investigation, Dr. E. Walton directed attention to the low toxicity of this type of arsenical compound, and showed that trypanocidal action is enhanced by an amide-group in the *p*-position in phenylarsonic acid[4].

The next two contributions dealt with the new streptococcicidal drugs, of which the first example was Domagk's 2 : 4-diaminoazobenzene-4′-sulphonamide[5], which was speedily shown, as the result of work in France and in Great Britain, to be replaceable by the simpler substance *p*-aminobenzenesulphonamide (sulphanilamide), which is already in use on a large scale. Mr. W. H. Gray stated that the results of numerous attempts to improve upon this simple substance indicated that both the sulphur atom and the amino-group are essential, that duplication of either on the same nucleus destroys activity, which is also the effect of additional substituents. A more active but more toxic substance is 4 : 4′-diaminodiphenylsulphone, in which activity also disappears on elimination of either the sulphone or the amino-groups. Dealing with biological work on these drugs, Dr. G. A. H. Buttle said that sulphanilamide will cure mice infected with 10,000 times the lethal dose of streptococci. As tested on mice, the drug appears to have some action in all bacterial infections characterized by rapid multiplication of the invading bacterium, but it fails in infections where a small number of organisms can produce a sufficiently potent toxin to kill the animal, as in diphtheria. As regards the mode of action, there is experimental evidence for the view that by some means still unknown the drug delays the growth of the organisms or affects them in such a manner as to facilitate their destruction by the leucocytes of the blood[6].

Returning to anti-malarial drugs, Dr. H. King described work done in collaboration with Dr. Cohen and Dr. Ainley on two substances based on the structure of quinine, details of which will be published shortly.

Dr. W. H. Linnell showed that although there are a number of useful acridine derivatives in use in medicine as bactericides and amœbicides, the possibilities of this heterocyclic nucleus have not been fully explored, and in his recent survey[7] of monoamino- and diamino-acridines, he has found that 1-aminoacridines are not bactericidal, that an amino-group in position 3 lowers toxicity and that 3 : 8-diaminoacridine is as active as, but much less toxic than, the well-known 2 : 8-diaminoacridine (proflavine).

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[1] Schmidt, *Z. angew. Chem.*, **43**, 963 (1930). Gray and Trevan, *Trans. Roy. Soc. Trop. Med. Hyg*, **25**, 147 (1931)

[2] See, for example, van Dongen and Sanches, *Arch. intern Pharmacodyn*, **55**, 52 (1937)

[3] Butler, Hostler and Cretcher, *J. Amer. Chem. Soc.*, **59**, 2354 (1937).

[4] Morgan and Walton, *Chem. and Ind*, **56**, 853 (1937).

[5] Domagk, *Deut. med. Woch.*, **61**, 250 (1935).

[6] Gray, Buttle and Stephenson, *Biochem. J.*, **31**, 724 (1937).

[7] Albert and Linnell, *J. Chem. Soc*, 88, 1614 (1936); also a further paper in the Press

The Quatercentenary of the University of Coimbra

THE beautiful old city of Coimbra, the ancient capital of the kingdom of Portugal from the time of King Afonso Henriques to that of King Afonso III, rises picturesquely from the banks of the Mondego River and is crowned by the historic buildings of its university. The first centre of higher learning in Portugal, the first "Estudo geral", was established at Lisbon in March 1290 by King Diniz, but was later brought to the capital at Coimbra (in 1308). Twice transferred back in the fourteenth century (1338 and 1377) to the banks of the Tagus, the University was finally established at Coimbra in 1537 by King John III, who had undertaken a great reform of university studies. These reforms culminated in the reign of King José I, when in the last quarter of the eighteenth century his famous Prime Minister, the Marquês de Pombal, greatly transformed and modernized the work of the University, introducing especially the study of natural science.

The four hundredth anniversary of the final establishment of the University at Coimbra in 1537 was celebrated during the days December 6–10 by a series of fine ceremonies and much splendid hospitality. Many men of letters and science had come from various parts of the world to do honour to the famous University, and were entertained in a most lavish manner by the Government of Portugal, the University authorities, and the City of Coimbra.

The British guests who had come specially to Portugal for the quatercentenary were Prof. F. G. Donnan (chemistry, University of London and the Royal Society) and Miss Jane Donnan, Prof. W. J. Entwistle (Spanish and Portuguese, University of Oxford), Mr. J. Ramsbottom (keeper of botany, British Museum (Natural History)), Prof. W. F. Starkie (Spanish and Italian, Trinity College, Dublin) and Prof. W. M. Thornton (electrical engineering, Universities of Durham, Birmingham, Reading and Bristol). The British Embassy in Lisbon was represented by the chargé d'affaires, Mr. Bateman, and the secretary, Mr. Gorell-Barnes (who also represented the University of Cambridge), whilst Mr. Dible, British Consul in Oporto, represented the consular service. Notable amongst those who represented the British colony in Lisbon were Mr. R. G. Jayne, head of the well-known shipping firm of Garland, Laidley and Co., and the Rev. Stewart Robertson (who also represented the University of Edinburgh) and Mrs. Robertson.

The celebrations began in the afternoon of December 6 with a general assembly in the "Patio" of the University, followed by addresses of welcome and a reception in the splendid official apartments of the distinguished Rector of the University, Dr. João Duarte de Oliveira.

During the forenoon of December 7 an exhibition of books was opened in the general Library of the University. This building, constructed between 1717 and 1725 on the initiative of the Rector, Nuno da Silva Teles, is a magnificent example of the Portuguese baroque style of the period of King John V, and contains a vast store of valuable manuscripts and books. There was also opened at the same time a most interesting display of early documents in the archives of the University.

At noon came addresses of welcome by the City Council and a reception in the University; the President of the Republic, his Excellency General Oscar de Fragoso Carmona, had intended to be present, but he was prevented from doing so by indisposition.

Most of the afternoon of December 7 was dedicated to a solemn session in the famous "Sala dos Capêlos" of the University. This noble hall was the work of the Rector, Manuel de Saldanha, who in 1654 decided to transform and embellish the great salon of the Royal Palace which at that time served for the ceremonies of the University. It possesses a fine dado of the beautiful "azulejos", that is, painted and glazed tiles, for which Portugal is so famous, and a splendid domed ceiling of painted panels, whilst its walls are adorned by portraits of the kings and queens of Portugal. Addresses were delivered by the Rector and the Minister of Education, Dr. Antonio Faria Carneiro Pacheco, and Prof. Damião Peres gave an eloquent account of the University of Coimbra in the history of Portuguese culture. Then short speeches of congratulation were made by members of the various foreign delegations, Prof. Entwistle speaking in Portuguese on behalf of the representatives of Great Britain

The afternoon of December 7 concluded with the inauguration of the "Sala do Brasil" in the Faculty of Letters. In the evening a splendid gala dinner was given in the University, at which were present the diplomatic corps and the senior delegates of the various nations. This was followed by a concert given by the symphony orchestra of the national broadcasting station. The Prime Minister, his Excellency Dr. Antonio de Oliveira Salazar, was able to be present during a part of these festivities.

At 11 o'clock on the morning of December 8, High Mass was celebrated by his Eminence the Cardinal Patriarch of Portugal, whilst during the afternoon in the Sala dos Capêlos, Senhor Mario Brandão was admitted to the degree of doctor, and honorary doctorates were conferred on a number of the foreign delegates, including Prof. Donnan and Mr. Ramsbottom. This was a scene never to be forgotten by the visitors. Round the great hall sat the diplomatic corps and the professors of the various faculties, the latter clad in their black gowns and silken "capelos" (differing in colour for each faculty) and wearing on their heads the wonderful "borlas" or academic hats. The body of the hall was filled with many ladies and guests of the University, whilst at the back surged an enthusiastic throng of students who gave Dr. Brandão and the honorary doctors a very hearty welcome. An extremely interesting feature of this ancient and historic ceremony was the embracing of the Rector Magnificus and the dean of the faculty by each honorary doctor in turn, whilst Dr. Brandão had the further privilege of being led round the stalls and the duty of embracing all the members of the faculties. One realized that this was a noble ceremony characteristic of the ancient brotherhood of learning, in which every new doctor was admitted to a special order and given a very friendly welcome by his elder brothers.

In the evening of December 8 a great banquet was given by the City Council in the hall of the splendid new High School named after King John III. At this banquet many students, all clad in their characteristic long black gowns, were present, so the proceedings were much enlivened by the gaiety and joy of youth. Various foreign delegates (including the present writer) were haled from the high table by groups of very pleasant fellows, given a student's gown, and conducted round the hall amidst cheers and rejoicing. One signed innumerable cards, drank much of the good wine of the country to the honour of Coimbra and Portugal, tried to speak bad Portuguese, and endeavoured to keep one's head and feet. It was evident that these good fellows, the representatives that night of the hope of the world, were admitting us to their comradeship and to the fellowship of the University of Coimbra. May God bless them!

On December 9 the programme included a football match and a torchlight procession of the students. Unfortunately, these events had to be cancelled owing to heavy rain. However, there was a very interesting concert of Portuguese music in the afternoon, given by the Philharmonic Orchestra of Lisbon, an evening meeting in the Avenida Theatre, and a gala ball in the great High School of King John III.

The celebrations closed on December 10 with a visit to the beautiful mountain resort of Buçaco and a lunch in the Palace Hotel. Thus terminated a visit to Coimbra and its famous University which will live in the memories of the British delegates as one of the pleasantest and most interesting events of their lives. The old city of Coimbra, crowned by its ancient University, and with its great Romanesque Cathedral of Sé Velha and its old church of Santa Cruz, in which lie buried King Afonso Henriques and King Sancho I, will ever remain with us a vivid and happy memory. We retain also a keen appreciation of the present as well as of the glorious past, and rejoice to have seen with our own eyes the great advances made in the University of Coimbra, as elsewhere in the land of our ancient and loyal allies, under the wise and beneficent leadership of President General Carmona and his great Prime Minister, Dr. Salazar. Dr. Salazar himself is a man of learning, one of the greatest, if not the greatest, of the sons of his Alma Mater, Coimbra. A distinguished professor of that University, destiny has led him to dedicate his pre-eminent abilities and virtues to the prosperity and happiness of the land of his birth. We who have experienced the splendid hospitality of his Government, and have had the privilege of witnessing the great and beneficent results of his wise and patriotic leadership of the Portuguese nation, unite wholeheartedly in wishing him and all our good friends of Portugal every prosperity and happiness in the future.

Before leaving Coimbra, I spent a very pleasant afternoon in the company of the professors of chemistry, Prof. Ruy Gustavo Couceiro da Costa and Prof. K. Coper. A remarkable experience was the visit to the Chemical Laboratory, a building in the neo-classical style erected in the last quarter of the eighteenth century during the reform period of the Marquês de Pombal (who approved and signed the architect's plan). How it would have rejoiced the heart of Lavoisier! Certainly the great Marquis must have been a man of remarkable foresight, and one cannot blame him or his architect for not having designed a building suitable to the requirements of 1937. Various interesting researches were in progress—a proof that good work can be done in buildings of great historical interest. Nevertheless, in case these lines should meet the eyes of Dr. Salazar—which is, perhaps, unlikely—I would humbly suggest that now is the time for him to beat the record of the great Marquis!

Another very interesting visit was paid to the English Institute, due to the energy and initiative of Dr. West, and now under the able direction of Mr. Leonard S. Downes, who represented the University of Glasgow at the celebrations. Amongst many other things, one was astonished to find here a library containing some English scientific journals and a goodly number of the most modern English books on chemistry and physics. In fact, the professors of chemistry told me that they were much indebted to the English Institute for keeping them in touch with the progress of British science. It is evident that the English Institute is very much alive and worthy of the strongest support. In the modern world the 'invisible' export of thought is an element of deep significance and importance. Britons in the past have been too apt to think that foreign nations are bound to assimilate the products of their thought and research by reason of some sort of inevitable predestination. This curious diffidence—or sublime trust in Providence—is not much good in the rough catch-as-catch-can of the thrusting modern world.

So, at last, came the train that bore us away from this city of learning, poetry and romance, where immortal Camões once lived and beautiful Inéz de Castro loved and suffered. With every student of Coimbra one could exclaim, "Não é Universidade como a minha!"

In conclusion, the British visitors to the Coimbra quatercentenary are deeply indebted to His Majesty's Embassy at Lisbon for invaluable help and much personal care and attention. Several of us, including the writer of this article, desire also to express our grateful thanks to Mr. Pell, the Minister of the United States in Portugal, and Mrs. Pell, for very delightful hospitality.

F. G. Donnan.

Obituary Notices

Prof. Charles Gravier

PROF. CHARLES GRAVIER, of the Natural History Museum of Paris, died on November 15 in his seventy-third year. Born at Orléans in 1865, and educated at the Ecole Normale of Saint-Cloud, he made his first step in the academic service of his country with an appointment in 1887 to a professorship at the Ecole Normale of Grenoble. In 1893, he was *agrégé des Sciences Naturelles* and in 1894 became *Professeur de Lycée* at Clermont-Ferrand, and two years later obtained his doctorate with a thesis on the Polychæta entitled "Recherches sur les Phyllodociens".

From Clermont-Ferrand Gravier moved to Paris, where he held the post of assistant first to E. Perrier and afterwards to L. Joubin at the Natural History Museum. In 1917 he was appointed *Professeur au Muséum* (*Vers et Crustacés*), a chair which he held until his death, and in 1922 he was elected a member of the Paris Academy of Sciences. He married a lady who also belonged to the academic world, for she held a chair of mathematics at the Ecole Normale of Sèvres, and their only son Maurice is a student of Scandinavian and Germanic philology.

Gravier saw more of the world than most men that follow an academic career, for he worked at the Zoological Station at Naples, at Bergen, in Germany, and was familiar with all the principal European museums. He went twice to America, and was entrusted with two scientific missions, to San Thomé in the Gulf of Guinea and afterwards to Djibouti in the Red Sea.

Gravier's life was devoted to the study of marine zoology, and his great powers of work enabled him to cover a wide field. He was mainly preoccupied with the systematics and morphology of the Polychæta and the Cœlenterates, but he was also deeply interested in their bionomics, and he had the capacity of extracting the last ounce of evolutionary significance from his material. He wrote upwards of eighty papers on the Cœlenterates, dealing with nearly all the groups of that phylum, and about a hundred and thirty papers on the Polychæta, of which nearly thirty were in collaboration with J. L. Dantan. He also published on the Crustacea and sponges.

Much of Gravier's work was in the form of short notes, two or three pages in length, but he also contributed a number of substantial memoirs. For example, in the Cœlenterates he described the corals of the second French Antarctic expedition and also those collected by the Prince of Monaco's oceanographic expeditions. In the Crustacea he described in 1912 the parasitic Copepoda of the second French Antarctic expedition and in 1931 published a valuable account of the breeding habits of the group. The bulk of his work was on the Polychæta, and in this group his main contributions were the description of the Polychæta of the first and second French Antarctic expeditions, his memoir on the Polychæta of the Red Sea, his papers on the breeding habits of the group, and more recently his account in collaboration with J. L. Dantan of the planktonic Polychætes obtained by fishing at night with a light in the Bay of Algiers and off the coast of Annam. He also made a special study of freshwater Polychætes.

All Gravier's work was careful and finished, and displayed the characteristic French clarity, proportion and sense of style. As a man, he had great charm. He never obtruded his great learning and always remained courteous, unassuming and kind,

C. C. A. M.

Prof. E. L. Nichols

ON November 10 the death occurred of Prof. E. L. Nichols, emeritus professor of physics in Cornell University, in his eighty-fourth year. Prof. Nichols's connexion with Cornell was of very long standing, as he studied there from 1871 until 1875 and was appointed professor of physics in the University in 1887. Thus for the past fifty years he has been continuously associated with Cornell, his appointment as emeritus professor dating from 1919. Previous to 1887, he had held the post of professor of physics, first at the University of Kentucky and then at Kansas University.

The period through which Prof. Nichols lived was one of most active and intense development in the realm of physics; this will be the more readily appreciated from the fact that he was for a short time associated with Edison in the development of the incandescent lamp. Throughout his life, his most constant interest was in photometry, optics and fluorescence, and he was responsible for a very large number of papers on various aspects of these subjects. His investigations of fluorescent phenomena were particularly numerous, and the book he wrote in collaboration with H. L. Howes and D. T. Wilbur on "Cathodo-Luminescence and the Luminescence of Incandescent Solids" is probably his most important work. Measurements of fluorescence are difficult at any time, and in his early work Prof. Nichols must have been very seriously hampered by the absence of the photometric standards to which we are now accustomed; but it must have been a source of considerable interest and satisfaction to him to see the rapidly growing industrial importance of the subject of fluorescence during the last few years, in connexion with new forms of lighting devices and with cathode ray tube development.

In addition to his own research activities, Prof. Nichols played an important part at the end of the last century in placing research in its correct perspective in American universities. At that time, teaching was almost the sole concern of the staffs of the various universities, and it is largely due to the energy and foresight of men such as him that at the present time the majority of American universities recognize research as being one of their most important functions.

In 1929, Prof. Nichols was awarded the Ives Medal of the Optical Society of America, and the present writer recollects with pleasure the dinner at which the medal was presented, and the speech by the late Mr. I. G. Priest, then president of the Society, in which he referred in glowing terms to the great service the medallist had rendered to optics.

W. D. W.

THE death is reported from Wellington, New Zealand, of Dr. Herbert William Williams, Bishop of Waiapu and well known as a Maori scholar, which took place on December 7 at the age of seventy-seven years. Dr. Williams was the third in descent of his family to hold this bishopric, both his grandfather and his father having held it before him. Dr. Williams was born at Waeranga-a-hika and was educated at Christ's College, Christchurch, and Canterbury College. After graduating in the University of New Zealand, he held a scholarship at Jesus College, Cambridge, where he graduated as a senior optime in 1884. After a brief period as a master at Haileybury he was ordained. In 1888 he returned to New Zealand, and in 1929 was elected to succeed Bishop Sedgwich in this diocese. Dr. Williams's life-long acquaintance and friendship with the Maori gave him an exceptional position as an authority on their history and culture. He was the author of a Maori dictionary, which appeared in 1917, of a bibliography of printed Maori, which appeared in 1924, and of "First Lessons in Maori". His scholarship was recognized by the award of the degree of Litt.D. of the University of New Zealand in 1924 and of the Litt.D. of Cambridge in 1925. He was a fellow of the Royal Society of New Zealand, of which he was president in 1935. He was also president of the Polynesian Society in 1929.

WE regret to announce the following deaths :

Prof. G. A. Buckmaster, emeritus professor of physiology in the University of Bristol, on December 19, aged seventy-eight years.

Mr. A. G. Edie, C.I.E., formerly chief conservator of forests, Bombay, on December 18, aged sixty-five years.

Prof. L. N. G. Filon, C.B.E., F.R.S., Goldsmid professor of mathematics in the University of London, formerly vice-chancellor of the University, on December 29, aged sixty-two years.

Miss Elizabeth Sanderson Haldane, C.H., author of works on Descartes, Ferrier and Hegel, and known for her interest in adult education, on December 24, aged seventy-five years.

Rear-Admiral R. S. Patton, since 1929 director of the U.S. Coast and Geodetic Survey, on November 25, aged fifty-four years.

Dr. Ivan K. Urumoff, known for his work on the flora of Bulgaria, aged eighty-one years.

News and Views

New Year Honours

THE New Year Honours list contains the names of the following men of science and others associated with scientific work : *Viscount* : Lord Nuffield, for public and philanthropic services. *Baron* : Sir Henry Lopes, Bt., deputy president of the University College of the South West, Exeter. *G.C.V.O.* : Lord Horder. *G.B.E.* : Sir Andrew Duncan, chairman of the Central Electricity Board, 1927–35. *K.C.B.* : Mr. K. McK. Clark, director of the National Gallery and surveyor of the King's Pictures. *K.B.E.* : Mr. T. Rigg, director of the Cawthron Institute, Nelson, Dominion of New Zealand ; Dr. W. H. McLean, for services to education and economic development in the Colonies ; Dr. W. D. Ross, president of the British Academy and provost of Oriel College, Oxford. *Knights* : Dr. Zia-Uddin Ahmad, vice-chancellor of the Aligarh Muslim University, United Provinces, India ; Prof. G. A. R. Callender, first director of the National Maritime Museum ; Mr. W. Palin Elderton, chairman of the British Insurance Association, actuary and manager of the Equitable Life Assurance Society ; Mr. W. Reavell, lately president of the British Engineers' Association ; Dr. W. G. Savage, county medical officer of health, Somerset ; Dr. T. F. Sibly, vice-chancellor of the University of Reading, member of the Advisory Council of the Department of Scientific and Industrial Research ; Mr. J. P. Ross-Taylor, chairman of the Highland and Agricultural Society ; Dr. C. McM. Wilson, dean of St. Mary's Hospital Medical School ; Mr. D. R. Wilson, H.M. Chief Inspector of Factories, Home Office.

C.B. : Major-General W. P. MacArthur, honorary physician to the King, commandant and director of studies, Royal Army Medical College, Millbank ; Major-General A. E. Davidson, director of mechanization, War Office. *C.M.G.* : Mr. F. Hemming, secretary to the International Committee for the Application of the Agreement regarding Non-intervention in Spain, who is secretary of the International Commission of Zoological Nomenclature ; Dr. P. H. Manson-Bahr, consulting physician to the Colonial Office ; Dr. J. D. Tothill, director of agriculture, Uganda Protectorate. *C.I.E.* : Mr. C. F. Bell, chief conservator of forests, Central Provinces and Berar ; Lieutenant-Colonel G. T. Burke, lately secretary, Medical Council of India; Dr. C. W. B. Normand, director-general of observatories, Government of India; Khan Bahadur Shapurji Nasarvanji Jamshedji Ratnagar, lately conservator of forests, Southern Circle, Bombay. *C.B.E.:* Mr. J. B. Beresford, secretary of the University Grants Committee and also of the Standing Commission on Museums and Galleries; Mr. J. Dewar, surveyor-general, Federated Malay States and Straits Settlements; Mr. H. J. G. Griffin, secretary of the Council for the Preservation of Rural England; Mr. A. L. Hetherington, assistant secretary of the Department of Scientific and Industrial Research; Dr. J. W. Mellor, lately director of the British Refractories Research Association; Dr. E. C. Snow, joint honorary secretary of the Royal Statistical Society; Dr. A. H. Thompson, professor of history in the University of Leeds, and member of the Royal Commission on Historical Monuments (England).

O.B.E.: Captain T. W. Barnard, director of the Barnard Institute of Radiology, Madras; Mr. T. R. Charlton, commissioner of lands, Crown surveyor, and chairman, Mining Board, Fiji; Mr. R. A. Farquharson, geologist in charge, Water-Boring Scheme, Somaliland Protectorate; Dr. R. S. G. Knight, manager and deputy superintendent, Royal Naval Cordite Factory, Holton Heath; Mr. F. Leney, lately curator, Norwich Castle Museum and Art Gallery; Mr. H. M. O Lester, deputy director, Sleeping Sickness Service, Nigeria; Mr. W. B. Rimmer, acting director of the Solar Observatory at Mount Stromlo, Commonwealth of Australia; Ram Chandra Srivastava, director of the Imperial Institute of Sugar Technology, Cawnpore, United Provinces, India; Dr. V. E. Wilkins, principal, Ministry of Agriculture and Fisheries. *M.B.E.:* Mr. J. Coutts, lately curator, Royal Botanic Gardens, Kew; Mr. W. A. Fyffe, public analyst for the Isle of Man; Mr. W. B. Mercer, agricultural organizer for Cheshire and principal of the Reaseheath Farm Institute; Mr. A. E. Spencer, computor, Land and Survey Department, Uganda. *Kaisar-i-Hind Gold Medal:* Dr. R. R. Stewart, principal of Gordon College, Rawalpindi, Punjab.

Indian Science Congress Association at Calcutta

THE twenty-fifth annual meeting of the Indian Science Congress Association, to which the British Association has sent a large delegation, opened at Calcutta on January 3 under the presidency of Sir James Jeans. Lord Rutherford was to have been president, and that portion of the address which he had prepared, representing his final word on what he used to describe as "the new alchemy", is printed on pp. 58–61 of this issue of NATURE. Sir James Jeans made his address brief, so that he might read to the assembled Congress a portion of that prepared by Lord Rutherford. In the first part of his address, Sir James paid eloquent tribute to the man whose place he was filling—"one of the greatest scientists of all time". He spoke of his greatness, his simplicity and sincerity, and remarked on his genius for friendship and good comradeship, an aspect of Rutherford's character which has also been demonstrated in the tributes to his memory we have been privileged to publish. In spite of the honours showered upon him, he was always "unassuming and ready to listen patiently to even the youngest and most inexperienced of his pupils or fellow-workers". Speaking of the work he accomplished, Sir James said that, "in his flair for the right line of approach to a problem, as well as in the simple directness of his methods of attack, he often reminds us of Faraday, but he had two great advantages which Faraday did not possess—first, exuberant bodily health and energy, and second, the opportunity and capacity to direct a band of enthusiastic co-workers. Great though Faraday's output of work was, it seems to me that to match Rutherford's work in quantity as well as in quality, we must go back to Newton".

Progress of Science in India

IN the second part of his address, Sir James Jeans referred to the progress of science during the quarter of a century since the Congress was founded, and to the contributions of Indian workers. Restricting himself to the field of mathematics and physics, he mentioned the remarkable discoveries made in pure mathematics by Ramanujan in his short life; the work of Sir Venkata Raman in sound and the theory of music, and his discovery of the spectral effect now known everywhere by his name; the investigations of Prof. M. Saha in astrophysics, "which gave us our first clear understanding of the meaning of stellar spectra, and so unlocked the road to vast new fields of astronomical knowledge"; and also the work of many Indians, especially Chandrasekhar and Kothari, on conditions in the interiors of stars. Many, other than mathematicians and physicists, would also be thinking of the great experimental skill of the late Sir Jagadis Chandra Bose. In 1911, Sir James said, there were no Indian-born fellows of the Royal Society; now there are four. In 1911, the Royal Society published no papers by Indians; in 1936, the Society published ten. The past twenty-five years have been one of the greatest periods in the history of science, a period of unprecedented progress in which India has taken its part and which has seen the remarkable growth of India as a scientific nation.

Policy and the Aborigines in Australia

IT is to be hoped that no apparent difference of opinion among anthropologists as to the ultimate fate of the Australian aborigines will be allowed to obscure the plain present duty of the Commonwealth Government in the matter of reform of policy and methods of administration. The report of Dr. Donald F. F. Thomson, research fellow of the University of Melbourne, to the Commonwealth Government on his observations as a special patrol officer for a period of fifteen months among the natives of Arnhem Land in the Northern Territories is uncompromising in its directness. He recommends, according to a dispatch of the Canberra correspondent of *The Times* in the issue of December 30, that the remains of the tribalized natives of the Northern Territories, who come under the control of the Commonwealth Government, should be segregated in an inviolable reserve; and that legislation similar to that in force in New Guinea for the protection of natives should be imposed in their interest. Watering depots for pearlers on the coast of Arnhem Land should be abolished. The policy of administering native justice should be revised; the police should not be allowed to act as protectors; and special courts for the aborigines should be established. It is recommended further that the Commonwealth Government should set up a Department of Native Affairs under a trained protector and staffed by men trained to apply anthropological methods; while eventually the administration of native affairs throughout Australia should be brought under one control. The Arnhem Land natives should not be permitted to leave the reserve, and missions should be requested to remove their stations to the outskirts of the reserve to prevent the entry of outside influence.

SETTING aside the larger question of the unification of control of aboriginal affairs throughout Australia, for which much is to be said, Dr. Thomson's recommendations represent the absolute minimum of immediate and urgent reform essential for the preservation of the aborigines of the Northern Territories. Mr. McEwen, Commonwealth Minister of the Interior, is reported to have expressed the view that, as it is inevitable that sooner or later the aborigines must come into contact with civilization, they should be prepared for it. Apparently he accepts an opinion attributed to "some anthropologists" that the segregation of tribalized natives "is undesirable and impracticable". Without a more precise statement of its authority, such an opinion carries little conviction; and it is contrary to the views of anthropologists most competent to speak. How far segregation is practicable and likely to be beneficial depends upon the will of the Australian people to ensure that full effect shall be given to that policy, which past experience shows alone to be capable of affording the aboriginal an opportunity to survive. Segregation does not necessarily entail a state of stagnation in which the aboriginal tribe is a museum piece. When once conditions favourable, and indeed essential, to the continued existence of the aborigines have been secured, it will be possible to plan their future and guide development along lines consistent with their character and tradition.

Segregation in Polish Universities

NEARLY one thousand outstanding scholars in leading universities in the United States have signed an open letter to their colleagues in some of the universities of Poland, where Jewish students are now segregated from their fellows, and repeated acts of violence are reported against them and Jewish professors. It is realized that the university authorities are faced with great difficulties on account of religious and racial differences, but to bring these conditions of strife into the classrooms and laboratories by adoption of a policy of segregation violates the principle of intellectual freedom upon which university life must be based. "Such discrimination", the signatories protest, "seems to us alien to the spirit of academic freedom and of the free co-operation in the pursuit of knowledge that is so essential to the world of scholarship". The distinguished members of the faculties of Polish institutions of higher learning who have raised their voices against this discrimination will, it is hoped, be encouraged by this support of their American colleagues to continue their efforts to maintain the high tradition of such institutions in the free republic of scholarship. Sympathy with suffering, and sensitiveness to injustice, are attributes which distinguish man from all his fellow creatures; and any deliberate action which evokes them cannot be other than a reversion to primitive instincts. In this twentieth century it is depressing to see the law of the jungle being accepted and applied to secure racial and national domination, when such great powers and opportunities exist for the progressive evolution of man's higher nature. Those of us who believe in a nobler destiny for the human race than has yet been reached find a certain amount of comfort in the dismay expressed by American scholars at the extension to Poland of a spirit of intolerance foreign to every principle for which a university should stand.

Institute of Economic and Social Research

ANNOUNCEMENT is made of the formation of a new Institute of Economic and Social Research. Sir Josiah Stamp is to be the first president of the Institute, and Prof. N. F. Hall, professor of political economy in the University of London (University College), is to be director. Among the functions of the Institute are the carrying out of research, either by its own staff or by others temporarily associated with it, into the facts and problems of contemporary human society, and the publication of the results of researches, subject to adequate safeguards for the impartial and scientific character of these publications. Financial support for the Institute is being provided by the Sir Halley Stewart Trust, the trustees of the late Lord Leverhulme, the Pilgrim Trust and the Rockefeller Foundation. An annual income has been guaranteed of £10,000 for five years, and £5,000 for two years after. The offices of the Institute will be at 32 Gordon Square, London, W.C.1.

Physical Society's Exhibition

THE Catalogue of the Physical Society's Exhibition, held in the Imperial College of Science and Technology on January 4, 5 and 6, covers 226 pages, has many illustrations and is well arranged. The paging is on the bottom edge of the page, the number of the stall on the top outer corner and the name of firm exhibiting on the top inner corner. It is divided into two sections, Trade (177 pages) and Research (36 pages), and an alphabetical list of exhibitors in each section is provided which gives also the number of the stall. A four-page index of the instruments exhibited with indication of the pages on which they are described is also provided. Reference to the catalogue is therefore easy and quick. New exhibits are indicated in the catalogue by an asterisk and on the stalls by a red star. As compared with last year, the exhibits in the Research Section have nearly doubled, while those in the Trade Section are about the same with a somewhat larger proportion of red stars. Some of the illustrations convey more information as to the working parts of the instruments than in past years, and are more useful to prospective buyers. Those on pp. 28, 165, 176 and 179 may be taken as examples. Discourses were delivered on January 4 by Captain G. C. C. Damant on "Diving in Deep Water and Shallow", on January 5 by Prof. A. F. C. Pollard on "Mechanical Amplification of Small Displacements" and by Sir Richard Gregory on "Science and Citizenship" jointly to the visitors to the Exhibition and to those attending the Exhibition of School Apparatus by the Science Masters' Association.

Engineering and Economics

IN an address to the Society of Engineers on October 4, entitled "Engineering and the New Economics", Dr. H. Chatley suggested that the engineer can contribute to the solution of economic problems of to-day in three ways. In the first place, the engineer can study the problem in terms of realities, such as goods, energy and services, and endeavour to disentangle them from the cobwebs of finance. Secondly, some engineers by entering politics can assist in spreading ideas on the realities of life. Thirdly, the engineer both by speech and by writing can help to explode some old fallacies and to educate the public in newer ideas and especially in that of the impartial application of scientific method to public affairs. Dr. Chatley illustrated his argument in respect of the last point by outlining in some detail the way in which the engineer can assist in the development of a sound fiscal policy in regard to coal and oil as well as in regard to the prevention of atmospheric pollution, the preservation of amenities, the question of values and prices, international debts, and population limits, and concluded by asserting that it is the duty of the engineer to understand the problems which have been raised by the misapplication by others of his skill. Scientific method should play an important part in citizenship since the classification of facts, the recognition of their sequence and significance and the habit of forming an unbiased judgment upon the facts which are characteristic of the scientific frame of mind are also essentials of good citizenship.

Awards for War Inventions

THE final report of the Royal Commission on Awards to Inventors, which has now been published (Cmd. 5594) shows that, in all, 1,834 applications were received by the Commission, of which 369 were dealt with by the Commission direct. Of the remaining 1,465, which were in the first instance considered by the Investigating Committee, 846 were withdrawn or apparently abandoned, 75 were referred to and later heard by the Commission and 544 were rejected by the Committee as having no reasonable chance of success. In 200 of them the claimant exercised his right of a personal appearance before the Investigating Committee. The total amount of awards was about £1,500,000, and a summary of the awards is appended to the report. Claims submitted to the Commission before the final date fixed by Royal Warrant (March 31, 1932) were virtually determined by December 31, 1933, but there were at that date certain claims the position of which had not been finally determined. The claims in question have since been otherwise disposed of, but while further sittings of the Commission were not necessary, the submission of a final report was delayed. The actual sittings of the Commission covered a period of fifteen years, and in that time the Commission lost by death its chairman, Lord Tomlin, as well as two members, Mr. A. C. Chapman and Prof. W. E. Dalby.

Commonwealth Fund Fellowships

THIRTY-FOUR of these fellowships, enabling British university men to devote two years to study and travel in the United States of America, are offered for award in 1938. Twenty-four are open to candidates of British descent, domiciled in the United Kingdom, who are graduates of universities therein, unmarried and less than thirty years of age; two to graduates of a university in a British dominion or colony; five are 'service fellowships' open only to candidates holding Government appointments in the British Empire over-seas; and three are Home Civil Service fellowships. The Committee of Award (chairman, Sir Walter H. Moberly) give primary consideration to intellectual ability, personality and initiative; account is also taken of character and health. Application, in the prescribed form, approved by the authorities of the college or university of which the candidate is or has been a member, must reach the Secretary to the Committee (35 Portman Square, W.1) by February 1. In 1937, awards were made to candidates from Cambridge (5), Cardiff, Glasgow, Liverpool (2), London (4), Manchester (2), Oxford (9), Reading, St. Andrews, New Zealand and South Africa. The subjects of study were very various, comprising: physics (3), chemistry (2), biophysics, zoology, physiology, medicine (2), engineering, architecture (2), law, political science, economics, international relations, education, modern languages, English literature, American literature, theology. The fellowships, in some respects complementary to the Rhodes scholarships, were established with the view of promoting mutual amity and understanding between Great Britain and the United States.

Constable's Portrayal of Weather

MR. L. C. W. Bonacina's paper on "John Constable's Centenary: His Position as a Painter of Weather" (*Quart. J. Roy. Meteor. Soc.*, October 1937) is a notable contribution to that affiliation of the Nature studies of the artist and scientific worker which is so much to be desired. The character of the country in which Constable was born and bred evidently influenced his practice of emphasizing cloud effects in landscape. The Suffolk countryside where the celebrated pictures of Flatford Mill, Dedham Mill and Stoke-by-Nayland were painted is the plain seen by the traveller on the London and North-Eastern Railway when crossing the River Stour above Manningtree. Here the land presents none of those emphatic forms which in rugged scenery tend to concentrate attention on the lower half of the confronting hemisphere, so the eye ranges freely over the sky, and the cloud is as important as the field in the composition of the picture. Originals of Constable's paintings are readily accessible in the National Gallery and the Victoria and Albert Museum, and many are familiar as engravings, so that Mr. Bonacina's judgments can easily be tested. We welcome his conclusion that Constable's generalization of particular types of cloud in a manner not possible for photography is of service to the meteorologist. The analysis of certain pictures in which transitory forms are so perfectly depicted as to introduce a cinematic effect is a notable contribution to art criticism. It is indeed entirely appropriate that the student of natural science should thus contribute to the understanding of landscape painting, for the critical faculty is as a rule more highly developed in the man of science than in the artist—who does more than he knows.

A Guide to Fishes

REGULAR visitors to the Fish Gallery at the British Museum (Natural History) during recent years have watched with interest the rearrangement under the supervision of Mr. J. R. Norman. The large number of new casts and models, due to the skill of Mr. S. Stammwitz, have resulted in an exhibition illustrative of fish life that would be difficult to improve upon with present-day resources. The first part of the new guide to the Gallery contains a general account of classification, the scheme adopted being that proposed by Dr. C. Tate Regan (British Museum (Natural History). Illustrated Guide to the Fish Gallery. By J. R. Norman. Pp. x+175+6 plates. London: Trustees of the British Museum, 1937. 1*s.* 6*d.*). A wealth of interesting notes on habits and on fisheries turns what might otherwise be a rather dull catalogue into fascinating matter for general reading. The second and rather larger portion of the book is taken up with descriptions of the special exhibits, of which there are eighteen. These are evidently such as will cater for the needs of most visitors. They include such items as the crucifix fish, of interest to the credulous rather than to the serious student, who will find more to his taste in the section (and exhibit) devoted to breeding habits and development of coloration. This is an excellent guide book, but it is more than that; it is an elementary text-book of fish life. It is well written and well illustrated, in which connexion a word of praise must be spared for Lieut.-Col. W. P. C. Tenison's accurate and charmingly executed drawings.

The School Certificate Examination

THE School Certificate Examination, its merits and demerits and how it might be improved: these are matters which so closely concern so many people—parents and employers as well as school and university teachers and administrators—that the National Union of Teachers has performed an important public service in printing and circulating Sir Philip Hartog's address at its Portsmouth Conference. Sir Philip, than whom a more competent critic could scarcely be found, exposes manifold weaknesses of the examination as at present administered. He discusses such questions as: What does passing the examination imply in terms of what each successful candidate will be able to do? What do the examiners suppose they are trying to test? What of the validity and consistency of the test? More than a quarter of the candidates fail: does this not point to serious maladjustment between education and examination? He makes five definite proposals for reform: (i) classify tests in such a way as to show employers in what cases they can rely on a pass as showing the possession of definite utilizable skills; (ii) give to each candidate a certificate characterizing his or her performance in each subject; (iii) abolish the group system in so far as it hampers the school in determining the examination programme to suit each child after investigation of individual aptitudes; (iv) supplement the school certificate by a cumulative school record; (v) protect certain subjects, such as English literature, history and general science, from examination pressure, providing at the same time for their compulsory inclusion in the curriculum and school time-tables.

Gardens for Busy Enthusiasts

THERE must be a considerable body of garden enthusiasts who have only a limited time in which to maintain horticultural beauty around their homes. Professional cares of the specialist often diminish the hours of leisure which might be devoted to gardening, or other causes may intervene. Mr. R. S. Lynch's paper on "Gardens of Easy Maintenance" (*J. Roy. Hort. Soc.*, 62, 9, 377–393, Sept. 1937) is a most useful help for such enthusiasts. Lawns are particularly insistent in their demands for attention, and for those who regard them as essential to garden beauty, Mr. Lynch has many suggestions for their more facile control. A pleasing arrangement of alpines upon a paved bank requires little attention, though it ministers well to formal artistry. The horticultural qualities of many perennial plants which demand neither pruning, frequent division, nor staking, are discussed in detail in the paper, whilst the claims of an evergreen garden are also considered. A large amount of practical information, which should help to meet a pressing modern need, is here portrayed.

Timber Seasoning in Australia

TIMBER seasoning has made very considerable progress in many countries of the world since the Great War. It was during that War that a great deal of research work in seasoning by means of kiln-drying was undertaken, more especially perhaps in Great Britain and in India. Owing to the enormous consumption of timber upon the War fronts all seasoned material was absorbed in a comparatively short space of time; and since then it is not an overstatement to say that good seasoned material of high quality is very difficult to obtain for many species of timbers. In this new departure of utilizing the kiln for drying timbers, Australia has not been behind other parts of the Empire. In 1933 the Division of Forest Products of the Council for Scientific and Industrial Research published as a pamphlet Part 1 of "A Guide to the Seasoning of Australian Timbers", in which it was pointed out that timbers of different species frequently differ so widely in physical properties that it is impossible to prescribe a general set of conditions for air-drying or kiln-drying for all timbers, or even for all sizes of one timber. Part 2 of this Guide has been recently issued (Div. of For. Products, Pamphlet No. 68, Technical Paper, No. 22. Melbourne, 1937) written by W. L. Greenhill and A. J. Thomas. The work of determining suitable kiln schedules for various species and sizes of timber is being carried out in laboratory kilns, supplemented by information operated by the Queensland forest service. Based on the results of the work carried out since the publication of Part 1, seasoning notes and suggested schedules for twenty-two additional species are given in the present pamphlet.

Tuberculosis in the Far East

THE problem of tuberculosis was one of the subjects dealt with at the Conference of Far Eastern Countries on Rural Hygiene last August (League of Nations. Health Organisation. Report of the Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene. Held at Bandoeng (Java), August, 1937. London: George Allen and Unwin, Ltd. 2*s*. 6*d*.). Tuberculosis is recognized as being one of the scourges in Eastern countries. Unfortunately, there is an almost complete absence of accurate data concerning the extent and severity of the disease in rural areas. The importance of carrying out preliminary surveys and sample tuberculin tests in the country is advocated. Financial limitations make it important that an anti-tuberculosis campaign should be simple and adapted to local conditions, and the gradual establishment of a network of rural dispensaries would appear advisable. The establishment of sanatoria, in the Western sense, would not seem to be applicable, but simpler institutions are suggested. A scheme for mass research on tuberculin sensitiveness was drafted.

Chinese Medicine and the Pangolin

The pangolin or scaly ant-eater (*Manis pentadactyla dalmanni*) is the most primitive of Chinese mammals, and although it is fully protected by law in the colony and island of Hong-Kong, the demand for its carcass makes more extensive protection in South China necessary (*Hong Kong Naturalist*, July 1937, 79). The animal itself is eaten, but a greater danger arises from the belief that the scales have medicinal value. Fresh scales are never used, but dried scales are roasted, ashed, cooked in oil, butter, vinegar, boy's urine, or roasted with earth or oyster-shells, to cure a variety of ills. Amongst these are excessive nervousness and hysterical crying in children, women possessed by devils and ogres, malarial fever and deafness. So much are pangolin scales in request for these purposes that yearly the scales from some 4,000 or 5,000 individuals were imported from Java, with a value of 3,700 guilders. But recent regulations in Java, which prohibit capturing and killing of pangolins and the export of scales, will turn the attention of the Chinese medicine men more forcibly towards the native product.

James Eights: a Pioneer Antarctic Naturalist

DR. W. T. CALMAN has done worthy service to the memory of an American naturalist of the early nineteenth century in his presidential address to the Linnean Society (*Proc. Linn. Soc.*, 149, 171; 1937). The accuracy of the descriptions and drawings made by James Eights, his discovery of a ten-legged pycnogon (*Decolopoda*), in which no one believed until the rediscovery of the species by the Scottish National Antarctic Expedition almost seventy years later, his discovery of a new seal and a new dolphin, neither of which he named, his description of the breeding of the king penguin, and of the South Shetland Islands, all mark him as a naturalist of keen perception. It is unfortunate that the appearance of his descriptions in journals not readily accessible should have obscured and delayed the recognition of his merit, and more sad to learn that in his own country he dropped out of the current and lived for a quarter of a century, until his death in 1882, in loneliness, obscurity and poverty.

Spectrograms of Nova Herculis 1934

THE editors of the *Astrophysical Journal* in 1935 collected data as to the spectrograms of Nova Herculis 1934 available at different observatories, partly with a view to the ultimate production of an atlas showing the changes day by day in the spectrum of the star during the first few months after the initial outburst. On the appointment of a Nova Sub-commission in the Commission of Stellar Spectra of the International Astronomical Union, this material was handed to Prof. F. J. M. Stratton as chairman of that Sub-commission. Further data as to the observational material available were secured, and now the spectrum of Nova Herculis for nearly every day is available from one source or another from the head of the Balmer series to $H\alpha$. The Solar Physics Committee at Cambridge has approved the production by the staff of the Solar Physics Observatory of an atlas showing daily changes over that range of spectrum. It is hoped to print the whole atlas on 16 stiff cards—one quarter of the spectrum on each card and one card for each month. The cost will depend on the number of subscribers to the atlas, and subscribers may be asked to pay as much as 25 shillings. If sufficient support is forthcoming, it is hoped to start work on the atlas early in 1938.

Rabies Prevention in India

DETAILS of the preventive treatment of rabies at the Pasteur Institute of India, Kasauli, are given in the thirty-fifth annual report for the year 1935 by the director, Dr. R. O. A. Smith. The total number of patients attending the Institute and its centres was 21,898, an increase of 657 patients as compared with the previous year, of whom 16,627 received the complete course of treatment. There were 86 deaths among these, a percentage death-rate of 0·52, which compares with 0·49 for the previous year. In addition, 1260 courses of vaccine for the prophylactic treatment of animals were issued during the year. The vaccine employed is a carbolized 5 per cent emulsion of sheep's brain prepared from sheep infected with the Paris fixed virus.

Twenty-Five Years of Research in Dairying

TWENTY-FIVE years ago the National Institute for Research in Dairying, University of Reading, was founded, and to celebrate the event an "Anniversary Review", compiled by the staff of the Institute, has been issued. This booklet presents a short history of the origin and development of the Institute, with a brief account of its present relationship with the farm, the dairying industry generally and the public. A summary is also given of the many and varied investigations carried out at the Institute, or in collaboration with other research centres, mainly between 1923 and the commencement of the present year.

Announcements

PROF. RICHARD KUHN will deliver the sixth Pedler Lecture of the Chemical Society at the London School of Hygiene and Tropical Medicine on January 27 at 5.30 p.m. The subject of the lecture will be "Synthesis of Polyenes".

THE medical faculty of the University of Zurich has elected Dr. William Cortedge of Rochester, U.S.A., an honorary doctor in recognition of his work on applied physics in medicine especially in roentgenology.

THE Rockefeller Foundation of New York has decided to award Profs. A. Kluyve of Delft and L. S. Ornstein of Utrecht financial support for five years for their radiobiological investigations, which have already been supported by the Foundation for three years.

THE Women's Medical Association of New York City offers the Mary Putnam Jacobi Fellowship (1000 dollars for one year) which is available for post-graduate work in the medical sciences. The fellowship is open to any woman graduate of an approved medical school. Further information can be obtained from Dr. Phoebe Du Bois, 150 East 73rd Street, New York.

THE Ophthalmological Society of the United Kingdom has instituted a Treacher Collins Prize of £100, which will be awarded every three years for the best essay submitted on a subject selected by the Council. It will be open to medical practitioners of any nationality, but the essay must be in English. The first subject selected is cerebro-spinal disease and its relation to the optic nerve. Essays should be submitted to the honorary secretary, 5 Racquet Court, Fleet Street, E.C.4, before December 31, 1938.

DR. HERMANN WINTZ, professor of obstetrics and gynæcology at Erlangen, has been awarded the Carlos Heiser Medal by the International Commission of Radiologists and Roentgenologists.

AN Italian society of metaphysics has recently been founded in Rome with a presidential council consisting of Prof. Ferdinando Cazzamalli, Dr. Luigi R. Sanguineti, Prof. G. Schepia and Dr. Emilio Servado. Further information can be obtained from the secretary, Dr. L. R. Sanguineti, Via Serbelloni 2, Milan.

THE twenty-seventh Dutch Congress of Natural Science and Medicine will be held at Nymwegen on April 11–13, 1939, under the presidency of Prof. G. Holst of Eindhoven. Further information can be obtained from the general secretary, Dr. D. Coelingh, Bussum, Holland.

A LAW for the reorganization of the University of Brazil and construction of the University City at Rio de Janeiro recently passed the House of Deputies. The Federal Government is now in charge of the construction of the University City, which will include the faculties of philosophy, education, fine arts, engineering, mining and metallurgy, chemistry and pharmacy, law, politics and economy, agriculture, veterinary medicine and music. There will also be a hospital.

"PHOTOMICROGRAPHY with the Vickers Projection Microscope" is the title of a booklet published by Messrs. Cooke, Troughton and Simms, Ltd., Buckingham Works, York, the present makers of the instrument, which was originally designed and manufactured at the Erith Works of Messrs. Vickers-Armstrong, Ltd. The apparatus is fully described, together with the electrical equipment and instructions for assembly. The manner of using and maintenance are described, and chapters are devoted to the theory of the microscope and preparation of specimens. The booklet contains much information on the subject of photomicrography and the use of the microscope in steel works practice, apart from the Vickers instrument, and is fully illustrated.

ASSISTANCE in the selection of suitable scientific books for public libraries is always welcomed. We are glad to see, therefore, that Prof. B. W. Holman, who is a member of the Brentford Borough Council, has contributed to the January issue of the *Fordwick*—a quarterly list of books added to the Brentford and Chiswick Public Libraries—a short article on recent books on social and other non-technical aspects of science.

"T. LL. H." informs us that in his review of Sir Frederick Maurice's "Life of Lord Haldane", the date of the appointment of the Royal Commission (NATURE, Dec. 11, p. 989) should have been 1909, not 1907.

ERRATUM. In the last line but one of the letter by Dr. A. S. Parkes entitled "Terminology of Sex Hormones" in NATURE of January 1, p. 36, for "*thryotrophic*" read "*thyrotrophic*".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

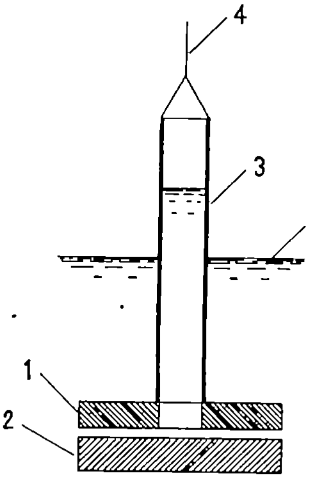
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 83.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Viscosity of Liquid Helium below the λ-Point

THE abnormally high heat conductivity of helium II below the λ-point, as first observed by Keesom, suggested to me the possibility of an explanation in terms of convection currents. This explanation would require helium II to have an abnormally low viscosity; at present, the only viscosity measurements on liquid helium have been made in Toronto[1], and showed that there is a drop in viscosity below the λ-point by a factor of 3 compared with liquid helium at normal pressure, and by a factor of 8 compared with the value just above the λ-point. In these experiments, however, no check was made to ensure that the motion was laminar, and not turbulent.

The important fact that liquid helium has a specific density ρ of about 0·15, not very different from that of an ordinary fluid, while its viscosity μ is very small comparable to that of a gas, makes its kinematic viscosity $\nu = \mu/\rho$ extraordinary small. Consequently when the liquid is in motion in an ordinary viscosimeter, the Reynolds number may become very high, while in order to keep the motion laminar, especially in the method used in Toronto, namely, the damping of an oscillating cylinder, the Reynolds number must be kept very low. This requirement was not fulfilled in the Toronto experiments, and the deduced value of viscosity thus refers to turbulent motion, and consequently may be higher by any amount than the real value.



The very small kinematic viscosity of liquid helium II thus makes it difficult to measure the viscosity. In an attempt to get laminar motion the following method (shown diagramatically in the accompanying illustration) was devised. The viscosity was measured by the pressure drop when the liquid flows through the gap between the disks 1 and 2; these disks were of glass and were optically flat, the gap between them being adjustable by mica distance pieces. The upper disk, 1, was 3 cm. in diameter with a central hole of 1·5 cm. diameter, over which a glass tube (3) was fixed. Lowering and raising this plunger in the liquid helium by means of the thread (4), the level of the liquid column in the tube 3 could be set above or below the level (5) of the liquid in the surrounding Dewar flask. The amount of flow and the pressure were deduced from the difference of the two levels, which was measured by cathetometer.

The results of the measurements were rather striking. When there were no distance pieces between the disks, and the plates 1 and 2 were brought into contact (by observation of optical fringes, their separation was estimated to be about half a micron), the flow of liquid above the λ-point could be only just detected over several minutes, while below the λ-point the liquid helium flowed quite easily, and the level in the tube 3 settled down in a few seconds. From the measurements we can conclude that the viscosity of helium II is at least 1,500 times smaller than that of helium I at normal pressure.

The experiments also showed that in the case of helium II, the pressure drop across the gap was proportional to the square of the velocity of flow, which means that the flow must have been turbulent. If, however, we calculate the viscosity, assuming the flow to have been laminar, we obtain a value of the order 10^{-9} C.G.S., which is evidently still only an upper limit to the true value. Using this estimate, the Reynolds number, even with such a small gap, comes out higher than 50,000, a value for which turbulence might indeed be expected.

We are making experiments in the hope of still further reducing the upper limit to the viscosity of liquid helium II, but the present upper limit (namely, 10^{-9} C.G.S.) is already very striking, since it is more than 10^4 times smaller than that of hydrogen gas (previously thought to be the fluid of least viscosity). The present limit is perhaps sufficient to suggest, by analogy with supraconductors, that the helium below the λ-point enters a special state which might be called a 'superfluid'.

As we have already mentioned, an abnormally low viscosity such as indicated by our experiments might indeed provide an explanation for the high thermal conductivity, and for the other anomalous properties observed by Allen, Peierls, and Uddin[2]. It is evidently possible that the turbulent motion, inevitably set up in the technical manipulation required in working with the liquid helium II, might on account of the great fluidity, not die out, even in the small capillary tubes in which the thermal conductivity was measured; such turbulence would transport heat extremely efficiently by convection.

P. KAPITZA.

Institute for Physical Problems,
Academy of Sciences,
Moscow.

Dec. 3.

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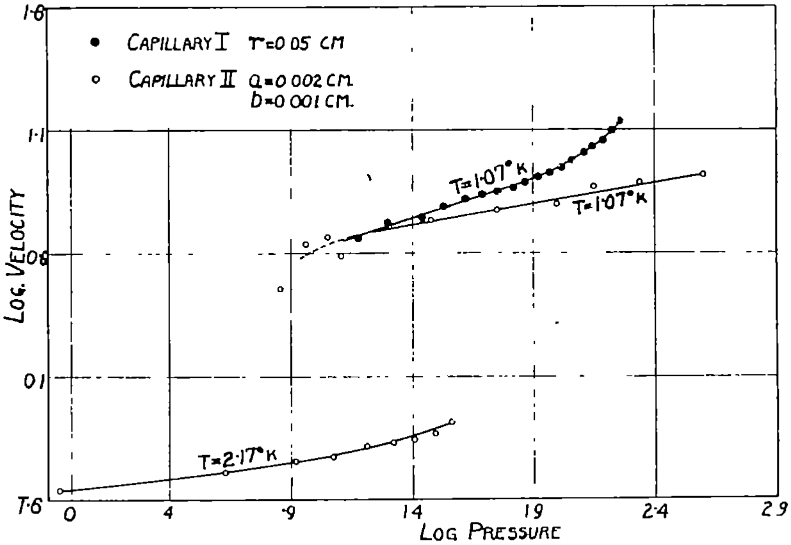
[1] Burton, NATURE, 135, 265 (1935); Wilhelm, Misener and Clark, *Proc. Roy Soc.*, A, 151, 342 (1935).

[2] NATURE, 140, 62 (1937).

Flow of Liquid Helium II

A SURVEY of the various properties of liquid helium II has prompted us to investigate its viscosity more carefully. One of us[1] had previously deduced an upper limit of 10^{-5} C.G.S. units for the viscosity of helium II by measuring the damping of an oscillating cylinder. We had reached the same conclusion as Kapitza in the letter above; namely, that due to the high Reynolds number involved, the measurements probably represent non-laminar flow.

The present data were obtained from observations on the flow of liquid helium II through long capillaries. Two capillaries were used; the first had a circular bore of radius 0·05 cm. and length 130 cm. and drained a reservoir of 5·0 cm. diameter; the second was a thermometer capillary 93·5 cm. long and of elliptical cross-section with semi-axes 0·001 cm. and 0·002 cm., which was attached to a reservoir of 0·1 cm. diameter. The measurements were made by raising or lowering the reservoir with attached capillary so that the level of liquid helium in the reservoir was a centimetre or so above or below that of the surrounding liquid helium bath. The rate of change of level in the reservoir was then determined from the cathetometer eye-piece scale and a stop-watch; measurements were made until the levels became coincident. The data showing velocities of flow through the capillary and the corresponding pressure difference at the ends of the capillary are given in the accompanying table and plotted on a logarithmic scale in the diagram.



Capillary I		Capillary II			
$T = 1·07°$ K.		$T = 1·07°$ K.		$T = 2·17°$ K.	
Velocity (cm./sec.)	Pressure (dynes)	Velocity (cm./sec.)	Pressure (dynes)	Velocity (cm./sec.)	Pressure (dynes)
13·9	183·5	8·35	402	0·837	36·6
11·5	154·5	6·92	218	0·757	31·3
10·3	127·7	6·88	143	0·715	26·1
9·0	105·0	6·30	101	0·685	21·1
8·2	83·5	6·05	56	0·655	16·4
7·5	65·7	5·55	30	0·609	12·1
6·9	49·3	4·70	11·3	0·570	8·3
6·1	34·1	4·39	9·2	0·525	4·3
5·2*	20·3	3·92	13·0	0·433	0·9
4·5*	15·2	2·88	7·2		

The following facts are evident:

(*a*) The velocity of flow, q, changes only slightly for large changes in pressure head, p. For the smaller capillary, the relation is approximately $p \propto q^4$, but at the lowest velocities an even higher power seems indicated.

(*b*) The velocity of flow, for given pressure head and temperature, changes only slightly with a change of cross-section area of the order of 10^3.

(*c*) The velocity of flow, for given pressure head and given cross-section, changes by about a factor of 10 with a change of temperature from 1·07° K. to 2·17° K.

(*d*) With the larger capillary and slightly higher velocities of flow, the pressure-velocity relation is approximately $p \propto q^3$, with the power of q decreasing as the velocity is increased.

If, for the purpose of calculating a possible upper limit to the viscosity, we assume the formula for laminar flow, that is, $p \propto q$, we obtain the value $\eta = 4 \times 10^{-9}$ C.G.S. units. This agrees with the upper limit given by Kapitza who, using velocities of flow considerably higher than ours, has obtained the relation $p \propto q^2$ and an upper limit to the viscosity of $\eta = 10^{-9}$ C.G.S. units.

The observed type of flow, however, in which the velocity becomes almost independent of pressure, most certainly cannot be treated as laminar or even as ordinary turbulent flow. Consequently any known formula cannot, from our data, give a value of the 'viscosity' which would have much meaning. It may be possible that the liquid helium II slips over the surface of the tube. In this case any flow method would be incapable of showing the 'viscous drag' of the liquid.

With regard to the suggestion that the high thermal conductivity of helium II might be explained by turbulence, we have calculated that the flow velocity necessary to transport all the heat input over the observed temperature gradient in the Allen, Peierls and Uddin experiments[2] is about 10^4 cm./sec. On the other hand, the greatest flow velocity produced by manipulation and by the pressure difference along the thermal conduction capillary will not be likely to be greater than 50 cm./sec. It seems, therefore, that undamped turbulent motion cannot account for an appreciable part of the high thermal conductivity which has been observed for helium II.

J. F. ALLEN.
A. D. MISENER.

Royal Society Mond Laboratory,
Cambridge.
Dec. 22.

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[1] Burton, E. F., NATURE, 135, 265 (1935).

[2] Allen, Peierls and Uddin, NATURE, 140, 62 (1937).

Some Experiments at Radio Frequencies on Supraconductors

MEASUREMENTS were made on an extruded tin wire carrying an alternating current of a frequency of about 200 kilocycles per second superposed upon a direct current. The resulting magnetic field at the surface of the wire was thus caused to pulsate cyclically.

When the temperature of the wire was slightly below the transition temperature, the pulsation in field tended to carry the material through the transition between the normal resisting and the supraconducting states. It was found that under these conditions the potential difference between the ends of the specimen contained a component of double the frequency of the alternating current and of the magnitude to be expected if the resistivity of the material in the outer portion of the wire was able to follow the pulsations in the magnetic field without an appreciable lag.

The double-frequency component was present only in that narrow range of combinations of temperature and current for which a pulsation in resistance was to be expected. If there is any lag in the destruction of the supraconducting state by a magnetic field and in its re-establishment, it can be stated that the lags are small as compared with 2 micro-seconds.

Other measurements at radio frequencies up to 3,000 kilocycles per second indicate that for tin and tantalum the transition temperatures are the same for direct currents equal in magnitude to the root-mean-square of the high-frequency currents. When cooled below the transition temperatures, these materials offered no detectable resistance to currents of these frequencies.

It is expected that the more complete report of the work will appear in the February issue of the *Journal of Research of the National Bureau of Standards.*

F. B. SILSBEE.
National Bureau of Standards, F. G. BRICKWEDDE.
Washington, D.C. Dec. 3. R. B. SCOTT.

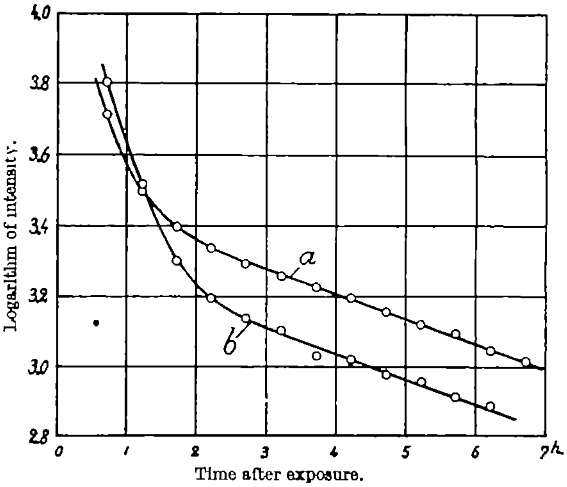
Isomeric Radio-Isotopes of Bromine

THE number of different radio-isotopes seems in several cases greater than can be explained by attributing to each of them a different mass-number. In particular, bromine irradiated with neutrons, γ-rays and deuterons gives four radio-isotopes (T = 7 min., 18 min., 250 min. and about 36 h.); and it seems that two of them, namely, the isotopes with T = 18 min. and T = 250 min., must have the same mass-number 80[1]). These facts, together with some others, have led several authors to assume the existence of isomeric nuclei.

Fleischmann[2] has recently investigated whether in the process (n, γ) the ratio of the two isomeric forms of ^{80}Br depends on the impinging neutron energy. He found that the resonance neutrons responsible for the formation of both isomers have the same absorption coefficient in boron, and concluded that the resonance levels of the compound nucleus leading to the two forms of ^{80}Br are identical. The ratio of equilibrium quantities of ^{80}Br (18 min.) and ^{80}Br (250 min.) is about 2·3 both for thermal and resonance neutrons.

As in this case the radio-isotopes are formed by neutron capture, it seemed to us of interest to investigate whether this ratio remains the same when the radioactivity is excited by the process (n, 2n), that is, when the collision of a nucleus with a fast neutron results in the expulsion of two neutrons. In consequence we have irradiated bromine (*a*) with fast neutrons having energies up to 14 × 10⁶ ev. produced by bombarding lithium with deuterons of 350 ekv., (*b*) with neutrons slowed down in a hydrogenated medium and originating from the same source or, alternatively, from a radon plus beryllium source. In both cases, the times of exposure and conditions of measurements were identical. During the runs the intensity and the voltage of the bombarding deuteron current were kept practically constant.

Bromine was exposed in the form of element; the irradiated bromine was transferred into a thin-walled glass vessel having the form of a cylindrical Dewar flask of 16 mm. inner diameter, which was put directly on a Geiger-Müller counter having brass walls of 0·05 mm. thickness. The activity was followed during 7 hours in order to determine exactly the ratio of the two isomers. It may be mentioned that in case (*a*) the activity obtained with a bombarding deuteron current of about 300 microamp. was so large that counting could be started only when the 7 min. product has practically decayed (about half an hour after the end of the exposure). The ratio of the initial number of impulses due to the two isomers and calculated for an infinitely long exposure was found in case (*a*) (process n, 2n) equal to 0·56 and in case (*b*) (process n, γ) equal to about 2. Fleischmann has obtained a slightly higher value in this last case, but it must be remembered that the exact experimental value depends on the conditions of absorption of the two kinds of β-rays in the particular arrangement used, if their energy distributions are different.



DECAY CURVES OF ^{80}BR OBTAINED WITH (*a*) FAST NEUTRONS AND WITH (*b*) SLOW NEUTRONS.

The logarithmic decay curves relative to the two cases are represented in the accompanying graph. It can be seen that initially the activity of radio-bromine formed by fast neutrons is smaller than the activity due to slow neutrons; on the other hand, it is much larger on the subsequent part of the curves.

Process (*a*) consists in the expulsion of two neutrons from the excited compound nucleus, while in process (*b*) we have to do only with a γ-radiation. It would be of interest to see whether an intermediate value of the ratio Br (18 min.) : Br (250 min.) is obtained when the radio-isotopes are formed with expulsion of one neutron, that is, by irradiation with hard γ-rays.

A. SOŁTAN.
Institute of Experimental Physics,
University, Warsaw.
L. WERTENSTEIN.
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Warsaw Society of Sciences.

Nov. 24.

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[1] Bothe, W., and Gentner, W., *Z. Phys.*, 106, 236 (1937).

[2] Fleischmann, R., *Z. Phys.*, 107, 205 (1937).

Formation of Lipin Phosphorus in Normal and Rachitic Rats, with a Radioactive Phosphorus Isotope as an Indicator

IN previous papers[1,2] we communicated the results of some experiments on phosphorus metabolism in normal, rachitic, and rachitic rats treated with vitamin D, by which the distribution, absorption and re-excretion in relation to the deposition in bone of the active phosphorus administered were examined.

Significant differences between the three groups of rats could not be established. A very rapid entrance of the 'labelled' phosphorus into the bone was perceptible in all cases. Furthermore, it was observed that one hour after the injection into the tail vein, a considerable amount of the radioactive phosphorus was re-excreted into the small intestine, whereas the phosphorus within one hour had disappeared entirely from the blood in several rats.

We have now investigated the formation of lipin phosphorus after injection of inorganic phosphorus in six normal and rachitic rats. The 'labelled' phosphorus was administered as sodium phosphate in an aqueous solution of pH 6·4. For that purpose a fixed quantity of the radioactive solution was injected into the tail vein. A certain time after the injection of the active sodium phosphate—in this experiment after ½ and after 2 hours—the rats were decapitated and the blood was caught in a tared cup. The body and the head were immediately plunged into liquid air, then pulverized and kept in a frozen condition in solid carbon dioxide, until the chemical estimations were done and the preparations for the determination of the radioactivity were made.

The radioactivity was measured with an ionization chamber[2] in four preparations of each animal, namely, the blood, the total-phosphorus fraction, the lipin-phosphorus fraction and the remaining phosphorus fraction. In addition, the total phosphorus, the lipin phosphorus and the remaining phosphorus content of the whole rats were chemically estimated. The results of the determination of the radioactivity proved that almost the whole of the active phosphorus injected could be recovered. The figures for the radioactivity of the several phosphorus fractions, however, showed a large variation, so that a significant difference between the normal and rachitic rats could not be established.

We found, however, two facts of importance, which will be discussed in this letter; namely, the low radioactivity of the blood and the rapid formation of lipin phosphorus from the inorganic phosphorus of sodium phosphate.

In the first place, the blood figures confirmed our previous results; it was found that both within half an hour and two hours after the injection, the active phosphorus for the most part had disappeared from the blood. At most, 16 per cent of the injected phosphorus was still present in the whole blood.

A second interesting and unexpected fact was observed concerning the formation of lipin phosphorus. In earlier investigations, Artom[3] and his collaborators had shown that about nine hours after the ingestion of fat and radioactive phosphorus, comparatively large quantities of the active phosphorus were already found in the phospholipins of liver and gut of a rat. Hahn and Hevesy[4] showed that, in one hour after the subcutaneous injection of labelled sodium phosphate, labelled lecithin was already formed in the brain tissue of a fully grown rat. Now we were able to establish that both in normal and rachitic rats, within half an hour after the injection of the active phosphorus, a large amount was present in the phospholipins of the whole animal. Sometimes about 30 per cent of the active phosphorus injected was determined in the lipin phosphorus fraction.

Therefore, it is obvious that the formation of lipin phosphorus from inorganic phosphorus proceeds very rapidly. Whether this process is a real esterification by which the lipins are constantly broken down and rebuilt again under enzymatic action, or the process is only an exchange of organic phosphorus atoms of the lipins for inorganic phosphorus atoms of the sodium phosphate, must be left here undecided. We purpose to examine this question later. Though a detailed account of these and further experiments will be published elsewhere, we direct attention to the accompanying table, which proves the large individual variation in the figures for the blood and for the lipid fraction of the whole animal.

Rat	Interval after injection	Percentage of active phosphorus injected, found in:	
		Whole blood	Lipid fraction whole animal
	h. m.		
normal	0 30	0	27·5
normal	0 30	0	6·5
normal	0 30	15·5	11·2
rachitic	0 30	6·5	3·5
rachitic	0 30	10	14
rachitic	0 30	9·8	11·6
normal	2	0	24·5
normal	2	2·7	0
normal	2	8·3	10·5
rachitic	2	8	3·5
rachitic	2	15·2	5·5
rachitic	2	16·4	16

In our opinion, therefore, it is necessary to use a sufficiently large number of rats in each experiment.

Finally, we wish to express our thanks to Mr. J. C. de Back, Mr. J. Bouman, Mr. W. F. van Schalkwijk and Mr. G. J. van der Maas for their valuable assistance in this experiment.

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[2] *Proc Roy. Acad. Amsterdam*, 40, 547 (1937).
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[4] *Skand. Arch Physiol.*, 77, 148 (1937).

British Fisheries, Phosphate and the Solar Radiation Constant

IN the autumn of 1921 there was a remarkable movement of water in the Atlantic, northwards and into the English Channel. This persisted into the early winter, and water temperature rose, though air and ground temperatures were falling[1]. No explanation has been given for this occurrence, nor has it happened since then to the same extent.

In 1923 the phosphate content of the water of the English Channel was determined, and it was shown that, late in the spring, this constituent became exhausted in the surface water, while the deeper water was much depleted. Lack of phosphate therefore limits the multiplication of the phytoplankton and so of animals also. In winter, when light is deficient, much phosphate is set free again. Such measurements were repeated for several years, and my analyses have been continued by Dr. L. H. N. Cooper. Since 1923, there has been a decrease in the winter phosphate maximum, with minor irregularities. At the start the concentration was 20 per cent above the average and in the 1934–35 winter it was 26 per cent below it.

It has been shown by Russell[2] that the young of summer-spawning fish show a great decrease over this period, and though the young of the spring-spawning fish began to decrease later, their decrease is now even more pronounced.

The shortage of fish can only be made good when our coastal waters again become enriched by phosphate; this depends upon the influx of water enriched by the mixing of deep Atlantic water over the continental shelf.

The explanation of the movement of such large masses of warmed water, moving apparently because they have been warmed more than usual, is one that postulates a great supply of energy. When going through the results of Dr. C. G. Abbot[3] of the Smithsonian Institution, the remarkable maximum in the solar content during the autumn of 1921, as shown by his curves, at once offered what appeared to be a rational explanation. These solar variations are made up of a number of cycles differing in period and intensity, and I am indebted to Dr. Abbot[4] for the information "that the solar radiation has not since 1920 and 1921 been so high for any considerable time as it was in those years. Nor has there been any such great fall in the solar constant as that of 1922". The fluctuation of individual days may show a range of 8 per cent[5], but more usually fluctuations are nearer 2 per cent. Terrestrial effects have been traced with still smaller variations.

The revised value[6] for the solar content of radiation is 1·933 calories (15° C.) per cm.^{2} per minute; this is the value outside the earth's atmosphere. The amount of heat reaching the surface of the ocean depends also on the absorption of the atmosphere, which on a large scale is itself dependent upon the amount of water which has been evaporated. The changes in the solar constant are only small percentages, but even small percentage changes may conceivably produce very large effects since the energy involved is so great.

In conclusion, it may be said that, while the relation between phosphate concentration and the abundance of the plankton each year is well established, the connexion between the abnormal movements of large masses of water and the solar constant of radiation is a reasonable speculation which is capable of being tested further in the future.

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Marine Biological Laboratory,
Plymouth. Dec. 8.

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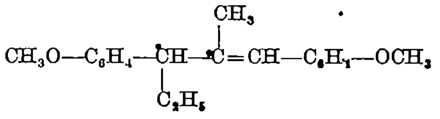
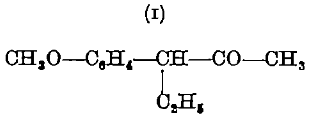
Œstrogenic Activity of Di-Anol, a Dimeride of *p*-Propenyl-Phenol

DI-ANETHOLE or iso-anethole (I) has been described by Kraut and Schlun[1] and later by Orndorff, Terrasse and Morton[2] as an unsaturated liquid dimeride of anethole. Its structure was established by Goodall and Haworth[3], who obtained from it, by oxidation, anisic acid and a ketone, which was identified as (II) by synthesis.



$$CH_3O—C_6H_4—\underset{\displaystyle C_2H_5}{CH}—\overset{\displaystyle CH_3}{C}=CH—C_6H_4—OCH_3$$

(I)



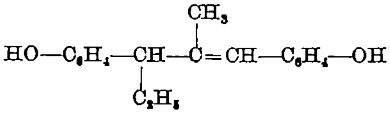
$$CH_3O—C_6H_4—\underset{\displaystyle C_2H_5}{CH}—CO—CH_3$$

(II)

This di-anethole has œstrogenic properties, doses of 100 mgm. producing œstrus in three out of five castrated female rats. Demethylation was effected by heating with 2 parts potassium hydroxide and 4 parts alcohol at 190–200° C. for 16 hours. The product is a dark brown gum which is fully active in doses of 0·1 mgm. This crude product was boiled with acetic anhydride and the crude acetate distilled at 277–280° at 23 mm. and gave on analysis: C, 75·0; H, 6·9 per cent ($C_{22}H_{24}O_4$ requires: C, 75·0; H, 6·9 per cent).

The free phenol was recovered by hydrolysis and distilled at 264–266° at 20 mm. This was a pale yellow gum which darkened in contact with air. (Found: C, 79·6; H, 7·5 per cent; $C_{18}H_{20}O_2$ requires: C, 80·55; H, 7·5 per cent.)

This product, *di-anol*, in 100γ doses produced œstrus in 100 per cent of rats used, while 50γ doses gave a 60 per cent response. The acetate, which is perfectly stable in air, is fully active in doses of 200γ. No crystalline derivative has so far been prepared. The structure of this phenolic gum was shown to be (III) by methylation, and identification of the product as di-anethole (I). The dimethyl ether was oxidized by the method of Goodall and Haworth, yielding anisic acid and the ketone II.



$$HO—C_6H_4—\underset{\displaystyle C_2H_5}{CH}—\overset{\displaystyle CH_3}{C}=CH—C_6H_4—OH$$

(III)

An investigation is being made into the possible occurrence of this substance among the phenolic by-products produced from the preparation of anol (*p*-propenyl phenol)[4,5] by demethylating anethole with alcoholic potassium hydroxide at 200°.

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---

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[2] Orndorff, Terrasse and Morton, *J. Amer. Chem. Soc.*, **19**, 859 (1897).

[3] Goodall and Haworth, *J. Chem Soc.*, 2482 (1930).

[4] Dodds and Lawson, NATURE, **139**, 627 (1937).

[5] Dodds and Lawson, NATURE, **139**, 1068 (1937).

Adrenal Cortex Differences in Male and Female Mice

THE sex difference in the adrenal cortex of mice, first described by Masui and Tamura[1] and later studied histologically and experimentally by Howard-Miller[2] and by Deanesly[3], has since been the subject of a number of publications[4,5,6]. Various far-reaching theories have been put forward, in spite of the fact that no other species so far studied shows the same histological distinction between male and female adrenals.

The essential difference, which can be first traced at the age of about five weeks, consists in the much greater development of the inner cortical zone in the young female mouse. Howard-Miller[2] introduced the term 'X-zone' for this region of small, darkly staining, lipoid-free cells, to distinguish it from the zona reticularis common to males and older females, which is smaller in area and less sharply delimited from the rest of the cortex (Deanesly[3], Fig. 2–5). It was found that the X-zone degenerated rapidly in the middle of the first pregnancy and more gradually with age in the non-parous female. Its growth and degeneration are unaffected by ovariectomy. Castration, however, causes a well-developed X-zone to arise, concurrently with the enlargement of the adrenal, but this, like the X-zone of the female, gradually degenerates in older castrated animals.[7] Cramer[4], for reasons not found convincing by other workers[8], describes this transient zone as part of the medulla and not as part of the cortex.

It has now been shown[9,10] that the castration change in mouse adrenals can be readily inhibited or abolished by injections of androgenic extracts of urine or various synthetic male hormones, even of *trans*-androstenediol in amounts inadequate to cause growth of the seminal vesicles. These results support the view that the difference in the adrenals of the two sexes is entirely controlled by the secretions of the gonads.

On the other hand, a recent study of pituitary-deficient dwarf mice from a well-known genetic strain tends to throw doubt on this theory. The dwarfs, described by Smith and MacDowell[11] and Kemp and Marx[12], are homozygous for the recessive dwarfing factor and cease to grow at about 7·5 gm.; their adrenals, though small, are normal in appearance. Examination showed, however, that they are of the male type in both sexes, that is, the X-zone fails to develop in the female at any age, and the zona reticularis is restricted to a narrow band round the medulla. In view of this finding, the effects of castration on the dwarf mice were also investigated. Four male dwarfs aged 2–5 months were castrated and killed 15, 25, 30 and 42 days after castration. Slight enlargement of the adrenals were found, but no X-zone arose, although in the normal mouse this is well developed at four weeks after castration.

The absence of the X-zone suggests strongly that it is dependent on some secretion of the pituitary in which the dwarf mice are deficient, but the condition of their reproductive organs makes it unlikely that the gonadotrophic hormone is involved. As Smith and MacDowell[11] have pointed out, the gonads and accessory organs are by no means infantile in the dwarf mice, particularly in the males; spermatozoa may be formed in the testes, and the seminal vesicles undergo appreciable development. After castration, the latter show typical shrinkage.

The X-zone, as suggested in earlier work[3], seems to be essentially connected with adrenal growth, since it develops when the whole cortex is growing actively, as, for example, in normal prepubertal females, or in males after castration, especially after prepubertal castration. It is a transitory hyperdevelopment of the inner cortex comparable to the zone which degenerates in the human adrenal after birth[2,3]. The fact that it regresses under the direct or indirect influence of male hormones provides no evidence in support of the theory advanced by Grollman[5] and Howard[6] that the X-zone is particularly associated with the known androgenic activity of the adrenal[13,14].

I am indebted to Dr. H. Grüneberg, Department of Genetics, University College, London, for a supply of the dwarf mice.

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[1] Masui and Tamura, *J. Coll. Agric. Tokyo*, **7**, 353 (1926)

[2] Howard-Miller, *Amer. J. Anat.*, **40**, 251 (1927).

[3] Deanesly, *Proc. Roy. Soc.*, B, **103**, 523 (1928).

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[11] Smith and MacDowell, *Anat. Rec.*, **46**, 249 (1930).

[12] Kemp and Marx, *Acta path. microbiol. scand.*, **13**, 1 (1936).

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Electric Impedance of Marine Egg Membranes

ALTERNATING current impedance measurements were made during the past summer on unfertilized and fertilized *Arbacia punctulata* eggs to determine whether or not an interpretation which has been given[1,2] for the low-frequency increase of capacity on fertilization is correct. The earlier data on *Hipponoe*[3] (*Tripneustes*) *esculentus* and *Arbacia*[1] egg suspensions showed the presence of two capacity elements, and it was suggested that the plasma membrane capacities of about 0·8 μf./cm.^{2} remained unchanged on fertilization and that the fertilization membranes appeared with capacities of about 2 and 3 μf./cm.^{2} respectively. The capacity element of the fertilized egg suspensions which was attributed to the plasma membrane has been much less pronounced in the recent measurements on both suspensions[4] and single eggs[5], and it has also been found, for both unfertilized and fertilized eggs, that the relatively non-conducting membrane lies either at or very close to the plasma membrane. Thus the increase in capacity on fertilization is probably due entirely to a change in the plasma membrane. It is possible that the second capacity element shown by the older measurements was due to unfertilized eggs in the fertilized suspensions.

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[1] Cole, K. S., and Cole, R. H., *J. Gen. Physiol.*, **19**, 625 (1936).

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Delayed Mitosis and Chromatid Fusion

INVESTIGATIONS have been made with the seeds of several plants on the production of chromosome mutations through ageing[1,2]. With such material it is difficult, if not impossible, to separate the primary changes from any secondary ones which may follow them. It is, in fact, these primary changes which are of extreme importance for any theory of structural change.

The pollen of many plants is viable over long periods and the time of the pollen-tube (second post-meiotic) mitosis can be controlled directly by the time of germination. I have made an investigation of the changes induced by ageing on the pollen of *Pæonia Veitchii* ($n=5$) and *Kniphofia rufa* ($n=6$). The mature pollen was collected and stored at laboratory temperatures in a desiccator over anhydrous calcium chloride and germinated after varying intervals on Knop-sucrose solution to obtain the pollen-tube division. There was little, if any, decrease in the percentage germination over the period of the experiment.

I find evidence of a new kind of structural change in old pollen. Numerous chromatid bridges occur in cells without fragments. Fig. 1 illustrates the type of the changes. I observed only two instances of fragmentation in cells without bridges. There is a lag phase of two to three weeks before the changes begin to occur with appreciable frequency. A curve of bridge formation with time is given in Fig. 2 for *Kniphofia rufa*. The frequency distribution of the bridges, 0, 1, 2 or 3, in the individual nuclei of any one set of observations is very close to the binomial expected on random formation. There is thus no interference within the nucleus between bridge production in the separate chromosomes or chromosome arms. No interlocked types or other configurations which could only have been derived from two chromosomes, as Husted[3] noticed after X-ray breakage, have been found. We can only suppose that the bridges originate by union of the homologous ends of the two sister chromatids derived by division from one parent chromosome. The same conclusion was reached by Upcott[4] from observations of similar bridges in the first post-meiotic mitosis in the immature pollen grain.

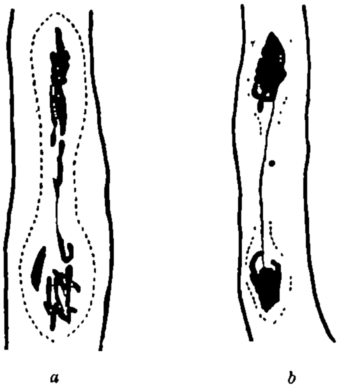

Fig. 1.

a: BRIDGE IN SHORT ARM OF CHROMOSOME IN 7 WEEKS OLD POLLEN OF *Kniphofia rufa*. THE BODY TO THE LEFT OF THE LOWER ANAPHASE GROUP IS A PERSISTENT NUCLEOLUS. ×1200. *b*: SINGLE BRIDGE IN 3 WEEKS OLD POLLEN OF *Pæonia Veitchii*. ×1200.

These findings reopen the questions which have been much discussed in the mechanics of structural change, as to the possibility of the union of chromosome ends and of the existence of a definite 'end-body' to the chromosome preventing such union[5]. They suggest that the changes produced by age may obey different rules from those produced by X-ray treatment. Any general theory of structural change must take into account these differences.

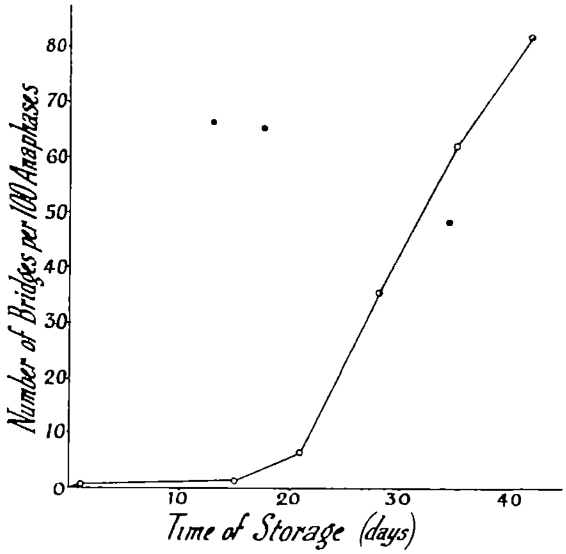

Fig. 2.

GRAPH SHOWING RELATION BETWEEN BRIDGE FORMATION AND TIME IN *Kniphofia rufa*.

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[1] Nawashin, M., and Gerassimowa, H., *Cytologia*, 7, 324 (1936).
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[3] Husted, L., *Genetics*, 21, 537 (1936).
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Osmosis in Physics and Biology

A MIXTURE was prepared containing lecithin and cholesterin (and beeswax) in a solution of ether; this mixture was imbibed (by vacuum) in the pores of a clay cylinder. This was dried and then filled with a molal solution of cane sugar and put in the same liquid; the solution was heated inside by an electric current and cooled outside by a water supply.

Water came out from the heated region against a pressure of 70 mm. mercury. This seems to offer an explanation of the mobilization of a liquid by living cells against the concentration gradient, and shows a possibility of using heat as a direct source of energy.

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Does Iron occur in the Solar Corona?

STRATTON[1] was able to recognize two 'forbidden' N II-lines in the beautiful photographs of the corona spectrum obtained by Sekiguti[1] at the total solar eclipse of June 19, 1936, and so to prove the occurrence of nitrogen in the solar corona. Moreover, Sekiguti noticed that two of the corona lines, λ 4815·9 and λ 5738·0, on his photographs came very close to the nebular lines λ 4814·78 and λ 5737 in the spectrum of η-Carinæ. One of these two lines (λ 4814·78) is amongst those which Merrill[2] recognized as 'forbidden' Fe II-lines. Should this identification be the correct one, this would mean that in addition to nitrogen another element, namely, iron, exists in the solar corona. In view of the interest generally taken in the chemical composition of the solar corona, we wish to discuss in some detail the possibility of such an identification.

It is strongly supported by the circumstance that λ 4814·78 is the strongest line of the multiplet to which it belongs. This is shown by the empirical evidence from the spectrum of η-Carinæ[2], which is supported by the following consideration: λ 4814·78 is due to the transition $3d^6\ (^3F)\ 4s\ ^4F_{4\frac{1}{2}} \rightarrow 3d^7\ ^4F_{4\frac{1}{2}}$, and is to be considered as an electric-quadrupole line. In the case of pure Russell-Saunders coupling, magnetic-dipole transitions occur exclusively between the fine structure components (levels) of an energy-term. Only if we take spin-orbit interaction into account (that is, at the same approximation at which intercombination lines appear) are magnetic-dipole transitions between the terms of the same electron configuration possible. As we are dealing in this case with a transition between two different electron configurations, it is only configuration interaction which can cause magnetic-dipole radiation. This, however, will be presumably negligibly small in comparison with electric-quadrupole radiation obtained already in zero order approximation. We can thus make use of the intensity formulæ for electric-quadrupole radiation in the case of pure Russell-Saunders coupling, which confirms the correctness of our statement that λ 4814·78 is the strongest line of the whole multiplet[3]. The intensity of the other lines of this multiplet is always less than about 40 per cent of the intensity of the line considered. As this is one of the faintest in the corona spectrum, the remaining lines of this multiplet can obviously not be visible on Sekiguti's photographs.

A very serious objection, however, against considering λ 4815·9 as a Fe II-line is the impossibility of tracing any other iron line in the corona spectrum, particularly those, the initial term of which is the same as that of λ 4814·78; for example, the intercombination line λ 4416·28, which is in the η-Carinæ spectrum nearly twice (9 : 4) as strong as λ 4814·78. Thus it is not quite justifiable to identify the corona line λ 4815·9 with λ 4814·78 in the spectrum of η-Carinæ unless additional evidence is obtained.

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[1] NATURE, 140, 724 (1937).

[2] *Astrophys. J.*, 67, 391 (1928).

[3] Bowen, I. S., *Rev. Mod. Phys*, 8, 35 (1936).

PROF. RUBINOWICZ has somewhat overstated my point of view in suggesting that a provisional identification of two forbidden lines of N II in the coronal spectrum proved the occurrence of nitrogen in the corona. He carefully safeguards himself from any claim that a suggested identification of one forbidden line of Fe II proves the presence of iron. But the case for iron is actually stronger than he has stated. The missing line, λ 4416·28, to which he refers, is a forbidden transition between two levels in the same electronic configuration; and a search by Dr. Dobbie and myself of the more likely transitions of this class, which might give lines in the region of spectrum available for study, has indeed failed to show any coronal lines. On the other hand, Prof. Tanaka's list of coronal lines[1] does show coincidences with two forbidden Fe II lines, λ 4244·0, $a\ ^4F_{4\frac{1}{2}} - a\ ^4G_{5\frac{1}{2}}$, and λ 5072·4, $a\ ^4F_{4\frac{1}{2}} - a\ ^4H_{4\frac{1}{2}}$, these lines, like Prof. Sekiguti's line λ 4814·5, $a\,^4F_{4\frac{1}{2}} - b\,^4F_{4\frac{1}{2}}$, all represent transitions from levels in the d^6s configuration to the lowest level of the d^7 configuration. The suggestion is that the conditions at this eclipse were favourable for the emission of forbidden lines of Fe II caused by transitions between two different electronic configurations; in such cases the transition probabilities for electric quadrupole radiation would be much higher than for magnetic dipole radiation.

The reality of faint lines observed but once in a coronal spectrum must remain uncertain. The stronger coronal lines, however, vary so much from eclipse to eclipse and from point to point in the corona that the very weak lines may well be irregularly present or absent. This provisional identification of forbidden lines does not touch the main corona spectrum but may serve as a pointer towards its ultimate identification.

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[1] *Proc. Phys Math. Soc.* Japan, (iii), 19, 93 (1937)

Adsorption of Constituents of a Solid Phase on the Surface

IT is a well-known fact that the concentration of alloying elements in the scale formed on heating an alloy in air differs in most cases considerably from the average composition of the material. The product of high-temperature oxidation of brass, for example, consists of zinc oxide only. At lower temperatures cuprous oxide is the prevailing constituent[1]. Iitaka and Miyake found nothing but BeO on the surface of copper-beryllium alloys containing so little as 1 per cent of beryllium. Copper-aluminium alloys with several per cent aluminium content, heated with a Bunsen burner, gave Al_2O_3 in places which had been embedded in the flame, while CuO was found on those parts of the surface which had been in contact with air[2].

Attempts at explaining these rather complicated phenomena were based chiefly on chemical arguments. The absence of copper oxide on brass, for example, was attributed to the reduction of cuprous oxide by zinc. Although the importance of secondary chemical reactions in some special cases can scarcely be contested, the accumulation of a constituent of an alloy on the surface can be explained in a quite general manner on a purely physical basis.

It was anticipated by J. W. Gibbs and J. J. Thomson and proved experimentally, that the tendency to reduce the free surface energy of a solution to a minimum results in concentration of the constituent with the smallest surface tension on the surface[3]. Although there were *liquid* solutions which were concerned in these investigations, there is nothing in the argument which would prevent applying the conclusion to the state of equilibrium of a *solid* phase. If, following Desch[4], we assume as a tentative hypothesis that the values of the surface tension of solid metals are roughly proportional to those for the liquid state in the neighbourhood of the freezing point, we can arrange metals according to their surface tension in a following series :

Sb, Bi, Pb, Hg, Sn, Cd, Zn, Ag, Au, Cu ;

the surface tension of antimony being the smallest, that of copper the greatest. As to the surface tension of other metals, no data are available. In any alloy the constituent preceding the others in this series should tend to accumulate on the surface. As the surface tension of metals is higher than that of any compound or non-metallic element, non-metallic constituents should also show a tendency to displace the metal from the surface. At ordinary temperatures the rate of diffusion is so small that it would take a very long time to reach the state of equilibrium ; it is only when the diffusion is accelerated by high temperature or loosening the crystal texture by alternating stresses or polishing, that the effect is brought into prominence. The conclusion was confirmed by the following experiments :

A copper specimen containing 0·01 per cent of sulphur, etched in nitric acid, which had given the normal copper pattern on electron diffraction examination, was kept *in vacuo* for 4 hours at 800° C. After this treatment the covelline copper sulphide pattern has been obtained without any trace of copper rings. It shows that all the metallic copper has been displaced from the surface down to the depth of several tenths of an angstrom at least.

An etched bar from the same material was clamped in a lathe and rotated rapidly, while the free end was loaded. It was cooled all the time to prevent oxidation. On examination of a specimen cut from the part next to the chuck, it is found that copper sulphide has been formed on the surface.

A specimen burnished under benzene with an agate burnisher gave also the copper sulphide pattern. When using copper with 0·005 per cent sulphur content, copper sulphide rings were still clearly visible. Pure re-melted copper treated in a similar way yielded the usual diffuse pattern of polished copper.

A 98 per cent copper 2 per cent beryllium alloy burnished under benzene gave diffuse haloes, the spacings of which, 1·86 A. and 1·11 A., correspond, according to Prins's formula, to the size of beryllium atoms[5]. It points to the existence of a pure beryllium layer on the surface.

A 71/29 brass burnished under benzene and dipped afterwards in ammonium sulphide solution gave the wurzite zinc sulphide pattern. Apparently there is a thin layer of pure zinc on a polished brass surface.

These results throw fresh light on the problems of corrosion resistance of alloys, especially at high temperatures. Adsorption on the surface explains the protective action exercised by some constituents even if present in quite small quantities. An improvement which polishing produces in the corrosion-resisting properties of some stainless steels with low nickel content may be also interpreted from this point of view. The problem of bearing alloys is another field where this phenomenon may be expected to take an important role.

A more detailed account will be published in *Bull. Int. de l'Acad. Polonaise de Sci. et Lettres.*

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Cracow. Nov. 17.

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[1] Dunn, J. S., *J. Inst. Met.*, **46**, 25 (1931). Preston and Bircumshaw, *Phil. Mag.*, **20**, 706 (1935). Krupkowski and Jaszczurowski, *Rev. Met.*, **33**, 652 (1936) and others.

[2] Iitaka, I., and Miyake, S., NATURE, **136**, 437 (1935) and **137**, 457 (1936).

[3] See, for example, Adam, N. K., "The Physics and Chemistry of Surfaces" (chapter iv).

[4] Desch, C. H., "The Chemistry of Solids", p. 53.

[5] Dobinski, S., *Phil. Mag.*, **23**, 397 (1937).

Viscosity of Air

RECENT determinations of the viscosity of air by Bond[1] (capillary tube method) and Kellstrom[2] (rotating cylinder) have yielded a value

$$\eta_{23^\circ \text{ C.}} = (1834{\cdot}8 \times 10^{-7}) \text{ C.G.S.}$$

Substituted in Millikan's data on the determination of e, this value gives

$$e = 4{\cdot}817 \times 10^{-10} \text{ E.S.U.},$$

which is considerably higher than values of e obtained by other methods.

In conjunction with Dr. Bond, I commenced a fresh determination with several improvements in the apparatus. As a result of a large number of experiments on three different sets of tubes, I find

$$\eta_{17^\circ \text{ C}} = (1800{\cdot}8 \pm 0{\cdot}7) \times 10^{-7} \text{ C.G.S.}$$

My experimental value of the temperature coefficient is $4{\cdot}93 \times 10^{-7}$ per ° C., agreeing with the value found by Millikan[3]. Thus I obtain

$$\eta_{23^\circ \text{ C.}} = (1830{\cdot}3 \pm 0{\cdot}7) \times 10^{-7} \text{ C.G.S.}$$

If this value is substituted in Millikan's oil drop data, the result is

$$e = (4{\cdot}800 \pm 0{\cdot}004) \times 10^{-10} \text{ E.S.U.},$$

which is in very good agreement with the value of e deduced by von Friesen[4] from recent values by X-ray and electron diffraction methods.

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Dec. 6.

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[2] Kellstrom, G., *Phil. Mag.*, **23**, 313 (1937).

[3] Millikan, R. A., *Ann. Phys*, **41**, 759 (1913).

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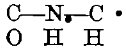
Pyrrolidone: a Chemical Group of Particular Significance to Differentiation

THE inquiry into whether or not the naturally occurring tissue components of general distribution play a part in developmental growth has brought out that each amino-acid and nucleic acid derivative has its own separate and peculiar effect upon the growth of *Obelia geniculata*[1].

Although the individuality is indubitable, certain compounds produce a like effect on differentiation expression when they are present singly in the culture solutions. Nicely enough, it is possible to trace a chemical relationship between these differentiation-forwarding substances other than the simple fact that they are composed of carbon, nitrogen, hydrogen and oxygen.

The differentiation-enhancing compounds are first, *d*-glutamic acid and its homologue *l*-aspartic, *l*-proline and *l*-hydroxyproline. The members of this group are interconvertible through pyrrolidone carboxylic acid, a common intermediary[2,3]. Then there is tyrosine, from which melanin is formed by tyrosinase through compounds identified as carrying the benzopyrrole ring[4]. Finally, differentiation is advanced by cytosine and thymine, two nucleic acid derivatives which carry the carbonyl-imid-methine sequence in heterocyclic configuration similar to pyrrolidone[5].



$$\underset{O}{C}-\underset{H}{N}-\underset{H}{C}$$

It is clear that the group of differentiation-forwarding compounds is united by the common possession of a potentiality for yielding a single and unique type of chemical configuration. The association is too close-knit to be fortuitous.

The assumption is therefore justified that in the pyrrolidone configuration or some part or derivative thereof is to be found that chemical constellation which is a specific determinant and participant in some phase of that chemical specialization which is differentiation, and through which cells are brought to their characterizing functionable and structural maturity.

The possible significance of this to neoplasia is clear—for through the application of the principle it is possible that cancer cells may be brought to maturity—if they can be so brought—and thus the lethal aspects of this growth be diverted. Work in this direction will be carried out.

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[2] Mitchell and Hamilton, "The Biochemistry of the Amino acids" (Chem. Catalog Co., New York, 1929).

[3] Weil-Malherbe and Krebs, *Biochem. J.*, **29**, 2077 (1935).

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[5] Levene and Bass, "Nucleic Acids" (Chem. Catalog Co., New York, 1931)

Points from Foregoing Letters

DR. P. KAPITZA describes new experiments from which he deduces that the viscosity of helium II (below the λ-point) is at least 1,500 times more than that of helium I at normal pressure, which may account for the abnormally high heat conductivity of helium II. He suggests that helium, below the λ-point, enters a special state that may be called super fluid. Further experiments are reported by J. F. Allen and A. D. Misener indicating that the flow of helium II at 1° K. does not follow the ordinary equation for laminar or turbulent motion. The authors consider that the type of motion observed might arise from slipping of helium II over the surface of the tube, in which case the flow method would not be likely to give a value of the viscosity which had much meaning, and that undamped turbulent motion cannot account for an appreciable part of the high thermal conductivity observed.

The potential difference between the end of a tin wire at the transition temperature (of supraconductivity) according to Dr. F. B. Silsbee, Dr. F. G. Brickwedde and R. B. Scott, contains a component of double the frequency of the alternating current (200 kc./sec.), when the last-mentioned is superposed upon a direct current, so that the resulting magnetic field at the surface of the wire is caused to pulsate cyclically.

Prof. A. Sołtan and Prof. L. Wertenstein have found that the ratio of formation of the two radio-isotopes of bromine with half-lives 18 min. and 250 min. which, according to recent views, are considered as representing two isomeric forms of the nucleus ^{80}Br, is distinctly different when the radioactivity is excited with fast (up to 14×10^6 ev.) and slow (thermal and resonance) neutrons. This ratio is equal in the first case to 0·56 and in the second case to 2.

By injecting 'labelled' sodium phosphate into the tail vein of six normal and six rachitic rats, Dr. M. J. L. Dols and Prof. B. C. P. Jansen, in collaboration with Prof. G. J. Sizoo and F. Barendregt found that within half an hour a considerable amount of the inorganic phosphorus injected had been transformed into organic phosphorus of lipins. The blood figures confirmed their previous results; within half an hour after the injection, the active phosphorus had, for the most part, disappeared from the blood. Significant differences between normal and rachitic rats could not be established.

From changes observed since 1923, Dr. W. R. G. Atkins points out that the relation between phosphate concentration and the abundance of plankton in the water of the English Channel is well established. He suggests that there is also a connexion between the abnormal movement of large masses of water from the Atlantic Ocean to the Channel and the change in the amount of radiation from the sun.

Miss Ruth Deanesly reports that castration of young male dwarf mice does not enlarge the '*X*-zone' of the adrenal, a region of small, darkly stained, lipoid-free cells, found in the adrenal cortex of normal female mice, and also developing in normal castrated mice, unless counteracted by injections of male sex hormone. The new experiments indicate that the development of the '*X*-zone' is not controlled solely by secretion of the gonads but may be dependent upon some secretion of the pituitary in which the dwarf males are deficient.

H. N. Barber reports that chromatid bridges are induced by ageing in the second postmeiotic mitosis of pollen of *Pæonia* and *Kniphofia* species. They are probably formed by union of the homologous ends of the sister chromatids derived by division from one parent chromosome.

Prof. A. Rubinowicz notices that Prof. Sekiguti's identification of the coronal line λ 4815·9 with the nebular line λ 4814·78 in the spectrum of η-Carinæ would indicate the occurrence of iron in the solar corona. Although this identification appears to be partially justifiable, certainly further evidence for its support is needed. Prof. F. J. M. Stratton also discusses this identification.

Dr. S. Dobinski finds that the concentration of alloying elements in the neighbourhood of the surface is governed by the surface tension of the constituents and differs in most cases considerably from the average composition of the material. Electron diffraction experiments on some copper alloys confirm this view.

Research Items

Effect of the Medium on Radium-sensitivity of Cells

IN a communication addressed to the Editor, Dr. G. Harker, of the Cancer Research Committee, University of Sydney, describes the extension of his observations (NATURE, 137, 190; 1936) on the inhibiting effect of radiation from radium plaques on the inversion of sucrose by living yeast cells, an effect now found also with X-radiation. If during irradiation with radium the cells are kept in suspension by gentle stirring, the inversion of sucrose is less than in the unstirred cells, although, owing to settling, the latter are much closer to the radium. The magnitude, and even the direction, of this effect are dependent on the neutral salt content of the medium. Since Loofbourow *et al.* (NATURE, 139, 589; 1937) have shown that stimulating substances may be liberated from irradiated cells, Dr. Harker removed the aqueous suspension fluid by centrifuging the suspension of cells after 18 hours irradiation by 30 mgm. of radium, and re-suspended the cells in fresh sucrose. It was found that the passage of substances from the cells into the liquid increased inversion in both this and the non-irradiated control specimen, but the increase was greater in the irradiated one. When the cells were irradiated in 10 per cent sucrose solution with the same quantity of radium, after 5 hours exposure the extent of inversion by the re-suspended yeast was less than that of the control; after 18 hours it was greater. It is concluded that in the early stages stimulating, and in the later stages inhibiting, substances are given off into the solution by irradiated yeast cells, and that the solution in contact with the cells plays an important part in these effects.

Anatomy of the Ox

WHILE a considerable amount of work has been done on the dog and horse, so that the anatomy of these animals is now fairly well known, not nearly so much has been done on cattle. In a recent publication, H. N. Chelva Ayyangar (Imp. Council Agri. Research, Sci. Monograph No. 11, 1937) has provided a detailed account of the course, constitution and distribution of the nerves supplying the levator anguli scapuli and rhomboideus muscles and of the formation of the phrenic nerve in the ox. In the same monograph are included descriptions of forty-seven deviations from the normal course or constitution of various arteries and nerves in the same animal. Thirty-seven of these have already appeared separately, but are here gathered together. The monograph is fully illustrated by seventy-one diagrams or photographs of the actual dissections.

Biology of Rhodesian Diptera

THE attention of students of Diptera is directed to two papers by Mr. Alexander Cuthbertson (*Proc. and Trans. Rhodesia Sci. Assoc.*, 35, August 1937). These articles deal with the biology of various Diptera inhabiting Rhodesia. In the first paper are given short accounts of the larva and pupa of *Solva* (Xylophagidæ) and of species of *Tabanus*, *Rhynchomyia* and *Tricylea*, which are also figured in the text. Three new species of Asilidæ are also described by Dr. E. O. Engel, of Munich, who collaborated with the author. In the second paper there are given biological notes and observations on various Diptera, including accounts of a number of species of Asilidæ and the prey which they had captured.

Sense Organs of Fishes

A CONDENSER-COUPLED five-stage amplifier, a Matthews's oscillograph, a loud-speaker and a delicate perfusion method were employed by A. Sand (*Proc. Roy. Soc.*, B, No. 833, Aug., 1937) to investigate the mechanism of the lateral sense organs of fishes. The types employed were the roach, the rudd, the plaice, the dogfish and three species of rays. The receptors of the lateral line system show a common mode of behaviour with those of the semicircular canals, which is perhaps not surprising when one takes into consideration the origin of the two sets of organs. Excitation is brought about by the movement of the fluid in the canal; that it is a fluid is demonstrated by the ease with which it can be utilized in perfusion. It is a system of great mechanical sensitivity and can appreciate tapping, made with a hammer on the table on which the specimen lies, that is too slight for perception with the hand. There is a spontaneous frequency of discharge from the individual end-organs, and a slow movement of the fluid in the canal produces a response over and above these. Over the greater portion of the range of stimulation the receptor organs obey the logarithmic law. The two directions of flow in the canal have contrary effects, that in one direction being excitatory and in the other inhibitory. The lateral-line sensory system is shown to be remarkably sensitive to low-frequency vibrations.

Polychætes from the Indian Ocean

THE Polychætes collected by the John Murray Expedition 1933–34 have yielded a high proportion of new forms. Mr. C. C. A. Monro, to whose care was allotted the task of describing the collection, has found it necessary to create one new genus, thirteen new species and four new varieties (John Murray Expedition 1933–34, Scientific Reports, 4, No. 8, Polychæta, 1937). Several of these came from deep water, whence, indeed, much of the collection came. Of the new species may be mentioned a *Nereis* with remarkably long pedal languets and a *Eunice* with extremely long and highly pectinate gills. Some of the species taken were previously known from localities in parts of the world far removed from the Indian Ocean. Thus from 1519 metres and below in the Arabian Sea comes a specimen of the Magellan *Goniada eximia* Ehlers, and from the Gulf of Aden at 91 metres an example of *Chætozone setosa* Malmgren, the single specimen being inseparable from one of the same species taken at Spitsbergen. This *Chætozone* had not previously been recorded from tropical seas. These and some other similar records again emphasize the cosmopolitan distribution of many Polychætes, and form one of the most valuable features of this excellent report.

Ecology of Soil Fungi

FACTORS which govern the numbers of soil fungi are of vital importance for the maintenance of continued fertility. Investigations into the effects of manurial treatment, season and crop upon the quantity and quality of soil micro-organisms have not been numerous, but Dr. Jagjiwan Singh has recently published the results of such a research problem (*Ann. App. Biol.*, 24, 1, 154–168, Feb. 1937). A direct correlation between soil fertility as measured by crop growth, and the number of fungi and Actinomycetes, has been established for two fields at the Rothamsted Experimental Station. Barn field, with permanent mangolds, and Broadbalk, with permanent wheat, are the two fields concerned. No dominant effect of the crop upon the soil micro-flora has been observed, nor can any effect of seasonal periodicity be claimed. Manurial treatments do not appear to induce specific fungal floras, though there was some evidence that *Penicillium* and *Dematium* species were more widely distributed in the Barn field, whilst *Fusarium* was most common in the permanent wheat land.

Long-range Weather Forecasting

SIR GILBERT WALKER has recently published an account of the methods adopted by the German Institute for Long-Range Weather Forecasting, under the directorship of F. Bauer, for its regular ten-day forecasts (*Quart. J. Roy. Meteorol. Soc.*, Oct. 1937). Statistical relationships connecting German weather with five-day means of pressure and temperature at distant centres of action are employed, also the method of studying the sequences of weather that followed the synoptic situations most resembling that of the forecast day; but apart from the thoroughness with which these parts of the work are done, there is nothing essentially novel about them. New ideas are, however, introduced in the conception of what may be translated as the 'broad-weather' situation—a condition of the atmosphere persisting for several days during which it controls the weather, being itself governed by conditions both in the troposphere and lower stratosphere. It has been found that the movements of regions of rising and falling surface pressure determined for a 24-hour interval, and defined by 24-hour isallobars, are usually almost completely in accordance with the gradient wind at a height of 5 km. and not with winds near the ground. At times, however, the 'steering' of the 24-hour isallobaric regions is by winds in the stratosphere, and that of the 3-hour isallobars by the winds of the lower troposphere. It has been found that the mean duration of a 'broad-weather' situation is 5½ days, and that their life-histories are closely connected with the formation and decay of 'highs' and 'lows' in the stratosphere. Since isallobaric systems most often move from some westerly point, this method would be less effective in British forecasting, where identification of the systems is hampered by paucity of observations to westward.

Rare Gases from the Hot Springs of Bath

OLDER examinations of the gases from Bath Springs had shown that these contained helium, argon and neon. The helium could be attributed to radioactive change and the argon might be derived from the atmosphere, but the reported presence of a large proportion of neon was unexplained, since this gas is less soluble than argon in water. M. W. Travers (*J. Chem. Soc.*, 1561 ; 1937) has analysed the gases from the King's Well and the Cross Spring and finds that the rare-gas fraction in each case consists of argon with about 12 per cent of helium and only 0·1 per cent of neon. The helium is certainly the product of radioactive change ; the argon and neon are probably of atmospheric origin, the neon content being about half that in the atmosphere on account of its lower solubility. The gases from the springs were found to be free from oxygen but contained carbon dioxide ; they contained about 13 c.c. of rare gas per litre. The rare gases were separated by means of fractionation by cooling.

Gypsum and Anhydrite

THE important transition temperature of gypsum and anhydrite : $CaSO_4, 2H_2O \rightleftharpoons CaSO_4 + 2H_2O$, was given as 63·5° by van't Hoff and his co-workers and has been generally accepted. Very different temperatures have been reported by later experimenters. A. E. Hill (*J. Amer. Chem. Soc.*, 59, 2242 ; 1937) has made a careful revision of this matter, particular attention being given to the attainment of equilibrium. It was known that anhydrite solutions could remain unsaturated or supersaturated for months, and hence an attempt was made to reach equilibrium from both directions, at 65°, 45° and 35°. From the solubility curves and previous data, it was found that a solubility curve could be drawn between the temperatures of 20° and 100° which was found to cut the well-authenticated curve for gypsum at 42°, which is the transition temperature. It will be seen that the new figure is about 20° lower than van't Hoff's figure of 63·5–66°. The usual difficulty of reaching equilibrium from the side of supersaturation was encountered.

Glide in Crystals

PROF. ANDRADE and his school are carrying out extensive work on the glide phenomena in strained single crystals. E. N. da C. Andrade and L. C. Tsien (*Proc. Roy. Soc.*, A, 163, 1 ; 1937) have investigated slip in single crystals of sodium and potassium which belong to the body centred cubic system. Work on other metals which crystallize in this system shows that glide usually takes place in the [111] direction, but that the glide plane is not, as it generally is in other structures, the most closely packed plane. The sodium and potassium crystals were formed by cooling a tube of the molten metal progressively from one end, and were stretched under paraffin oil. The slip markings on the surface of the crystal were correlated with X-ray Laue diagrams of the crystal structure. The direction of glide was always very close to a [111] direction. The glide plane was (123) in these experiments, in which the angle between the axis of the wire and the 123 plane lay between 30° and 50°. Single crystals of molybdenum were prepared by a method in which a region of high temperature gradient was made to travel along a wire which was maintained at a high temperature (Andrade, *Proc. Roy. Soc.*, A, 163, 16 ; 1937). The structure is body centred cubic, and experiments on the glide phenomena (L. C. Tsien and Y. S. Chow, *Proc. Roy. Soc.*, A, 163, 19 ; 1937) show that the glide direction is [111]. The glide plane is different at different temperatures, being very near a (110) plane at 100° C., and a (112) plane at 300° and 20°. It appears that the gliding is not connected with the closeness of packing of the planes.

Limitations of High-Voltage Insulation

DR. WHITEHEAD, of Johns Hopkins University, communicates an interesting paper to the *Journal of the Franklin Institute* of September on the limitations of high voltage. Fifty years ago, it was thought that electrical transmission distances in America would never go much beyond 150 miles and that the economical voltage would not rise much above 110 kilovolts. The grounds for this opinion seem to have been that the distances between available sources of power, whether hydraulic or steam, were never greater than about 300 miles. At the present time, there are not many transmission systems for distances greater than 150 miles, but there are several working at 220 kilovolts. A conspicuous example is the Boulder Dam—Los Angeles transmission line over a distance of 300 miles at 287 kilovolts.

Calculation has shown the economic advantage of power development and transmission to greater distance at a higher voltage. Dr. Whitehead discusses the limitations placed on a further increase of transmission voltage by the insulating properties of the materials which are at present available. Those most commonly used are the atmospheric air, ceramic materials such as glass and porcelain, petroleum oils and various composite fibrous materials such as impregnated paper. The important electrical properties of the materials used for the insulation of high-voltage circuits are conductivity and electric strength. The conductivity measures the ability of the material to withstand slow leakage, and the electric strength measures its ability to withstand breakdown or actual failure and short circuit. All materials, including liquids and gases, have some electrical conductivity, but they vary over a very wide range, the conductivity of copper being 10^{20} times greater than that of a good mineral oil. Those with high insulating properties may vary a million times between themselves, but they are all classified as available for high-voltage insulation.

All the materials used for insulating high voltage must have high electric strength. Usually the overhead high-voltage transmission line depends on the atmospheric air for its insulation. The conductivity of the air is so small initially that it can be neglected. As there are always a few ions present, they move backwards and forwards under the forces exerted by alternating high voltage, and when they move fast enough they have collisions with neutral ions, thus creating new ions and increasing the conductivity of the air between the lines. This causes the well-known corona or brush discharge surrounding the conductors. The discharge increases the conductivity and energy loss in the air and is thus a limitation to its insulating properties. Up to the present, it has been found possible—notwithstanding the great increases in voltage values—by separating the conductors sufficiently and increasing their diameter, to prevent coronas from forming. In the Boulder Dam line the main conductors are hollow and 1·4 inch in diameter; they work at 285 kv. To get a corona the voltage would have to be increased to 450 kv.

It appears that the saving effected in conducting material at higher transmission voltages is partly offset by the increased cost of the insulation. The higher the voltage the greater the cost of the insulation and the construction of the line, as the minimum total cost must always determine the most economical value of voltage. We have reached a stage in raising voltage values where the physical dimensions of the line are so great as to be practically prohibitive. To meet these limitations, special forms of construction of the conductor system and special auxiliaries to the insulation system have become necessary, and these impose further limitations to increasing the voltage.

For these reasons, engineers are studying the use of underground cables for high voltages. There are now several installations at 132 kv. and a few at 220 kv. Some of these systems using 'oil-filled' cables have given satisfaction for more than seven years, and credit is due to the engineers in the experimental laboratories where they were developed.

Building Research*

A SPECIAL feature of the report of the Building Research Board for the year 1936 is the retrospect prepared by the Director, Dr. R. E. Stradling, reviewing the progress made during the eleven years since the Station was established in its present laboratory at Garston, Herts. For four years previously the organization was taking shape, and the value of the experience then gained may be judged from the progress made since 1925. The work of the Station goes ahead continuously and, in knowledge of materials and methods and in experience, considerable progress has been made, but it is seldom possible in any one year to chronicle any definite advance. Over the longer period the work can be seen in better perspective, the import of it becomes more evident and lines of future development are more clearly indicated.

For example, the Library begun primarily for internal service with a stock of two thousand items, has increased fully tenfold in size and has become a focal point for world-wide information regarding all matters appertaining to building. Its functions are not merely to stock all this material, but also to include its study and documentation for the promotion of research and assistance in inquiries. The fact that this work of the Library, its resources, and the kind of service it can provide are insufficiently well known outside, justifies special mention of them in detail, for, as the Director notes, there is no reason why these services should not be equally available for the assistance of outside bodies as are those of the experimental and other facilities of the Station.

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* Department of Scientific and Industrial Research. Report of the Building Research Board, with a Report of the Director of Building Research for the Year 1936. Pp. vi + 210 + 25 plates. (London: H.M. Stationery Office, 1937). 4*s*. net.

A branch of the work which has expanded rapidly during these years is that of dealing with technical inquiries. In the past year the number of inquiries received from architects for advice on the problem of sound transmission in buildings has been commented upon. On this subject investigation shows that the solution is primarily a matter of planning, as structural precautions can mitigate but not eliminate the discomfort of having noisy and quiet rooms adjacent. The report indicates that the most promising method of dealing with the transmission of noise in buildings is the provision of what is described as a 'floating floor'. The special investigations carried out in this branch also include those which are necessary to resolve difficulties or problems met with in practical operations, and the independent testing carried out for manufacturers of proprietary products. Reference is made to several of the most important or interesting of these in the report.

During the period a vast amount of work has been done on, and in connexion with, building materials —stone, brick, concrete, etc.—and the continuance of these activities is indicated. About those, their properties and limitations, much information has been obtained and made available for use. The investigations on bricks and brickmaking clays having been brought to a stage at which they can usefully be applied, attention is now being given to what is referred to as the efficiency of the brickwork structure as regards such matters as strength, permanency of bond, thermal insulation and exclusion of rain. In the cleaning of the exteriors of buildings the use of chemicals is condemned as destructive, and a process is recommended in which fine jets of water are employed for a period dependent on conditions, and this is followed by brushing. It is held that this gives satisfactory results without causing immediate or ulterior damage to the stone or even to carvings on it.

Among the major investigations made during the year were a series of tests to ascertain the resistance of I-beams of high tensile steel and of mild steel to failure by bend yielding of the flanges, by shear yielding of the web and by buckling of the web. Where necessary the surfaces were scraped and painted with a thin coating of plaster of Paris, the flaking of which indicated local yielding; this is clearly seen in the photographs taken during the tests. On behalf of the Ministry of Transport, tests were made during the year on six bridges; some particulars are given of these, but the data obtained have yet to be completely analysed. Three of the bridges were tested to destruction—a stone arch bridge of 21-ft. span built in 1793 collapsed under a load of 77·6 tons, a brick arch bridge of the same span and date failed at 123 tons, while one constructed in 1870 of cast iron beams and plates, with a span of 13 feet, broke under 74·6 tons, in each case the load being applied by hydraulic jacks at the centre of the span.

The record of work and results as set out here fully justify the Board in its statement that in this short period the Station has become a real factor in the building industry.

Eskimo Origins

THE essay on the origins of the most ancient civilization of the Eskimo, for which a prize was awarded by the Danish Government to Mr. Henry B. Collins, jun., in 1936, is now published under the title "Archæology of St. Lawrence Island, Alaska" (Smithsonian Misc. Collect., **96**, 1).

The essay takes as its starting point a descriptive account of the results achieved by the author and others in excavations on ancient sites in St. Lawrence Island, which established the succession *Old Bering-Punuk-modern Eskimo* in Western Eskimo culture. On the basis of this material it has been possible to make a detailed comparison not only of the elements of the two prehistoric and the modern cultures *inter se*, but also of this Western Eskimo culture, both as a whole and in each of its phases, with the other Eskimo groups, ancient and modern, including the Thule culture of Th. Matthiassen, the Caribou Eskimo of Kaj Birket Smith, and the Eastern Eskimo, as well as the neighbouring aboriginal peoples and cultures of America and north-eastern Asia.

In arriving at a series of general conclusions a number of problems come under consideration.

As regards the relation of the Western Eskimo and the Thule cultures, it has been demonstrated by Matthiassen that the Thule culture must have originated in the west along the Alaskan or Siberian coast, north of Bering Straits. This is now seen to be within the range of the Old Bering Sea and Punuk cultures; and on the basis of the St. Lawrence Island finds, it is shown that the Thule culture is more closely allied to Punuk of a late stage and the modern culture than to the Old Bering Sea culture. The Thule culture has also been shown to be close to the modern Point Barrow Eskimo. There is a close relationship between the Old Bering Sea culture and the prehistoric or Birnirk culture of old Point Barrow sites—the Birnirk culture, in fact, was, in part at least, contemporaneous with the old Bering Sea culture, while the modern Point Barrow is the closest to the Thule, possessing a number of important Thule elements, absent in the Birnirk culture.

This prominence of the Thule elements in modern northern Alaska is explained as due to a late return migration within the past few centuries of Thule Eskimo, after the original eastward spread of the Thule culture, which had developed out of the Birnirk, rather than the Old Bering Sea culture. This inference of a late migration westward is supported by the cultural, linguistic and physical uniformity of modern Eastern and Western Eskimo, while the physical characters of the modern Point Barrow Eskimo are quite distinct from the skeletal material from old Point Barrow sites.

The hypothesis that the north coast of Alaska has been subjected to a relatively late wave of migration from the east would serve to explain the view that the Eskimo had entered as a wedge at Bering Strait, breaking off earlier connexions between the

Palæo-asiatic tribes of Siberia and the Indian tribes of the north-west coast of America, for which the strongest evidence lies in their mythologies.

As to the place and cultural stage at which the Thule culture originated, indications, at present far from definite, point to a period late in the Birnirk cultural stage, which itself must be regarded as an outgrowth of the Old Bering Sea culture, but with an even closer relationship to Punuk. Sites intermediate between Birnirk and the oldest eastern Thule sites excavated by Matthiassen are much desired.

The weight of evidence is against the Aleutian Islands having served as a migration route from Asia to America. The known cultural remains of the Aleutians are of an essentially Eskimoid or American character, showing that the islands must have been peopled from the Alaskan mainland. It would have been no difficult undertaking for such expert navigators as the early Aleuts to push on to the Commander Islands and Kamchatka, while the reverse journey is improbable for Asiatics. The character of the American (Alaskan and North-West) affinities in Kamchadal and Koryak culture and mythology favour the southern route from America to Asia over the Aleutian chain.

Although on theoretical grounds we are forced to assume that man originally entered the American continent at Bering Strait, archæological work in this region has as yet revealed no trace of these earliest immigrants; nor has any trace of pre-Eskimo culture been found on St. Lawrence Island. It has, however, been shown that the Old Bering Sea culture of St. Lawrence Island is basic to existing phases of northern Eskimo culture from Siberia to Greenland. The bearing of the Alaskan investigations on the theory of a central origin of Eskimo culture is to show that the view put forward by Kaj Birket Smith of Caribou Eskimo culture as a form of proto-Eskimo is untenable, demanding as it does that this culture should have been static through a period of hundreds, or even thousands, of years, while everywhere else Eskimo culture was undergoing marked changes.

The existence of a number of elements in the Old Bering Sea culture, such as toggle-harpoons, sledges, kayak, etc., which are of widespread distribution in the Old World, but in the New World are found only among the Eskimo, points to an Old World origin for a culture which embodied the general features of Eskimo culture as we know it in its earliest western form; while certain indications suggest north-east Siberia, between the mouths of the Anadyr and Kolyma Rivers, as the area in which the Old Bering Sea culture in its specific form came into being.

Stimulation of Adventitious Root Formation by Chemicals

ON November 6, 1937, by invitation of the Director, a meeting to discuss the use of chemicals for stimulating the formation of roots on cuttings was held at the Royal Botanic Gardens, Kew. It is well known to botanists that, following the investigations on the Continent which led to the discovery, isolation and chemical identification of hormone-like substances controlling the growth of seedlings, these were found also to be capable of inducing the formation of adventitious roots. Since then, use has been made of β-indole-acetic acid and other synthetically produced substances in the hope that their application in aqueous solutions either directly in jars or by watering the compost would induce the formation of roots on cuttings. It would be of great value to horticulturists if cuttings of plants which do not 'strike' easily could be stimulated to do so in this way, or if the rooting of moderately easy subjects which are cultivated on a very large scale could be accelerated.

It is evident that an authoritative opinion concerning the practical value of these substances can be formed only as a result of co-operation between botanists, practical horticulturists and those who manufacture the chemicals. For this reason, those interested in the subject from these points of view were invited to the meeting at Kew. That interest in the subject is widespread may be judged from the ready response which was received to the invitation.

An unfortunate fact is that those plants which present most difficulty to experienced cultivators are in most instances precisely those which show least response to the application of chemicals that induce root formation. The degree of response exhibited by other plants appears to be more or less proportional to the ease with which they root without special treatment, the easiest subjects reacting with greater facility than the more difficult ones. So far as can be judged at present, the greatest hope for the practical utility of root-promoting substances will be in accelerating the rooting of woody cuttings of plants of 'medium' difficulty, as well as cuttings of herbaceous plants such as chrysanthemums which, although easy to propagate without special treatment, are cultivated on a very large scale. The production of a root system at the earliest possible moment is of great importance to nurserymen, especially with the latter type of material.

It will be appreciated that in the present state of knowledge the use of these substances is far from being a panacea for all propagating difficulties. Nearly everyone who spoke stressed the fact that the amount of experimental work which has hitherto been carried out on the practical application of these substances is too small to permit judgment on them to be passed. The fundamental physiological processes on which their activity depends are not at present understood at all. It has been known for many years that very dilute acetic acid possesses root-promoting properties, and its use has often been recommended to horticulturists. A point which needs elucidation is whether in fact the more complex root-promoting substances which have now come into prominence are superior to acetic acid. The small amount of experimental work to test this point which has so far been carried out rather indicates that they are, but the matter is by no means clear.

In view of the economic importance of the subject and the very varied experience necessary for assessing the value of various researches which are being or may be carried out on this subject in the future, a small committee of scientific workers and horticulturists is being set up, with headquarters at Kew, to discuss the practical value of the results obtained. It is hoped that the committee may serve as a medium for the exchange of ideas, and also as a body which may be consulted by those who are working at isolated centres and are not in a position to decide in what directions their researches might most usefully be carried out. If at any time it is felt that further open meetings could usefully be held, the committee will decide where and when these might take place.

University Events

CAMBRIDGE.—The title of Stokes lecturer in mathematics has been conferred on Dr. S. Goldstein.

The Vice-Chancellor gives notice that the Cavendish professorship of experimental physics is vacant by the death of Lord Rutherford. A meeting of the electors will be held on February 11. If a proposal which is at present before the University is approved, the stipend of the professor will be £1,400 a year or while the professor holds a fellowship of a College with dividend £1,200, in addition to a non-pensionable payment of £200 a year for administration. Candidates for the professorship are requested to communicate with the Vice-Chancellor, and to send him on or before February 1 ten copies of any statement or testimonial which they desire to submit to the electors. If testimonials and references are sent they should not, taken together, exceed four in number.

The Adam Smith Prize is awarded to S. R. Dennison of Trinity College.

OXFORD.—S. J. Wright, for some years assistant-director and recently acting-director of the Institute for Research in Agricultural Engineering, has been appointed director.

Dr. J. R. Raeburn has been appointed a research officer under the Committee for Rural Economy.

A. G. Ogston has been elected to a fellowship at Balliol College for work in the biological sciences.

Dr. A. G. Gibson, Nuffield reader in morbid anatomy, has been elected to a professorial fellowship at Merton College.

Viscount Cecil of Chelwood has been appointed Romanes Lecturer for 1938.

The numbers of those reading the various main subjects of study in the academic year 1936–37 have recently been compiled. The largest science 'schools' are chemistry (207), physiology (194) and mathematics (143). Then come the new school of geography (100), agriculture and forestry (76), physics (59), zoology (40), engineering, botany and geology. About nine per cent of those reading these subjects are women. These numbers are greater than the corresponding numbers of the last survey. They are still small, however, compared with those of many other subjects. History (931), 'Greats', philosophy, politics and economics, and modern languages have each more than twice as many students as chemistry. Then come, in descending order of numbers, law (405), English, theology, music and Oriental studies.

SHEFFIELD.—The following appointments have recently been made: R. W. John, to be research assistant to the Department of Pathology; Douglas Harrison, to be assistant lecturer in electrical engineering; Donald Havenhand, to be assistant lecturer in metallurgy.

Science News a Century Ago

An Ascent of the Peak of Demawund

At a meeting of the Royal Geographical Society held on January 8, 1838, extracts were read from three communications. One of these was an account of an ascent of the peak of Demawund in September 1837 by Taylor Thomson, the paper being presented by W. F. Ainsworth (1807–96), who had been surgeon and geologist to the Euphrates expedition of Colonel Chesney. The mountain, it was stated, was about 40 miles east-north-east of Teheran and previously there had been no account of its ascent by a European or any measurement of its height. Thomson left Teheran on September 4, and after obtaining guides at a village, ascended to the summit on September 9 and spent the night there in a cave which was heated to upwards of 76° F. by the sulphurous vapour which issued from the rocks. The geological formation of the mountain, from Gernah upwards for about 1,000 feet seemed, said Thomson, to be a bed of sandstone of the coal formation, with one seam of coal; above this limestone occurred with a thickness of about 1,200 feet, then came greenstone coloured with iron to within 100 ft. of the summit, which was a deposit of pure sulphur. "The geological results of this expedition," said Ainsworth, "possess great interest by establishing the existence of a pseudo-volcano in these central districts of Western Asia, and ally themselves with the observations which Baron Humboldt has made upon the evidences of volcanic action, which he has traced everywhere on the great continent of Asia. It is a remarkable fact that throughout those districts of Taurus, Amanus, Kúrdistán and the Persian Apennines, in which I have travelled, I have never yet met with rocks of the secondary series. The absence of every member between the chalk and the primary formations is one of the most remarkable features in the geology of Western Asia."

Fossil Discoveries in France

On January 13, 1838, the *Athenæum* again directed attention to the recent discoveries of fossils in a French mine, remarking that "Further inspection increases the importance of the discoveries of M. Lartet and others . . . and fresh arrivals from him at the Academy of Sciences in Paris, produce new wonders. They combine the remains of animals, which, in all probability, no longer exist in nature, with some which do not appear to differ from those actually in being: the mine is still far from being exhausted, and a more favourable opportunity for the observations of geologists never before presented itself. The bones of the rhinoceros most abound; after these come those of deer, with their horns, and if an estimation may be formed by their size, the remains of a small and elegant species of ass or horse must have been deposited. New fragments of *macrotherium gigans* have come to light, which show that its claws bore a strong analogy to those of the Oryceteropus. The bears must have been totally different from any yet discovered; and those bones which belong to an animal called Amphicyon, by M. Lartet, show a strong analogy between it and the dog".

Samuel Woodward, 1790–1838

On January 14, 1838, Samuel Woodward, the Norwich geologist and antiquary, died at the age of forty-seven years. Born in Norwich on October 2, 1790, he was the only son of a bombasine weaver. His father died in 1795, and at the age of seven years he was placed with a shawl weaver, but from the age of fourteen for ten years he worked with a manufacturer of bombasines and camelots. His taste for reading was stimulated by his employer, and he became a teacher in both evening and Sunday schools. In 1814 he obtained a clerk's place in the Norwich Union Fire Office, and in 1820 a similar post in Gurney's (now Barclay's) Bank at Norwich and this he retained for the remainder of his life. Devoting his leizure to the study of the history of his native county, he wrote on its churches, its antiquities and its geology. In 1830 he published "A Synoptical Table of British Organic Remains" in which for the first time all the known British fossils were enumerated, and in 1833 his work "An Outline of the Geology of Norfolk". One of his sons, Bernard Bolingbroke Woodward (1816–69), became librarian in ordinary to Queen Victoria at Windsor Castle, and another, Samuel Pickworth Woodward (1821–65), in 1845 became the first professor of geology and natural history at the Royal Agricultural College, Cirencester, and from 1848 until his death was an assistant in the department of geology and mineralogy of the British Museum.

Societies and Academies

Edinburgh

Royal Society of Edinburgh, December 6.

H. J. Bhabha: Production of electron showers by cosmic rays. Blackett and Occhialini showed in 1932 that cosmic rays produce showers. The quantum theory is capable of explaining these showers. Very high energy electrons lose practically their whole energy by emitting a few high energy quanta. Each high energy quantum is chiefly absorbed by the creation of a pair of positive and negative electrons. When, therefore, a very high energy electron passes through matter, it emits a few hard quanta, each of which in turn produces an electron pair, which again emit quanta and so on. Thus, if the initial energy be high enough, many hundred particles may be created, forming a shower.

R. S. Barclay and W. O. Kermack: The decline of the birth-rate: regularities revealed by an analysis of the rates observed in certain European countries. An analysis of the birth-rates in Sweden, Denmark and Finland has been made by a method analogous to that previously employed by Kermack, McKendrick and McKinley in connexion with the death-rates of Scotland, England and Wales, and Sweden. As in the latter case, regularities of a somewhat simple type are revealed. The results are applied in the calculation of specific fertility rates for England and Wales for the past six decades.

J. Small: Quantitative evolution (4, 5 and 6). (4) The effect (K) of an organismal factor depresses the apparent *Dp*-ages of Compositæ in direct proportion to time. This rectilinearity indicates that species in Compositæ have a limited life-time, and that genera are similar. (5) The K values give 'free' *Dp*-ages which do not depart significantly from a rectilinear series in time. (6) The *Dp*-age unit is 2 million years for angiosperms. Their normal species life-time is 12 million years, with generic life-times at 24 million years. Consequential data are given for residual doubling in numbers, also present rates for origins and extinctions. It is concluded that the presence or absence of eliminative natural selection is a matter for statistical inquiry.

T. M. Macrobert: Induction proofs of the relations between certain asymptotic expansions and corresponding generalized hypergeometric functions. The formulæ are established for simple cases by contour integration, and are then deduced for the general cases by induction. They are then employed to evaluate integrals involving Legendre functions and hypergeometric functions.

Paris

Academy of Sciences, November 22 (*C.R.*, 206, 941–1020).

Claude Chabauty: The units of a body of algebraical numbers which are submitted to algebraic conditions.

Paul Vincensini: A characteristic property of conformal transformations of the plane.

Fernand Aimond: Some properties of surfaces deduced from the conditions of equilibrium of convex surfaces.

Marcel Decuyper: Series of Laplace any four consecutive radii of which form a quadrilateral.

A. P. Dietzmann: Infinite groups.

Armand Rauch: Certain integral functions of the order $\rho < 1/2$.

Alexandre Favre: The study of the Toussaint-Carafoli hydrodynamic tunnel with the view of obtaining bidimensional movements. Flow with circulation.

Robert Silber: The influence of the blast from the propelling screw on the carrying power of an aeroplane, and the method to be followed for utilizing the results of tests of carrying power of a wing submitted to an air current from a screw.

Paul Muller: A new double image astronomical micrometer. A modification of the method used in the Rochon telescope. The instrument has been in use in the 16 cm. equatorial of the Strasbourg Observatory since January 1937, and has proved satisfactory.

Jean Mercier and Jean Dubois: Contribution to the study of solid friction. Preliminary studies on the variation of the coefficient of friction caused by changes in the pressure and the velocity.

P. L. Violle: Concerning Dewar flasks. The earliest description of a high vacuum and silvered surface in a glass flask for the purpose of reducing radiation appears to be that of J. Violle in 1882.

Henri Moreau: A preliminary study of precision mercury thermometers in fused quartz.

Leonid Gabrilovitch: Sorting waves by periodically variable resistance systems.

Wilfried Heller: The influence of the size of colloidal particles on their optical anisotropy.

Maurice Cotte: The orthogonal systems of electronic optics and their application to spectroscopy.

Pierre Barchewitz: The (CH) absorption bands of saturated and ethylene hydrocarbons between 6000 and 9500 A.

Maurice Lambrey: New observations on the disengagement of nitric oxide by various nitrated products at a low temperature. From a study of the gases evolved from crystallized tetranitropentaerythrite, it would appear that the true decomposition velocity is not measurable below a temperature of 50° C. This conclusion is confirmed by applying the same method to nitrocellulose powders stabilized with diphenylamine.

Edouard Rencker : Dilatometric researches on tempering and annealing of boric anhydride glass.

C. Zenghelis and El. Stathis : The formation of colloids by hydrogen. Salts of gold, silver, platinum and palladium are readily reduced by zinc in acid solution or by aluminium in alkaline solution ; but the reduced metals are not colloidal. By the addition of a little gum to such solutions the metals are readily produced in a stable colloidal condition.

André Borocco : The comparative study of the dissociation pressures of sodium and potassium hydrides and deuterides. Measurements made by a differential method show that the deuterides have higher dissociation pressures than the corresponding hydrides.

Martial Félix Taboury and Elie Gray : The corrosion of zinc in distilled water alone or in the presence of a gaseous atmosphere.

Siegfried Halberstadt : The exact conditions of the formation of the compound of tungstic acid and *o*-oxyquinoline. The precipitation is quantitative when the pH of the solution is 3·5 : in the presence of phosphoric acid, none of the latter is coprecipitated.

Charles Courtot and André Bernanose : Phenomena of chemico-luminescence, in the visible spectrum, of molecules containing the amide group.

Daniel Bodroux and René Thomassin : Syntheses of paracyclohexylbenzylic aldehyde and of paracyclohexylbenzoic acid.

Antoine Willemart : Homologues of para-anthracene : polymers of 9-methylanthracene and of 9-ethylanthracene.

Jean Kandel : The catalytic hydrogenation of β-ionone : dihydro-β-ionone, dihydro-β-ionol. Some derivatives of α- and β-ionol.

Paul Gaubert : Liquid crystals obtained by sublimation.

Pierre Bellair : The sandy formations of eastern lower Provence.

Georges Déjardin and Albert Arnulf : The ultra-violet absorption spectrum of atmospheric ozone. Except for the effect of temperature, there is no appreciable difference of structure between the spectrum of atmospheric ozone and the spectrum observed in the laboratory.

Théodore Solacolu and Démètre Constantinesco : The modifications undergone by seedlings after remaining a relatively short time in solutions of β-indolyl-acetic acid. β-indolyl-acetic acid is capable of stimulating the plant cell after a short time of contact (15 minutes). The effects last a long time, even if the plant continues to develop in ordinary water.

Mlle. Anne Raffy and Maurice Fontaine : Determinations of flavin in the course of development in cultures of *Eremothecium Ashbyii*.

André Goris : The atisine of *Aconitum heterophyllum* and the anthorine of *Aconitum anthora*. Anthorine is identical with atisine (Jowett), and it is suggested that the latter name be retained for the alkaloid.

Henri Berrier : Substances of the type of plant auxines in the course of the evolution of *Bombyx mori*.

Jean Roche and René Combette : The reversibility of the denaturation and coagulation of methæmoglobin.

Gustave Guittonneau and Mlle Marie Bejambes: Chromo-resistance and calcium phosphate coating of micro-organisms heated in milk.

Raymond Hovasse : The Zooxanthellæ are dinoflagellates.

Constantin Levaditi, André Girard, Aron Vaismann, André Ray and Guy Richard : 4-Nitro-4-aminodiphenylsulphoxide and its action in the experimental toxi-infection of mice.

Copenhagen

Royal Danish Academy of Sciences and Letters

October 22.

Otto Neugebauer : Babylonian theory of eclipses.

November 5.

Knud Jessen : Contributions to the late glacial flora of Ireland.

November 19.

Niels Bohr : Mechanism of nuclear reactions. A discussion of the applications of thermodynamical analogies for the analysis of nuclear reactions.

December 3.

Harald Bohr and Donald A. Flanders : Algebraic equations with almost periodic coefficients.

December 3.

G. Hevesy and Ladislav Hahn : Origin of egg phosphorus.

December 3.

G. Hevesy and Hilde Levi : The artificial radioactivity of hafnium and some other elements.

Moscow

Academy of Sciences (*C.R.*, 16, No. 8, 1937).

V. A. Florin : Determination of instantaneous stresses in skeletons of soils.

G. S. Landsberg and S. A. Ukholin : Frequency of oscillations of the hydroxyl group in methyl alcohol and its dependence on the density.

S. A. Ukholin : Dependence of the spectrum of an aqueous compound on the density and the pressure.

V. L. Levšin and S. N. Rževkin : Mechanism of luminescence in liquids under ultra-sonic treatment.

A. T. Akimov : Specific electrical resistance of frozen soils.

L. Gindin and F. Šemiakin : Linear corrosion of metals. Selective corrosion of iron according to the system water-sulphuric acid-propyl alcohol, at the boundary of three phases.

L. Gindin, I. I. Torsujev and V. A. Kazakova : Relation to metals of sulphur solutions and of a series of organic sulphur compounds in saturated hydrocarbons. The relation to iron of ethyl- and butyl-mercaptan solutions in cyclohexane.

M. I. Kniaginičev and T. M. Gorelkina : New solvents of gluten proteins.

L. A. Dremliug : A frost-resistant triple potato hybrid, *Solanum acaule* × *S. tuberosum* (Furstenkrone) × *S. tuberosum* (*Centifolia*).

M. V. Favorskij : New fixatives for chromosome morphology.

G. V. Gershuni, A. M. Andreev and A. A. Arapova : Concerning the cochlear potentials in man.

V. S. Shardakov : Salt resistance of the cotton plant. Localization of salts in the leaf tissues.

Forthcoming Events

[Meeting marked with an asterisk is open to the public.]

Monday, January 10

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Eric Shipton: "The Shaksgam Expedition of 1937".

Tuesday, January 11

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir George Lee: "Recent Engineering Developments in the General Post Office".

Wednesday, January 12

SOCIETY OF GLASS TECHNOLOGY (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 3–9.—Series of public lectures on "Glass in Modern Life".*

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR MAINTENANCE ENGINEERS (Grade V) at the B.B.C.—The Engineering Establishment Officer, British Broadcasting Corporation, Broadcasting House, London, W.1 (January 15).

TECHNICAL OFFICER at the Air Defence Experimental Station, Biggin Hill, Kent—The Superintendent (January 15).

JUNIOR LECTURER IN SOCIAL STUDIES in the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (January 18).

LECTURER IN BIOLOGY in the Cardiff Technical College—The Director of Education, City Hall, Cardiff (January 19).

SCIENTIFIC ASSISTANT (chiefly biology) to the Metropolitan Water Board—The Clerk of the Board, 173 Rosebery Avenue, London, E.C.1 (January 21).

DEMONSTRATOR IN ENTOMOLOGY in the Liverpool School of Tropical Medicine, Pembroke Place, Liverpool, 3 (January 31).

CAVENDISH PROFESSOR OF PHYSICS in the University of Cambridge—The Vice-Chancellor (February 1).

GEORGE HOLT PROFESSOR OF PATHOLOGY in the University of Liverpool—The Registrar (February 12).

RESEARCH CHEMIST in the British Colliery Owners' Research Laboratory, Royal School of Mines, South Kensington, S.W.7.

ASSISTANT (grade III) in the Aerodynamics Department of the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (Quote Ref. No. 641B).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Empire Cancer Campaign. Fourteenth Annual Report of the General Council, presented at the Meeting held at the House of Lords, 30.11.37. Edited by J. P. Lockhart-Mummery. Pp. xxxiii+247. (London: British Empire Cancer Campaign.) [2611

A Review of Developments in the Applications of Boron in Agriculture and Horticulture, 1935–37. By R. W. G. Dennis. Pp. 15. (London: Boron Agricultural Bureau.) [2611

Report of the Commissioner for the Special Areas in England and Wales for the Year ended September 30. (Cmd. 5595.) Pp. xii+209. 3*s*. 6*d*. net. Report of the Commissioner for the Special Areas in Scotland for the period July 7, 1936–August 1937. (Cmd. 5604.) Pp. 76. 1*s*. 3*d*. net. (London: H.M. Stationery Office.) [2711

North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1936–37. Pp. 43. (Aberdeen: North of Scotland College of Agriculture.) [112

University of Cambridge. Solar Physics Observatory. Twenty-fifth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1936 August 1–1937 July 31. Pp. 4. (Cambridge: Solar Physics Observatory.) [112

Scottish Development Council. Economic Series, No. 14: Scottish Industry. Third Report of the "Oil from Coal" Committee (revised). Pp. 46. (Glasgow: Scottish Development Council.) 6*d*. net. [612

British Industries Fair, 1938, Olympia and Earls Court, London, February 21st to March 4th. Organized by the Department of Overseas Trade. Special Overseas advance edition. Pp. Ad. xvi+xvi+392+Ad. 104. (London: Department of Overseas Trade.) 1*s*. [2412

Catalogue of the Twenty-eighth Annual Exhibition of Scientific Instruments and Apparatus, held at the Imperial College of Science and Technology, South Kensington, London, S.W.7. January 4th, 5th and 6th, 1938. Pp. 226. (London: Physical Society.) [3012

Other Countries

Pubblicazioni della Università Cattolica del Sacro Cuore. Serie 6, Scienze biologiche, Vol. 9: Metodi competi e limiti della psicologia nello studio e nella prevenzione della delinquenza. Per Fr. Agostino Gemelli. Seconda edizione. Pp. xvi+147. 12 lire. Serie 6, Scienze biologiche, Vol. 10: Contributi del Laboratorio di psicologia. Per A. Gemelli, H. Rohracher, G. Cossetti, G. Cornelli, G. Zunini. Pp. 261+10 plates. 25 lire. (Milano: Società Editrice "Vita e Pensiero".) [2011

National Research Council of Canada. Bibliography on the Influence of Mineral Deficiencies on Growth and Reproduction of Farm Animals. By Muriel E. Whalley. Pp. 89. (Ottawa: National Research Council.) [2611

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 15: Selected Clinical Articles (Part 2). Pp. 19+3 plates. (Delhi: Manager of Publications.) 1.4 rupees; 2*s*. [2611

Smithsonian Miscellaneous Collections. Vol. 91, No. 28: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. New Species of Hydroids from the Puerto Rican Region. By C. McLean Fraser. (Publication 3443.) Pp. 7+2 plates. (Washington, D.C.: Smithsonian Institution.) [2711

Union of South Africa: Department of Mines: Geological Survey. Bulletin No. 10: The Chromite Deposits of the Bushveld Igneous Complex, Transvaal. By Dr. W. Kupferbürger and Dr. B. V. Lombaard, in collaboration with Dr. B. Wasserstein and C. M. Schwellnus. Pp. 48+2 plates. (Pretoria: Government Printer.) 6*d*. [112

Uppsala Universitets Årsskrift, 1935, No. 16: Contributions to the Study of the Theory of Selection. 2: The Problem of Ornithophily. By Douglas Melin. Pp. 355. (Uppsala: A. B. Lundequistska Bokhandeln.) 12.00 kr. [112

Instituto Botanico de la Universidad Central. Estudio botanico-quimico del *Espeletia grandiflora* (Frailejon del paramo del Angel.) By Prof. Acosta Solís and Dr. S. T. Machado. Pp. 62+5 plates. (Quito: Universidad Central.) [112

Herbertia. Vol. 4. Dedicated to the Memory of William Herbert, 1778–1847. Edited by Hamilton P. Traub. Pp. 280. (Orlando, Fla.: American Amaryllis Society.) [112

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 156: The Effect of Ground on the Aerodynamic Characteristics of a Monoplane Wing. By Itirô Tani, Masuo Taima and Sôdi Simidu. Pp. 23–76. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 65 sen. [612

Report of the Haffkine Institute for the Year 1936. By Lieut.-Col. S. S. Sokhey. Pp. iii+82. (Bombay: Government Printing and Stationery Office.) 3 annas; 4*d*. [612

Smithsonian Institution: United States National Museum. Bulletin 166: The Oxystomatous and Allied Crabs of America. By Mary J. Rathbun. Pp. vi+278+86 plates. (Washington, D.C.: Government Printing Office.) 60 cents. [612

University of Sydney. Publications in Geography, No. 4: Land Utilization Regions of Tasmania. By A. G. Lowndes and W. H. Maze. Pp. 29+5 plates. (Sydney: University of Sydney.) 2*s*. 6*d*. [612

Victorian Bush Nursing Association. Twenty-Sixth Annual Report and Statement of Accounts to 30th June 1937. Pp. 328. (Melbourne: Victorian Bush Nursing Association.) [612

Union of South Africa: Department of Mines: Geological Survey. Memoir No. 34: The Water-Bearing Properties of the more important Geological Formations in the Union of South Africa. By Dr. H. F. Frommurze. Pp. 186. 5*s*. Memoir No. 35: The Geology and Archæology of the Vaal River Basin. By P. G. Söhnge, D. J. L. Visser and V. Van Riet Lowe. Pp. 192 (32 plates). 5*s*. (Pretoria: Government Printer.) [612

National Research Council. Transactions of the American Geophysical Union, Eighteenth Annual Meeting, April 28, 29, 30, 1937, Washington, D.C. Regional Meeting, June 21 to 26, 1937, Denver, Colorado. Part 1: Reports and Papers, Washington, D.C.; General Assembly and Sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography and Volcanology. Pp. 264. 1.75 dollars. Part 2: Reports and Papers, Section of Hydrology and South Continental Divide Snow-Survey Conference. Pp. 265–664. 2.25 dollars. (Washington, D.C.: National Academy of Sciences.) [612

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 22: The Effect of Twist on the Strength and Length of Cotton Fibre. By Harirao Navkal and Dr. Nazir Ahmad. Pp. 34. (Bombay: Indian Central Cotton Committee.) 8 annas. [612

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 105, 1ère Partie: Procès-verbaux (Juillet 1937). Pp. 57. 3.00 kr. Vol. 105, 2ème Partie: Rapport Administratif (1936–1937). Pp. 80. 3.00 kr. (Copenhague: Andr. Fred. Høst et fils.) [612

Catalogues, etc.

The Phosphate Question. Pp. 8. (London: British Glues and Chemicals, Ltd.)

Sotheran's Price Current of Literature. No. 852: Annotated Catalogue of Works on Medicine, Surgery and Pharmacology. (Medical Series, No. 2.) Pp. 144. (London: Henry Sotheran, Ltd.)

Cambridge Universal Vibrograph for Vertical, Horizontal, Rotational or Spot Vibrations. (Folder No. 62.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Calendar for 1938. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.).

A Catalogue of Important Books and Periodicals on Geology and Palaeontology. (No. 544.) Pp. 38. (London: Bernard Quaritch, Ltd.).

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The British Association and Imperial Unity

THERE are plans for ensuing peace which may seem on a hasty or superficial view to have little or nothing in common. A closer analysis, however, shows that, in many instances, points of contact are exhibited such that men of good will, seeking to save our civilization from the dangers that beset it, may find in the structure of very divergent plans some greatest common measure which will make possible effective united action.

The policy of the British nation, as it is expressed by the National Government, is one of firm support of those principles of collective security set forth in the Covenant of the League of Nations. To that end is the national scheme of rearmament directed ; to that policy—a policy which recognizes that the older method of denying to one's opponent the justice which one claims for one's self is neither right in morals nor effective in action—we are committed over and over again, if words have any binding significance. It is the plain duty of every citizen who supports that policy to use to the utmost such powers as he possesses to bring the ideals of the Covenant of the League of Nations into the realm of fact. The need is urgent, and opportunities, once lost, are not likely to recur.

What part can the man of science play in this world-drama ? His responsibilities are great and, while he cannot, in common fairness, be asked to shoulder all the blame for the misuse of the great gifts which the genius of his predecessors and contemporaries has showered upon mankind, it is in some measure his responsibility in that he has placed dangerous weapons in the hands of those whose minds are not mature enough to use them wisely and well.

Mayhap the man of science himself, considered as a social animal, is still in that stage. This is possible, but unlikely, for the scientific worker to-day is showing himself increasingly alive to the importance of the impact of the advance of knowledge on society, whether the society be that of the nation or the world at large, and the toast "Here's to science—may it never be of any use to anyone at any time" is drunk with less and less enthusiasm as the century grows older.

Nowhere is that increasing awareness more clearly shown than in the programmes of the British Association. Some years ago, the Council considered carefully how the Association, within the framework of its constitution, could most profitably assist towards a better adjustment between the advancement of science and social progress. Effect has been given to these considerations by specially distinguishing papers, addresses and discourses which have a direct bearing on the relations between science and the interests of the community, and by arranging that, at each annual meeting, a proportion of the work of the meeting shall be devoted to the elucidation of such problems.

The efforts made in this direction have been widely recognized and appreciated, but are they a sufficient contribution to the general problem ? Such work, though it makes contact with imperial and international matters in so far as it concerns itself with social questions of wide interest, yet barely touches the fringe of those problems which, unwisely and irrationally attacked, may lead the world down the ringing grooves of change to a goal which shall see the shattering of all those ideals for which a sane civilization stands.

The problem is as much emotional as rational. Even if the Association directly concerns itself—as we earnestly hope it will—with finding scientific solutions for some of the social and economic problems which deface and weaken the structure of our international relations, such rational solutions will be but one step towards that freedom from national animosities and clashing interests which is the greatest guarantee of international peace.

For the British nation, the first guarantee of peace, internal or external, is a united Empire, united, not by the bonds of self-interest, enlightened or not, but by a sympathetic understanding of each other's difficulties and problems; and that is equally true of the relations between nation and nation. It is the creation of a friendly spirit of good will that matters most, and it is a favourable omen for the future that the Association, in the most recent of its activities, is directing its energies towards a task which will assuredly increase the spirit of good will and understanding between the constituents of our Empire. The sending of a delegation nearly a hundred strong to the silver jubilee celebrations of the Indian Science Congress Association is an event unprecedented in the history of the British Association. Over-seas meetings are an old-established feature of the Association's work, but the sending abroad of an independent delegation during the year of an ordinary meeting at home is quite another story. Lord Rutherford, with his accustomed wisdom, quickly perceived the importance of this step, and his considered opinion, expressed with that lucidity and emphasis which were part of his being, was that the Association could undertake no more important work than that of sending delegations to outlying parts of the Commonwealth, and that the success of the British Association in days to come would in no small measure depend on the development of its activities in these important directions.

Lord Rutherford, in more regions of thought than that of physical science, had an uncanny gift for seeing the answer to the sum without going through the dull mechanick process of working out the algebra, and in this matter, as in many others, it is more than likely that he spoke with a wise prevision. The British West Indies, Kenya Colony, Malaya . . . each has its problems, social, educational and scientific, and a visit by a delegation from the Association to one of these Dependencies, or to those greater Dominions which already know something at first hand of the Association's activities, would be welcomed as giving to the region visited some direct knowledge of the most recent advances in science, affording an opportunity for the discussion of special problems, and, more than all, of cultivating that spirit of mutual aid which is at the root of all healthy social life. Is it too much to hope that, within the next few years, we shall see a delegation formed which shall carry a message of good will to the British West Indies?

The work of such delegations by no means exhausts the possibilities. The Association carries on much of its work quietly during the intervals of its meetings by means of research committees, appointed at the annual meeting. The researches of these committees have done much to systematize and clarify our knowledge, and in many instances have resulted in important additions thereto. It is sufficient here to instance the work of the great committee on Electrical Standards and of the committees on Seismological Investigations and on the Calculation of Mathematical Tables. There are many Imperial economic and other problems which might profitably be attacked by research committees acting under the ægis of the Association. It would be very desirable, also, to extend hospitality more frequently to students from the outlying posts of the Empire who desire to take part in the ordinary meetings of the Association. More than this, there are possibilities, so far imperfectly explored, of sending delegations to the meetings of sister Associations in other countries, thereby doing something to promote that atmosphere of mutual understanding which is such a powerful dissipator of jarrings and jealousies.

Each of these activities, considered as a contribution to the causes of Imperial unity and of international peace, may be in itself a little thing; but a little thing well done is a very great thing, and, indeed, the sum total of these matters is far from being small. The prosecution of these tasks will involve the Association in grave financial responsibilities, responsibilities which for these great causes are well worth incurring, and the Association could raise no more enduring monument to the memory of the great physicist who has so recently left us, than by the institution of a series of delegations to be known for all time as the Rutherford delegations, and to be charged with the duty of fostering the unity of the Empire by carrying the lamp of science and learning to her uttermost dependencies.

A Philosophy of Science

Through Science to Philosophy
By Prof. Herbert Dingle. Pp. vii + 364. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 15*s*. net.

PROF. H. DINGLE here expounds a philosophy of science on a purely phenomenalist basis. It is the kind of philosophy that no one believes in except at the moment of philosophizing, and for that reason is difficult to work out systematically without lapsing into more ordinary ways of thinking. Nevertheless, the effort is worth while as providing a test case. We can discover the primary assumptions necessarily presupposed in scientific thought only by the method of working out extreme theories which try to dispense with or contradict common assumptions. In the reviewer's opinion, some of Prof. Dingle's assumptions are wrong and his theory will not work, but he has made a valuable contribution to thought in that he has developed this type of theory more clearly and consistently than others who have put forward phenomenalist or positivist views. In particular, it is far better than the efforts of those who call themselves Logical Positivists, who have so entangled themselves in an impossible logical or linguistic theory that they never get so far as to discuss anything of interest.

The author's main assumptions may be set out as three negative and five positive statements. (1) There is no 'external world' about the nature of which science gathers information. (2) The common-sense dualism of matter (as something existing on its own and moving and extended in space and time) and mind (as something which is aware of matter) is to be rejected. (3) The common-sense theory of 'physical objects', namely, that there are things, like tables and chairs, to which certain groups of perceptible qualities necessarily belong, is to be rejected. The concept of 'physical objects' Prof. Dingle considers to be not merely crude and needing refinement, but also definitely incompatible with scientific method, and therefore to be totally rejected. The positive assumptions are as follows: (1) The starting-point for science is simply my awareness of the data of my sense experience, interpreted in a solipsist sense, as though I were the only observer. (2) The only dualism admitted is the contrast between fact (or experience) and reason (or the concepts used in co-ordinating facts). (3) Experience consists of present and past data; ultimately of 'atoms' of experience which can be grouped at will into 'molecules' of experience. All reasoning processes necessarily deal with past experience or memories. (4) My own private experience is expanded by including 'pseudo-experience' due to communications from other people. That is to say, spoken or written words are not taken simply as they are, but as representing what might have been my own experience, and so take their place in memory as representatives. (5) Science consists in correlations between atoms of experience made by means of concepts, which are creatures of reason created for this purpose and to be altered as required, within the limits of the laws of logic.

On these lines, Prof. Dingle proceeds to expound modern physical theory. In fact, he is able to deal very easily with a number of outstanding problems and paradoxes; such as causality and the uncertainty principle, the treatment of unobservables, the puzzles of time measurements, and the question whether the universe is 'running down'. Incidentally he criticizes views expressed by Sir Arthur Eddington, Prof. E. A. Milne and others. All these subjects are dealt with in a very interesting way and, granted the assumptions, the conclusions are reasonable. What it comes to is that ordinary physical theory can be translated into Prof. Dingle's language without apparent loss and, in some respects, with considerable gain in simplicity and clarity. The difficulties of his theory do not lie here, but further back in his repudiation of physical objects and what he says about fact and reason. The stumbling-block is not physical theory but the process of observation.

It is the function of reason, Prof. Dingle says, to find correlations among facts. The facts are simply my memories. But memory may deceive me, and give me apparent facts which refuse to be correlated, as when I forget things or remember them wrongly. Such facts, he explains (pp. 62, 163–164, 188 *seq.*) are rejected as physical facts and become merely psychological facts. That is to say, if I remember something which does not fit in with my theories, I take it as being no part of the world of physics but as a peculiar mental process, the causes of which the science of psychology might be able to explain if it were sufficiently advanced. This seems to make things too easy. It leaves us wondering why investigators take all the trouble they do to investigate a non-existent external world and why physical theories are so complicated as they are.

The author's views on the subject of observation are perhaps not unfairly represented by his statement (p. 292): "When we say we see a star our experience is simply that of a bright point." Notice the word 'simply'. What about the telescope which had to be designed, built, adjusted, maintained and finally directed towards some definite part of the sky ? If we did not bother to do any of these things ourselves, other people did and in their manipulations they were making use of the common-sense theory of physical objects and not of the author's theory. Even if we merely walk out of doors and look at the sky, our actions imply the existence of physical objects, our own bodies among them. The weakness of the phenomenalist theory comes out in the very inadequate account of biology in Chapter vi. The biologist has always clung firmly to a belief in physical objects. The weakness is also seen in the seventh chapter, which deals with psychology. If it is only the psychology of my own mind, there is no difficulty. But the author says that the actions of other people are "psychological movements". How do these differ from physical movements ? If it is because they are incompatible with physical laws, then physical laws are false or the observations mistaken. If they are compatible, what is the distinction ? The distinction is clearly one which Prof. Dingle is debarred from pointing out, namely, that they proceed from a peculiar type of physical object, the type to which I myself and other people belong. It is probably quite true that the formulation of physical theory does not require physical objects, but it does not follow that the concept must be abandoned, much less that it is incompatible with scientific method.

In conclusion, this is a stimulating book, always clear and often witty. It should be a useful corrective for experimental scientists lapsing into dogmatism, but may be dangerous reading for mathematicians.

A. D. R.

Forests and Forestry in West Africa

The Forests of West Africa and the Sahara: a Study of Modern Conditions. By Prof. E. P. Stebbing. Pp. viii + 245 + 49 plates. (London and Edinburgh: W. and R. Chambers, Ltd., 1937.) 15*s*. net.

THE author early raises two debatable issues: he considers that (1) the general use of the word 'savannah' in Africa is wrong; and (2) the use of this wrong term has misled both forester and layman into thinking that savannahs are useless and cannot be improved upon. The reviewer disputes both these points, on the grounds that (1) the savannahs of Africa to-day conform to the ecological type recognized as such, irrespective of their origin; and (2) Nigeria possesses some 8,000 square miles of savannah reserves, most of which have been under ameliorative treatment for many years, which refutes the second contention. Elsewhere in West Africa it may hold good, but the most recent literature and information (Marshall, "Gold Coast"; also Moor, Proc. Brit. Emp. for Conf., 1935) on the subject indicate a definite change in opinion.

The main points emphasized, however, in the early chapters (i–v) are the menace of soil impoverishment in West Africa, and that the present position is one of considerable danger. Here the author is certainly right. The cause, as in many other parts of the world, is man's misuse of the land, as a result of which considerable areas have become depopulated. Sand displacement would be a better term to use than sand accumulation, as apart from local drift-hollows and special localities (for example, Ténéré dunes) the movement is one of erosion; the drift soils seen to-day were laid down in a recent period of depression.

Incidentally, M. Aubréville, Inspecteur Principal des Eaux et Forêts, states (Aubréville, "Report on Colonie du Niger, 1935") that the Saharan dunes shown in the photograph facing p. 16 are ancient *fixed* dunes temporarily exposed by the removal of the millet crop; nevertheless, the exposure materially aids erosion. Prof. Stebbing rightly argues that a proper programme of reservation will do much to improve matters, but in connexion with this, on pages 39, 43–44, suggests that the selection of forest reserves should be done by the political and not by the forest officers; later on (p. 45) this is contradicted, and it certainly does appear uneconomic to allow a political officer to carry out scientific and technical duties when officers specially trained for the purpose are available. It is the generally accepted practice that, while the support of the political officer must always be enlisted, and while he *settles* the reserves, their actual selection rests with the forester; and, as by this means one West African country has added 5,000 square miles of reserve to its forest estate within the last five years, it would seem wrong to depart from it without cogent reasons.

The author gives some excellent advice in regard to reserve selection, but on p. 46 makes a statement that cannot go unchallenged: "So far the idea that the commercial forest is the only thing to look for and reserve has held sway, to the exclusion, or almost exclusion, of the equally important agricultural issues. . . ." This is not so in any of the English colonies; and reference to almost any report in West African forests from Moloney's time ("Sketch of the Forestry of West Africa", 1887) to the present will reveal that the value of protection forests and the aid they give to agriculture has ever been strongly emphasized; indeed, this formed a marked feature of the policy laid down by Sir Frederick (now Lord) Lugard ("Political Memoranda", 1918).

The suggested establishment of two great reserved zones right across the country is important; it is assumed that only forest (that is, savannah or 'fringing forest') within these zones will be reserved. While these belts of reservation will be of undoubted value, it is not made clear that they in themselves are not sufficient to form a 'climatic barrier', unless supported by intervening and well-distributed reserves of considerable magnitude; thus while concentrating to some extent on these 'tension belts', the interacting factors that justify reservation must be reviewed and used as the real guide to reservation throughout the country as a whole. But why omit the 'rain forests'? Apart from their commercial value (£500,000 annually) and apart from their strategic value, generally lost sight of, their situation gives them immense climatic significance.

The rotational treatment of farmland suggested in Chapter vi on a *bush-fallow* system improved by tree planting can only do good, and will particularly benefit those regions where so-called 'land-hunger' (that is, soil degradation) has reached an acute stage.

The organization in the Ivory Coast service (Chapter vii) is of interest. The comparison, however, would, for obvious reasons, have better been made with the Gold Coast rather than with Nigeria; the Nigerian organization (p. 63) is not correctly described, and consequently except from an academic point of view many of the observations on pages 64–68 lose much of their value; the same applies to certain remarks in the summary.

From a forester's point of view, Chapters viii–xii are the most useful in the book. They deal in considerable detail with different sylvicultural operations in parts of French and British West Africa. The field nurseries of the Ivory Coast under natural shade appear excellent, and it is also clearly shown that nursery methods depend not only on their locality but also on the specific purpose of the nursery. The fact that it is often easier to have too much shade in the dry zone than in the wet, as observed in the Ivory Coast, is well illustrated in the Nigerian photographs on p. 88. Stump-planting introduced into Nigeria in 1923 met with instant success, and apparently spread to the French colonies about ten years later; in 1935 Aubréville refers to it as a novel and savage, though successful, method. The different technique in Sierra Leone attracts attention. The records of 'rain forest' improvement work, too, are of considerable value and make interesting reading, collated as they are from several sources.

Some minor notes or corrections should be made in regard to the above chapters, namely: Tabe Nursery photograph (p. 89) "*Acacia*" should read "*Cassia*". Research in Togoland into the Iroko gall (*Phytolima lata*) occurred so early as 1912. Olokemeji Reserve is 25·19 square miles, not 2,519 acres. The sandalwood trees felled at the author's request at Olokemeji were scented, etc.

Details of the Ivory Coast forest concessions have been known officially in England and the Coast for some years, but the actual concessionaires' technique has not been recorded in English, nor previously has any direct comparison been made between French and English methods. The striking difference is the single tax paid by the English concessionaire and the numerous petty exactions levied on his French opposite number; the ultimate amounts paid are approximately the same. Rents are not charged on concession in English colonies, as they would fall unduly hard on the African concessionaire.

The concessionaires' methods differ somewhat, mainly because in the Ivory Coast certain factors necessitate a closer utilization and so more detailed 'cruising' methods. Such factors include a lower rate of wages, lower minimum girth-limits and a less particular market. Is it not a misprint to say that the English concessionaires only look three months ahead? The short account of Ijora mill, as the author says, proves an exception to the common belief that Government cannot manage a business concern, but the conversion percentage is startlingly high.

Coming from such a facile and distinguished pen as the author's, the publication is a little disappointing, and there are some noticeable omissions from a book which gives a 'wide grasp' of the forests of West Africa and which is a study of modern conditions. These omissions are the more marked as certain other operations are treated with such detail. For example: Why barely mention the Nigerian enumeration surveys? They were in full force in 1934. Ameliorative treatment of savannahs, initiated in Nigeria on an extensive scale almost twenty years ago and with markedly good results, is not mentioned ; indeed, by implication, its existence seems to be almost denied. Tsetse, for years a serious difficulty in forestry, is avoided.

Exploitation on the Gold Coast, one of the largest exporting countries in West Africa, with its own peculiar problems, is not referred to. No reference is made to progress in reservation : there are other omissions. The early wide view taken on desiccation, followed by the detailed treatment given to certain work, together with the omissions of at least equally important work, make the whole appear somewhat disconnected and almost misleading to anyone unacquainted with West Africa, and gives the impression that the country still deserves its former description of "West Africa the Elusive". It is a pity, too, that no mention is made of earlier work done by such men as Punch, Foster, Chevalier, Thompson, Unwin, Reder and others. On the other hand, attention has rightly been directed to the dangers arising from soil misuse and impoverishment, and many of the sylvicultural and utilization details collected together for the first time will prove very informative to West Africans and to those interested in that sub-continent. A good map would have enhanced the value of the work ; the photographs throughout are numerous and excellent.

J. R. A.

Developmental Abnormalities of the Eye

Developmental Abnormalities of the Eye
By Dr. Ida Mann. (Published for the *British Journal of Ophthalmology*.) Pp. xi + 444. (Cambridge : At the University Press, 1937.) 50*s*. net.

THE dependence of the empirical sciences on the pure sciences, and the essential value of research in the latter, even although at the time it seems merely academic and of little practical utility, if the former are to evolve on rational lines, are nowhere better exemplified than in the advances which have taken place in our knowledge of congenital defects and aberrations in the visual organs. Two factors have lately combined to revolutionize our conceptions of ocular malformations : a widespread interest in what may be called the science of experimental embryology, whereby defects are produced by chemical or physical traumata on the developing organism and, in some cases, are systematically perpetuated by in-breeding, and the immense improvements in the methods of clinical study rendered available by innovations in the technique of clinical observation, such as the slit-lamp, whereby minute changes which hitherto had either escaped attention or had been looked upon as incidental and of no importance, can be intimately studied and adequately assessed. As a result, quite a number of new developmental aberrations have been discovered in the last two decades, the common occurrence of others which before had been considered rare has been established, and in many more our knowledge has been widened and co-ordinated, so that what had hitherto been vague conceptions stimulating the elaboration of (in some cases) a dozen or more explanatory hypotheses by the ingenious, has been rationalized and set upon scientific foundations.

In this story of progress Miss Ida Mann has played a part which has been by no means inconspicuous, and alone in the English-speaking world, both by her original work and by her literary presentation of the problems raised by herself and others, can challenge comparison with such Continental names as v. Szily of Münster or Seefelder of Innsbruck. Some six years ago she published a monograph on the development of the human eye, which to-day is probably the most exhaustive and authoritative treatise on the subject in any language. There now has appeared as its logical successor an elaborate monograph on the developmental abnormalities of the eye, wherein the detailed information gathered in the first monograph is applied with the same authoritative knowledge and wide experience to the elucidation of the more practical problems of clinical medicine.

To many the study of congenital and developmental abnormalities may seem tedious and sterile : tedious because too often they are presented as a chain of shortly described, isolated morphological pictures ; sterile because, with few exceptions, they do not yield to treatment or amelioration. It is most refreshing to read this book and realize that this science need not be a mere catalogue of cases, to find that when these conditions are arranged against their appropriate background of comparative anatomy and embryology, and when they are considered not as separate entities but are marshalled consecutively, one leading up to and merging ætiologically into the other, their study becomes a series of fascinating stories.

The book is in every way a good one ; irreplaceable in so far as it is unique; comprehensive and reasonably exhaustive without becoming discursive; authoritative in that the work and theories of others receive criticism always penetrating and shrewd and very knowledgeable; and well-written in a clear and easy style. To some extent it is uneven in detail, for the author has enjoyed the writing of it and has not hesitated to enlarge preferentially on those portions of the subject to which she herself has contributed original work; but this is a good thing, for her interest and enthusiasm lighten the narrative and give it an intimate and personal flavour.

The monograph, like its predecessor, is sponsored by the *British Journal of Ophthalmology*, and those responsible are to be congratulated on their vision in producing a work of undoubted scientific importance which appeals to a small public; and Sir John Parsons has contributed a kindly foreword. There is a bibliography which is full but by no means exhaustive; and the illustrations are profuse and excellent; a very large proportion are original, and Miss Mann is an artist of merit. The printing and production show the usual finish and luxury of the Cambridge University Press.

S. D.-E.

Social Values of Science

What Science really Means:
an Explanation of the History and Empirical Method of General Science. By Julius W. Friend and James Feibleman. Pp. 222. (London: George Allen and Unwin, Ltd., 1937.) 7*s*. 6*d*. net.

THE average science graduate of to-day seldom receives a training in scientific methods, and, on the other hand, the few art students who are taught scientific method rarely have a scientific background for their studies. Accordingly, the failure of many scientific workers to appreciate or understand the principles of the scientific method is paralleled by a corresponding lack of knowledge of the potentialities and limitations of that method on the part of the educated community in general. The situation is the more serious as not only are scientific workers considering the social and economic consequences of their work more closely, but also the community in general takes a keener interest in the application of science to social as well as to industrial problems, and is apt to blame science for consequences for which it cannot reasonably be held responsible. This book should fill a gap in the training of the scientific worker and also give the general reader an insight into the methods of science, and some appreciation of their potentialities and limitations, which should to some extent prevent hasty and unfair judgments upon them.

In the opening chapters, the authors' review of the original development of empiricism and of the relations between experimental work and speculative reason leads to an explanation of some current misconceptions of empiricism, and will probably surprise some scientific workers by its indication of how far back experiment goes. The most suggestive and stimulating chapters of the book are, however, those in which the authors discuss the logic of science, causality and probability and the future of empiricism. These chapters not only administer a salutary corrective to the tendency to over-emphasize induction or deduction, and to discriminate between pure and applied science, but also stimulate sound thinking about the mechanism of discovery and the conditions of scientific progress. Especially welcome is the discussion in the final chapter of the reasons for the backwardness of the social sciences, and of the relation between science and society. The present position of social science is, in fact, largely attributed to failure to understand scientific method and consequent neglect of deduction. So far from pleading for the accumulation of further data, the authors urge that failure to synthesize the mass of uncorrelated data already accumulated is a definite obstacle to progress.

The condition of social science is, however, discussed from another point of view. It affects both the question whether science will be allowed to develop unimpeded, and also whether society itself will continue to develop. Unless social science guides technical developments their application may cancel each other, and without social science we can have no sufficient or authoritative judgment of good or bad. The final question is whether society will understand science in time for science to develop a science of society by which both science and society can be preserved. The authors are firmly convinced that social science is possible, but even here they stress the importance of the theoretical aspect and the need for the great specialization within individual sciences to be balanced by a general synthesis embracing all sciences and greater rationality.

The book can be heartily commended to those who have no time for a more detailed study, such as Bavink's "The Anatomy of Modern Science", but who wish to understand the nature of scientific method and obtain some background of scientific philosophy.

R. Brightman.

(1) Principles of Mechanics of Frozen Grounds

By N. A. Tsitovitch and M. J. Soumgin. Pp. 432. (Moscow and Leningrad: Academy of Sciences of the U.S.S.R. Press, 1937.) 13 roubles. (In Russian.)

(2) Vechnaa merzlota pochvy v predelach S.S.S.R.

By M. Sumgin. (Akademia Nauk: Souza Sovetskich Sozialisticheskich Respublik.) 2-e dopolnennoe izdanie. Pp. 379. (Moscow and Leningrad: Izdatel'stvo Akademii Nauk S.S.S.R., 1937.) 12 roubles.

(1) IN the first of these two books the authors have collected an enormous mass of experimental data almost entirely from Russian sources on the properties of frozen soils. The scope of the work is perhaps rather over-optimistically enterprising, but it may surprise those who are unable to keep up with recent Russian soil work that so vast a range of experiments should have been attempted.

Frozen soil is first discussed as a four-phase system, and the effects of freezing in producing heaving under various conditions are studied. This is followed by a very detailed account of work on many of the physical properties of frozen soils. Mechanical properties such as resistance to loading and shear occupy a considerable section of the book. It is a pity that some account of the work of Pigulevski on the shearing of soils is not included, and Pokrowski's experiments on loading receive only slight mention. Methods are described for measuring elasticity moduli, Poisson's ratios, and viscosities, though here, as elsewhere, one regrets that so little attention has been paid to any recent work outside the U.S.S.R. The effects of thawing are also discussed. The second part of the book deals with such practical applications as the effects of frozen soil on the stability of bridges and buildings. In areas where the soil is almost always frozen, the risk of rare thaws must be considered.

(2) The second book is a new edition of Soumgin's treatise on the distribution of permanently frozen soils in the territory of the Soviet Union. The first edition, published in 1926, has required considerable alteration to include the work described in (1). The book is intended for Russian readers, and although the maps are interesting its appeal will be much less general than that of (1). Both books would be the better for a wider bibliography, both Russian and foreign. G. W. S. B.

A Textbook of General Biology

By Prof. E. Grace White. Second revised edition. Pp. 667. (London: Henry Kimpton, 1937.) 15*s*. net.

THOUGH written by an American professor of biology for American students, this book, which takes a rather different point of view in elementary biology teaching, is worthy of bringing to the notice of teachers of biology in other countries. As a book of reference the teacher should find it very useful, though as a book for students it would be rather disconcerting, since the subject-matter is so different from that used for most classes, at any rate in Great Britain. For example, the first type animal in the book is the grasshopper.

Nevertheless, teachers should derive considerable inspiration from this well thought out and well-written work. It is divided into three parts. Part 1 deals with a typical plant and typical green plant, in all their aspects—physiology, morphology, etc. Part 2 gives the most recent conceptions of biochemistry, biophysics, cytology, and genetics. This is followed by very well-written and very important chapters on the history of biological thought, culminating in a review of present-day conceptions.

Part 3 is more stereotyped in its review of the organization of the plant and animal kingdoms. It is from Part 2 that British teachers of biology will glean most ideas for improving their presentation of the subject to students of all grades up to the Higher School Certificate standard.

The Spotted Lion

By Kenneth Gandar Dower. Pp. x + 331 + 24 plates. (London and Toronto: William Heinemann, Ltd., 1937.) 8*s*. 6*d*. net.

THIS is a book which will infallibly commend itself to the far from numerous class who, having experienced, love the African wild. Others will enjoy the reading, but the book is primarily for those who believe that "Kenya was worth more to the world when she produced wonders and imaginings than sisal and coffee", for those like the author who "hate the whole spirit of successful Bognorization which is disenchanting the land". Mr. Gandar Dower believes that the best he can hope for from his readers is the half-conscious thought, "Why, this is good", and from those who have known the old safari days he will doubtless obtain his desired verdict. For them the book, charmingly written, will come as a relief and a joy after the stereotyped routine of the usual expedition of to-day.

That no spotted lion was obtained, that such a variation of the normal animal may not even exist as a definite race, simply does not matter. The beast serves admirably as a peg on which to hang accounts of adventures very engagingly told. It should be added that the illustrations are excellent; one of a hippopotamus swimming and another of wild dogs over a kill strike the reviewer as especially good, but it is invidious to choose. Mr. R. I. Pocock, formerly of the Zoological Society's Gardens, contributes a "Note", leading, as he says, to "no precise conclusion". J. P.

Wanderings of a Bird-Lover in Africa

By Madeline Alston. Pp. 256 + 9 plates. (London: H.F. and G. Witherby, Ltd., 1937.) 8*s*. 6*d*. net.

THIS book, written with an obvious enthusiasm, will be appreciated more by those who know South Africa and its fauna than by naturalists living in the northern hemisphere. The birds are often described by hints at coloration and habits, and will probably pass unrecognized by strangers to the land. The letterpress is pleasantly and graphically written, and the illustrations—one in colour the remainder in pencil—are delightful.

Science and Ethics*

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IN the early years of the Association, a favourite theme in the annual address of the retiring president was the relation between science and religion. To a majority of modern scientists nothing is more dull and fruitless than attempts to make science the handmaid of theology. But there is an aspect of religion with which science is vitally concerned, namely, ethics, and this has been well called "the religion of science".

Science, as we all know, is tested, verifiable, organized knowledge; ethics pertains to ideals, conduct and character. Any programme looking to human welfare and betterment must include both science and ethics, and there would be a great gain for the world if organized religion and organized science would co-operate more effectively in the promotion of practical ethics.

The differences between the ethics of religion and that of science relate largely to questions of origin rather than of content or purpose. One regards the basis of ethics as supernatural, the other as natural; one derives ethical codes from divine commands, the other from human nature and social utility; one from direct revelation of the divine will, the other from germ-plasm, endocrines and social instincts. But in spite of these differences in origin, the content is essentially the same. Whether written on tables of stone or on the tables of our hearts, the 'cardinal virtues' are still virtues and the 'deadly sins' are still sins. The deepest instincts of human nature cry out for justice, truth, beauty, sympathy. Ethics that is based on the satisfaction of these desires and needs, on the enduring pleasures of the mind, the æsthetic sense, the love and service of one's fellow men, is not different from the ethics of the divine command to "lay up for yourselves treasures in heaven". Ethics which cultivates justice, truth, courage, beauty, sympathy, love is essentially the same in kind as the two great commandments, "Thou shalt love the Lord thy God with all thy heart, and thy neighbour as thyself". The new ethics of science does not differ in content from the old ethics of religion, and the commandments of a God within are no less binding than those of a God without.

Among the generalizations of science which have been charged with the weakening of ethics, first place must be given to the theory of the natural evolution of man and of ethical systems. It is a fundamental postulate of modern science that man is a part of Nature, and that his body, mind and social relations have undergone evolution in the long history of the human species. This is not a mere hypothesis but an established fact. There is positive evidence that in long past times there were types of human and partly human beings that were much more brutish in body, mind and social relations than the general average of the present race. There is abundant evidence that ethics has undergone evolution no less than intelligence; it has developed from its beginnings in the primitive family group, to tribal, racial, national and international relations; from the ideals and practices of savagery to those of barbarism and civilization; from the iron rule of vengeance, "an eye for an eye, a tooth for a tooth", to the ideals of love and forgiveness and that highest conception of ethics embodied in the Golden Rule. But as in physical evolution there are retarded individuals and races, so also in the development of ethical ideals some people are far behind others, and all fall short of their highest ideals.

The fact that ethical codes have differed widely among different peoples and in different stages of culture has sometimes been held to prove that there are no general ethical standards, but that ethical actions are merely those which seem good for me or my class or nation. But the fact that there are narrow and selfish codes of ethics as well as broad and generous ones does not prove that all are of equal value and that there are here no standards of excellence. In the living world there are many grades of organization from amoeba to man, many stages of progress from the egg to the adult, many advances in culture from savagery to civilization, but this does not prove that all these stages are of equal human worth; and the fact that truth, beauty and virtue are relative and not absolute does not mean that ignorance and wisdom are equally good.

As is well known, the distinctive principle running through the whole of Darwin's philosophy of evolution is what he called natural selection. Having studied the notable effects of human selection in the production of new breeds of domestic animals and cultivated plants, he sought for some comparable process operating in Nature without human guidance. This he found in the

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* Address of the retiring president of the American Association for the Advancement of Science, delivered at Indianapolis on December 28, 1937.

Malthusian principle of over-production of populations, the elimination of the less fit and the preservation of favoured races in the struggle for life. Although he regarded environment, whether organic or inorganic, as being in general the principal eliminator of the unfit, he assigned a certain role to the organism itself as selector and eliminator, especially in sexual selection, while in mental, moral and social evolution this auto-selection played even a larger part in his philosophy.

It has been charged by many humanists that this Darwinism is destructive of the highest ethical ideals. It is said to be the apotheosis of cruelty and selfishness, to recognize no values except survival, no ideals except success. In this struggle for existence, the weak go under, the strong survive. Militarists and dictators have seized upon this principle as justification of their philosophy that might makes right. Conflicts and wars are said to be both the means and measure of progress, and military training to be the highest type of discipline.

This is, however, a fundamental misconception of natural selection. Darwin himself repudiated this extension of his principle to the struggle between races and nations of men. Those who attempt to extend it into the field of intellectual, social and moral qualities should remember that the standards of fitness are wholly different in these fields. Physically, the fittest is the most viable and most capable of leaving offspring; intellectually, the fittest is the most rational; socially, the fittest is the most ethical. To attempt to measure intellectual or social fitness by standards of physical fitness is hopelessly to confuse the whole question, for human evolution has progressed in these three distinct paths. Man owes his unique position in Nature to this three-fold evolution, and although the factors of physical, intellectual and social progress are always balanced one against another, they are not mutually exclusive.

This leads to the inquiry whether human, or so-called artificial, selection is not also natural. If we define 'natural' as that which is regular and lawful, and not arbitrary and lawless, then human selection is also natural. The study of the behaviour of lower organisms, as well as that of human beings in all stages of development from the infant to the adult, has shown that selection is everywhere taking place. One-celled plants and animals, for example, avoid extremes of heat or cold, move or grow toward certain chemical substances and away from others, take in as food certain substances and reject others. Even germ cells show some of these same properties, and in general it may be said that all living things manifest differential sensitivity and reactivity, and that by a process of trial and error and finally trial and success they generally manage to eliminate reactions that are not satisfactory and to persist in those that are. This is the Darwinian principle extended to the reactions of organisms in which the organism itself is eliminator and selector.

Intelligence in animals and man is arrived at in this same way, by many trials and failures and finally trial and success, remembering of past failures and successes, elimination of the former and persistence in the latter A cat that by trial and error has learned to open the door of a cage, or a horse that has learned in the same way to lift a latch and open a gate, is intelligent with respect to that one situation; intelligence in human beings is acquired in the same way. Indeed, intelligence is the capacity of profiting by experience, while the ability to generalize experiences is what we call abstract thought, or reasoning.

In his famous Romanes Address in 1892 on "Evolution and Ethics", Prof. T. H. Huxley maintained that ethics consists in opposing the cosmic process of natural selection by intelligent human selection, and in replacing the ruthless destruction of the weak and helpless with human sympathy and co-operation. He illustrated the superiority of human selection by pointing out the fact that a cultivated garden left to Nature grows up to weeds and, therefore, that human intelligence can improve on the blind processes of Nature in meeting human needs.

All this is undoubtedly true; we are continually improving on Nature for our own purposes; all agriculture, industry, medicine, education are improvements on Nature. The notion that Nature is always perfect is certainly false, and the cry, "Back to Nature", is more likely to be a call to regress than to progress. But it is a mistake to suppose that human intelligence and purpose, social sympathy, co-operation and ethics in general are not also parts of Nature and products of natural evolution. In Darwin's theory the environment eliminates the unfit individual, but in individual adaptations to new conditions the organism itself eliminates many useless or injurious responses. In such cases the organism rather than the environment is the eliminator or selector, either by the hit or miss process of 'trial and error', or by the vastly more rapid and less wasteful method of remembered experience, that is, by intelligence. Thus intelligence can improve on the blind processes of Nature, because it is not blind, although it also is natural; and thus intelligence has become a prime factor in evolution.

It is clear that social ethics assumes the ability and the responsibility of individuals to regulate behaviour in accordance with ideals and codes of conduct. It therefore demands freedom to choose between alternatives that are offered. Without such freedom there can be no responsibility, no duty, no ethics. It has long been the creed of certain rigidly mechanistic scientists that freedom, responsibility and duty are mere delusions, and that human beings are automata, thinking, feeling and doing only those things which were predetermined by their heredity and environment over which they have no control This fatalistic creed was in large part a deduction from the determinism of Nature which was revealed in mathematics, astronomy, physics and chemistry, and was then extended by certain physiologists to all vital phenomena, including human life and personality Indeed, some of these 'hard determinists' went so far as to maintain that the whole course of human history was predetermined in the original constitution of the universe, that nations had risen and fallen, cultures and civilizations had come and gone, and that the present state of the world and its future destiny were all determined by inexorable laws. However, many biologists who investigated the behaviour of animals refused to regard them as mere automata, and students of human behaviour generally held that there must be some flaw or break in this logical chain that bound man helpless on the wheel of fate, some fallacy in the logic that denied him all freedom and responsibility, some monstrous error in the conclusion that saints and sinners, philanthropists and fiends were mere pawns or puppets in a game in which they were moved by forces over which they had no control.

The 'closed universe' of physical science is strangely unlike the world of human experience, but its adherents argue that experience is subject to delusions from which rigid logic and genuine science are supposed to be exempt. In such a 'closed universe' man does only what he is compelled to do; there is no freedom, responsibility or duty, no place for purposive education, ethics or religion.

As a way of escape, mathematicians and physicists, who were most impressed by the determinism of inanimate Nature, were generally inclined to adopt some form of Cartesian dualism, which would endow living beings, and especially man, with an unmaterial principle or soul which was not subject to this rigid determinism. But, on the other hand, students of life phenomena in general could find no sufficient evidence for such dualism, and hence arose the strange anomaly of physiologists and psychologists becoming more rigid determinists, so far as life and man are concerned, than students of the physical sciences.

Several scientists have expressed the view that Heisenberg's principle of indeterminacy in the subatomic field can somehow be converted into the novelty, creativity and freedom manifested by living things. But no one has shown explicitly how this can be done. Furthermore, biologists generally do not admit any fundamental indeterminacy in the behaviour of living beings. Novelty, creativity and freedom, wherever their origin has been traced, are found to be caused by new combinations of old elements or processes, whether these be atoms, molecules, genes, chromosomes, cells, organs, functions, or even sensations, memories and ideas. By such new combinations of old elements there emerge all the new properties of chemical compounds, and by new combinations of genes and chromosomes and environmental stimuli all the novelties of heredity and development arise. There is good evidence that even psychical properties, such as consciousness, intelligence and will, emerge in the process of development because of specific combinations of physical and psychical factors. This is, indeed, the whole philosophy of evolution; namely, that the entire universe, including man and all his faculties and activities, are the results of transformation rather than of new-formation, of emergence rather than of creation *de novo*.

Freedom does not mean uncaused activity; "the will is not a little deity encapsuled in the brain", but instead it is the sum of all those physical and psychical processes, including especially reflexes, conditionings and remembered experiences, which act as stimuli in initiating or directing behaviour. The will is not undetermined, uncaused, absolutely free, but is the result of the organization and experience of the organism, and in turn is a factor in determining behaviour. Therefore, we do not need to import from subatomic physics the uncertain principle of uncertainty in order to explain free will. The fact that man can control to a certain extent his own acts as well as phenomena outside himself requires neither a little dæmon in the electron nor a big one in the man.

Just one hundred years ago Wordsworth wrote:

> "Man now presides
> In power where once he trembled in his weakness;
> Science advances with gigantic strides,
> But are we aught enriched in love and meekness?"
> (Miscellaneous Sonnets, Part 3, 41, Jan. 1838.)

These lines are much more significant to-day than when they were penned, for so far as our knowledge of and control over natural forces and processes are concerned, we live in a new world.

"But are we aught enriched in love and meekness?"

Neither in human nature nor in social relations has progress kept pace with science. This is not the fault of science but rather of man and of society. The great advances in the applications of science have often been used for selfish purposes rather than for social welfare. Scientific progress in medicine and sanitation is far in advance of its social utilization, but not in advance of its urgent need. Rational and peaceful means of solving class conflicts and of preventing wars would be vastly less costly and more effective than strikes and armaments. The fact is that social progress has moved so much slower than science that one might say that scientific progress is matched against social stagnation. Many thoughtful persons are asking: "Will science, which has so largely made our modern civilization, end in destroying it?"

A fundamental fact is that improvements in human nature are not keeping pace with increasing knowledge of and control over outer Nature. By means of language, writing, printing, the radio, and all the means of communication and conservation of knowledge, each human generation transmits its accomplishments to succeeding ones.

Thus present science, culture and civilization represent the accumulated experience and knowledge of all the past, each succeeding generation standing, as it were, on the shoulders of preceding ones. Every individual, on the other hand, begins life where all his ancestors began, namely, in the valley of the germ cells; he then climbs to the summit of maturity and goes down into the valley of death. But society, gifted with continuous life, passes on with giant strides from mountain top to mountain top; and so it happens that science and civilization in general outrun individual heredity, for the learning and acquirements of each generation are not transmitted to succeeding ones through the germ cells but only through social contacts. For this reason increasing knowledge and power have greatly outrun improvements in inherent human nature.

What is the remedy, if any, for the lag in the progress of human nature behind the progress of science and society? Eugenics has been proposed as a possible and necessary solution of this problem. Undoubtedly great improvement in human heredity could be effected if the principles of good breeding which are used with such notable results in the improvement of domesticated animals and cultivated plants were to be used in the breeding of men. There is no doubt among students of heredity that by means of a system of selective breeding a healthier, longer-lived, more intelligent, more emotionally stable human type could be developed. But the difficulties in the way of such a eugenical programme are enormous where the human stock is so mixed, as it is in almost all races of men, and where the rules of good breeding would have to be self-administered or imposed by authorities that are influenced by social, racial or ethical prejudices. Even if these obstacles could be overcome and this programme wisely and persistently followed, it would take thousands of years to bring about any marked improvement in the masses of mankind.

Fortunately there are other and more rapidly acting remedies for this disharmony between social progress and biological inheritance. Heredity determines only the capacities and potentialities of an organism; the realization of those potentialities depends upon development, which is greatly influenced by environment, hormones, health or disease, use or disuse, conditioned reflexes or habits. In every individual there are many capacities that remain undeveloped because of lack of suitable stimuli to call them forth. Since these inherited potentialities may be social or antisocial, good or bad, it is the aim of enlightened society to develop the former and to suppress the latter. In the heredity of every human being there are many possible personalities; which one of these becomes actual depends upon developmental stimuli. Each of us might have been much better or much worse than we are if the conditions of our development had been different. Endocrinologists and students of nutrition are already preventing or overcoming many of the deficiencies or defects that arise in the course of development. In these respects science is contributing greatly to human welfare and to practical ethics.

But of all the possible means of rapidly improving social conditions, ethical education is probably the most promising. Indeed, education, based on a knowledge of the principles of development and aimed at the cultivation of better relations among all classes, races and nations, is the chief hope of social progress.

The most enduring effect of education is habit formation. Good education consists in large part in the formation of good habits of body, mind and morals. Heredity is original or first nature; habits are second nature, and for character formation and social value they are almost as important as heredity itself. To trust entirely to heredity to improve men or society is to forget that heredity furnishes capacities for evil as well as for good, and to disregard the universal experience of mankind that human nature may be improved by humane nurture.

On these grounds certain humanists have proposed that art, literature, history and political and moral philosophy should replace science in the educational programme, since, as they assert, science, being materialistic, non-ethical and lacking in high ideals, neglects or destroys the real values of life. The president of the University of Chicago has recently called science a failure in the educational process, and he urges a return to philosophy as the only sure road to sound discipline and true culture. Those who have never experienced the discipline and ennobling effects of scientific studies fear that science will destroy our civilization, and are calling upon educators to repent and to return to the good old subjects of classical learning. Without discussing the subject in general, it may be remarked that it was not science that caused the decay of former civilizations, nor was it in the power of classic art, literature and philosophy to save those civilizations. Certainly there are no other studies than science that distinguish so sharply truth from error, evidence from opinion, reason from emotion; none that teach a greater reverence for truth or inspire more laborious and persistent search for it. Great is philosophy, for it is an attempt at a synthesis of all knowledge, but if it is true philosophy it must be built upon science, which is tested knowledge.

> "To the solid ground of nature
> Trusts the Mind that builds for aye."

Education, then, which looks to the highest development of the physical, intellectual and moral capacities of men is the chief hope of human progress. Even any possible programme of improvement of inherited human nature must rest upon education concerning the principles of heredity and the methods of applying them to the breeding of men. Without waiting for the slow improvement of human nature through eugenics, great progress can be made toward the 'good society' by the better development of the capacities we already possess. As a matter of fact, all of the great advances from savagery to the highest civilizations have been made without corresponding improvements in heredity.

Although our inherited capacities have not greatly increased since our progenitors rose out of barbarism, yet there has grown up within us an increasing respect for the human mind and a deep conviction of the importance of its freedom. We who are the inheritors of the tradition of liberty of thought, speech and press, and who believe that freedom and responsibility are essential to all progress, should use our utmost influence to see that intellectual freedom shall not perish from the earth. Such freedom has been essential for the advance of science, and the time has come when science should stand for freedom, especially in those countries where force, war and unutterable ferocity are used to compel acceptance of political, social or scientific creeds.

There is no possibility that all men can be made alike in personality, nor any reason why all races and nations should hold the same political and social ideals. But there are good grounds for hoping that they may come to cherish the same fundamental ethical concepts; for the needs and satisfactions, the instincts and emotions of all men are essentially similar. Science is everywhere the same in aims and methods, and this fact greatly strengthens the hope that in a world bound together by science into one neighbourhood there may come to be common ideals regarding fundamental ethics. The greatest problems that confront the human race are how to promote social co-operation; how to increase loyalty to truth, how to promote justice, brotherhood; how to expand ethics until it shall embrace all mankind. This is a problem for science as well as for government, education and religion. Each of these agencies has its own proper functions to perform.

The ethics of science regards the search for truth as one of the highest duties of man; it regards noble human character as the finest product of evolution; it considers the service of all mankind as the universal good; it teaches that both human nature and humane nurture may be improved, that reason may overcome unreason, co-operation supplement competition, and the progress of the human race through future ages be promoted by human intelligence and purpose.

In its practical aspects the ethics of science includes everything that concerns human welfare and social relations; it includes eugenics and all possible means of improving human heredity through the discovery and application of the principles of genetics; it is concerned with the best means of attaining and maintaining an optimum population; it includes all those agencies, such as experimental biology and medicine, endocrinology, nutrition and child study, which promise to improve bodies and minds. It includes the many scientific aspects of economics, politics and government; it is concerned especially with education of a kind that establishes habits of rational thinking, generous feeling and courageous doing.

In spite of notable advances of our knowledge of these subjects, we still know too little about human nature and the causes of social disorders. The extension of the methods of experimental science into their study is bound to be one of the major advances of the future, as it has in the field of medicine since the days when human ills were thought to be due to demons. The ills of society have natural causes and they can be cured similarly by controlling those causes.

It has always been true and will continue to be true that knowledge outruns practice and that ideals are better than performance. How can men be induced to live up to the best they know? How can they be brought to substitute the spirit of service for selfishness, love for hate, reason for unreason? The long efforts of past centuries show that there is no rapid solution of this great problem. But in the co-operation of science, education and religion there is hope for the future.

Mineral Resources of the East Midlands

A JOINT discussion between Section C (Geology) and Section E (Geography) of the British Association on the "Potential Mineral Resources of Nottinghamshire and Lincolnshire and their Geographical Significance" was held on September 6. The region discussed included the whole of Nottinghamshire and Lincolnshire, and a wedge of Leicestershire which penetrates northwards between the two counties. Owing to geographical barriers on the north and south, this region has always been isolated from the rest of England. Even to-day, it is still practically unaffected by those great industrial movements which are elsewhere changing the aspect of the English lowlands.

The distribution of mineral resources in this region is dependent upon its geological constitution and structure. The newer rocks which occupy its surface range in age from the Permian to the Cretaceous. They dip gently eastwards and have experienced no appreciable disturbance. Their outcrops occupy broad belts of country which trend north and south, and give rise to scarplands and clay plains having a corresponding arrangement. The older rocks, which underly the newer, belong mainly to the Carboniferous system, and include a large extent of productive coal measures. They have been much disturbed, and suffered severe denudation before they were covered up by the later rocks.

Though coal and iron exceed all other minerals in importance, attention was first given to certain minor mineral resources which are essential to the development of any area where coal and iron are being exploited. This region is amply provided with such accessory minerals for the erection of buildings and the making and maintaining of roads. Whilst nearly half the region has good underground reserves of water, the problem of water supply is still unsolved for the great clay plains.

Turning to the two vital minerals, it was brought out in the discussion that, whilst the Derbyshire margin of the coal-field has been exploited for seven centuries and is approaching exhaustion, the Nottinghamshire field, though still in its infancy, has already become the most productive and economically worked field in England. Lying as it does in a basin that is largely hidden under a covering of newer rocks, its future development will be governed by several natural factors. First must be mentioned the regular increase of thickness of the newer rocks as they dip eastwards. This already attains a total of 3,000 feet east of Lincoln. Secondly, it has always been known that the coal measures under west Nottinghamshire dip eastwards. The Coal Commission of 1871 did not venture to extend that dip beyond the line of the River Trent, and therefore gave that as the eastern limit of the field. The Commission of 1905 took a rosier view and shifted the boundary to Boston. In 1925 the Geological Survey, basing its view upon the records of subsequent borings, returned to the opinion of the 1871 Commission; for they found that, under east Nottinghamshire, the eastwards dip was being reversed, and that the rate at which the seams were rising pointed to an early disappearance of the Coal Measures in that direction.

At this point in the discussion Dr. D. A. Wray, of the Geological Survey, roused considerable interest by making a most important statement embodying the results of still more recent borings, including one which had been recently put down near Lincoln. It seems that the measures rise less rapidly eastwards than had been thought, and that a considerable thickness of coal measures has been proved to underly west Lincolnshire. He revealed, however, a third and unsuspected adverse factor in the behaviour of the Upper Red Measures. These non-productive beds not only thicken eastwards but also pass unconformably across the bevelled edges of the productive measures, so that the latter cannot extend much farther east than Lincoln. Nevertheless, the net result of the fresh information, thus divulged for the first time, is that the extent of the proved coal-field has been increased by 50 per cent.

In considering the iron resources of the region, emphasis was laid upon the fact that the greatest reserves lie either at the extreme north, around Scunthorpe, or beyond the southern boundary, around Corby. Reference was also made to considerable reserves recently discovered in the southern end of the Lincolnshire Wolds.

In discussing the geographical significance of the geological information which had been supplied, attention was first given to industries associated with the accessory minerals. These are small and scattered. Dealing with transport, it was shown that the network of roads and railways form a close mesh over west Nottinghamshire but become a much wider mesh towards the east. East and west movement have always been impeded by the existence of several north-to-south barriers, of which the Trent has proved to be the most serious.

The close relationship of the overcoming of this barrier to industrial development was illustrated by the building of the Keadby bridge in 1861 and its enlargement in 1916, which was followed immediately by the rapid growth of the iron-works at Scunthorpe and Frodingham.

Discussion of the major minerals was limited to the iron industry. Since this requires a complicated and very costly plant, as well as labour skilled in the handling of hot metals, it was considered unlikely that the future would bring the development of any new centres; but that, on the contrary, there would be a further concentration of the industry at Scunthorpe and Frodingham in the north and at Corby in the south. Though the prophets disagreed concerning the more distant future of these centres, they were unanimously of the opinion that their prosperity is guaranteed by their resources for many years.

In view of these facts, and of the stationary or possibly declining population of Great Britain as a whole in the coming years, it was concluded that little or no redistribution of population would follow the future exploitation of the resources of the region under discussion. It may be pointed out here, however, as a remarkable oversight, that the geographical effects of the exploitation of the coal were not discussed, for the factors which control this compel the establishment of many new centres of industry, of many new lines of transport, and a large scattering movement of population.

H. H. S.

The Scientific Delegation in India

From a Correspondent

Darjeeling, December 30, 1937.

IT will be remembered that the great majority of the scientific delegation to India arranged by the British Association at the request of the Indian Science Congress Association, left England on the S.S. *Cathay* at the end of November. Their voyage could scarcely have been more prosperous; evidently heavy weather was just escaped, and only one rather rough night, when the ship was nearing Marseilles, caused a measure of complaint; while an unexpectedly strong southerly wind in the Red Sea kept the temperature tolerable. After arrival in Bombay, the party entered upon a whirl of entertainment, sight-seeing, and travel. Every possible opportunity, however, was given and taken for conversations in matters of common scientific interest between individual visitors and residents; old acquaintances were renewed, new contacts made. Lectures and broadcasts have been given at various points, and have been received with every manifestation of interest. The reception accorded to the party has everywhere been cordial in the extreme, and the enjoyment of a wonderful journey has been complete, save for the cases of slight indisposition apparently inseparable from any visit of a party of newcomers to India, and for two major causes of general regret. One of these has been the enforced return of Dr. A. B. Rendle to England from Bombay, owing to ill-health. The other has been the serious accident to Dr. W. W. Vaughan, who in darkness at the Taj Mahal fell and sustained a compound fracture of a leg.

At Bombay, the University entertained the party. In Hyderabad State all were guests of the Government throughout the sojourn, which included entertainment, inspection of the new Osmania University, visits to the forts of Golconda and Daulatabad and the rock-hewn temples of Ellora and Ajanta, and all the transport entailed, both by rail and road. At Agra, the Taj Mahal, the fort, and Fatehpur-Sikri were seen, and it is worthy of record that both here and elsewhere such world-famous monuments have at least equalled, if not exceeded, the visitors' preconceptions of them. The Latitude Variation Observatory and the Meteorological Station at Agra, and the Moslem University at Aligarh, were viewed by those specially interested. At Delhi, on Christmas Eve and Christmas Day, the party was splendidly entertained by the Government of India and by private individuals, and a fleet of cars provided by the Government facilitated visits to points of interest. At Dehra Dun, the Forestry Research Station and the Geodetic Survey Department were thoroughly investigated, and, the weather proving kind, nearly all the party drove up to the ridge of Mussoorie, from which most of them enjoyed their first view of Himalayan snow-peaks. A few individual members diverged from the main route to visit points of special interest to them.

At Benares the whole party was entertained by the Hindu University, and attended a convocation there, a brilliant ceremony at which honorary degrees were conferred on the president—Sir James Jeans—and others. The famous river-frontage of the city on the Ganges was viewed from boats, and many of the party found perhaps their greatest satisfaction in wandering among the lively and infinitely picturesque streets of the Indian city.

It had been ascertained during the voyage that for a very large proportion of the party Darjeeling was the Mecca of the tour, and it was accordingly requested by wireless, and duly arranged, that the special train should proceed to Siliguri, the terminus for the mountain road and railway, after a short halt at Calcutta, where there was time for no more than a few personal introductions, and for taking temporary leave of Prof. J. N. Mukherjee, who had accompanied and guided the party from Bombay, and to whom every member owes gratitude beyond expression.

It is from Darjeeling that this note is written. The weather, perfect throughout the tour, has favoured us to-day beyond conception: the famous views from the town and from Tiger Hill, of Kangchengjunga and its satallite range, of Makalu, of glimpses of Everest vouchsafed to some through a cloak of cloud, have reached their most splendid standard, and the half cannot be told of them. The party has to-morrow here for rest, and then returns to Calcutta for the Congress next week.

Obituary Notices

Prof. H. Molisch

HANS MOLISCH, whose death at the age of eighty-one years took place on December 8, was born in Brünn in 1856, the son of an intelligent and progressive nurseryman, who employed his son in his early years in his business, so that from his boyhood Molisch became interested in plants, and already when at the Grammar School in Brünn he distinguished himself by his botanical knowledge. His enthusiasm for the subject may have been further fired by his knowledge of the experimental plant-breeding which was being carried on in Brünn by the Abbé Mendel, who was a friend of his father. At any rate, when he entered the University of Vienna in 1876, he had already made up his mind to become a botanist, and in his autobiography, which was reviewed in NATURE of September 28, 1935, p. 494, he speaks with enthusiasm of his teacher, Julius Wiesner, and also of many kindnesses he received from Kerner von Marilaun, the director of the Botanical Gardens.

Molisch's doctor's degree was awarded to him for a thesis on the anatomy of the wood of the Ebenaceæ, and he was then appointed assistant to Prof. Wiesner, a post which he retained until 1889. Whilst acting as assistant, he became *Privat dozent*, and his lectures, which dealt with plant physiology, were always well attended. In 1889 he was appointed to a professorship in the Technical College at Graz, and in 1894 to the German University of Prague. While occupying the former position he published his histochemistry of vegetable foods and an important physiological study entitled "Die Pflanze in ihren Beziehungen zum Eisen", in which he showed that the chlorosis induced by growing plants in a medium devoid of iron is not a direct result of the absence of that element, but is the symptom of a pathological condition induced by lack of iron, for by sensitive microchemical tests, in which he always excelled, he proved that chlorophyll itself does not contain iron. After his promotion to Prague, he devoted some attention to the lower forms of plant life, stimulated in part by a request to investigate the microflora of the water supply of Prague, which was at that time of a very impure nature. In this way he became interested in the phosphorescent bacteria and other fungi, of which he published an account, and also made important discoveries in connexion with the nutrition of Algæ. But he also continued to work on the anatomy of plants, particularly on the laticiferous tissues, and studied microscopically the phenomena associated with the freezing of vegetable tissues. In 1897 he undertook a botanical tour into the tropics, spending some time on physiological investigations in Buitenzorg and returning via China, Japan and America.

On the retirement of Prof. Wiesner in 1909, Molisch was appointed to the chair of plant physiology in the University of Vienna, which he held until 1928, when on retiring he was made emeritus professor. During this period, he received an invitation to take charge for three years of the newly established Biological Institute of the University of Tôhoku in Japan and was granted leave of absence for three years for this purpose by the University of Vienna. This Eastern visit, and a subsequent invitation to lecture and work at the Bose Institute in Calcutta, widely extended his opportunities for observation as one can readily see in his "Lebensdauer der Pflanze" (1929), in which plants from many lands are discussed.

In a more recent book, "Pflanzenchemie und Pflanzenverwandschaft" (1933), Molisch took up again what he admits was his favourite study, the microchemistry of plants, this time with a view of ascertaining what connexion exists between the chemical composition of plants and their relationship.

In all his studies, Molisch never lost sight of the applied side of botany, and his early horticultural training led him to write in 1915 a most useful "Plant Physiology as a Theory of Horticulture", which has passed through six editions and has been translated into several languages. When we consider the multiplicity of subjects which have engaged his attention, we realize that Molisch possessed an eager and inquiring mind constantly seeking for the solution of problems which presented themselves to him, working unremittingly and rapidly, and that he was able to present the results of his investigations with clarity and in forceful language. He remained active to the end, and so recently as 1937, when in his eightieth year, he published a striking series of experiments under the title "Der Einfluss einer Pflanze auf die andere".

By Molisch's death botany has lost a veteran who has enriched botanical science not only in the domain of plant physiology, in which he was one of the foremost workers, but also, as the record of his numerous books indicates, one who was a capable investigator in many other directions.

WE regret to announce the following deaths:

Prof. N. A. Borodin, emeritus curator of fishes in the Harvard Museum of Comparative Zoology, on December 22, aged seventy years.

Mr. W. B. Grove, formerly honorary curator of the Fungus Herbarium in the University of Birmingham, on January 6, aged eighty-nine years.

Dr. A. B. Rendle, F.R.S., formerly keeper of the Department of Botany in the British Museum (Natural History), on January 11, aged seventy-two years.

Mr. J. L. Starkey, director of the Wellcome-Marston Expedition excavating at Tell Duweir, on January 10.

Prof. Otto H. Warburg, For.Mem.R.S., director of the Kaiser Wilhelm Institut fur Zellphysiologie, on January 11, aged fifty-four years.

News and Views

Science and Social Problems

WE recorded last week (p. 69) the formation of a National Institute of Economic and Social Research, one of the functions of which will be scientific inquiry into the facts and problems of contemporary human society. The committee which has had this development under discussion since last March includes leading representatives of various aspects of economics; but we miss the names of scientific workers in the wider field of social biology, or with intimate knowledge of the forces which are chiefly responsible for the problems involved in the changed and changing social structure of all civilized peoples. Two statements on the interaction between science and society may be used to illustrate what we have in mind. One is an address given by Prof. H. Levy on December 13 at a meeting called by the Manchester Scientists Peace Association. He pointed out that men of science and their pursuits are a part of society and that the results of their work do not affect society more certainly than the nature of society itself determines the nature and extent of their own investigations. Prof. Levy's address was in the main concerned with the scientific and objective study of problems of peace, and he urged the claims of the scientific man to a greater share in administrative responsibility. His argument is, however, essentially similar to that of Prof. J. Marrack in his thought-provoking essay on the social implications of biochemistry, contributed to the volume of essays "Perspectives in Biochemistry" which was presented to Sir Frederick Gowland Hopkins by past and present members of his laboratory on his seventy-fifth birthday. Prof. Marrack points out that the future trend of biochemical investigation in problems of nutrition depends largely on what form society takes. It is only as a result of the biochemical work of the last thirty years, the discovery of vitamins and the later investigations of mineral and protein requirements that it has become possible to draw up diet standards. From this fundamental knowledge, the conclusion is reached that the health of a large proportion of the people of Great Britain would be improved by a better diet and that the adequacy of a family's diet depends on the family income.

CONTINUANCE of the present interest in the study of deficiencies may provide the level of scientific and economic development which makes the study of such problems practicable, and the impact of biochemistry on society may result in an economic diet standard based on the principle of the law of diminishing returns. Instead of social services being expanded to ensure that such a diet can be obtained by all, our present social system may equally lead to a collapse with even more examples of food deficiency, and perhaps destroy the environment necessary for their study. Prof. Marrack suggests, however, that a society which took as a major objective the use of all possible resources to increase the material welfare of the people would aim at the physiological optimum, and investigation would be transferred from the negative object of avoiding disease to the positive object of using an abundant food supply to achieve a new standard of health and vigour. To the provision of this abundance, biochemistry can make its own contribution, and Prof. Marrack refers also to the way in which the study of the hormones offers man the possibility of controlling his environment to suit his wishes. The sense of power over Nature which the growing knowledge of biochemistry supplies should gradually give all men the confidence to shed traditional beliefs and inhibitions and to shape a society in which all the possible resources of science and production are used for the common good.

Evolution and Ethics

NEARLY half a century ago Prof. T. H. Huxley, in a brilliant lecture on "Evolution and Ethics", pointed out that the view that Darwinism signifies nothing more than striving after personal or national mastery at all costs is a crude misconception of this great principle. The evolution of man himself embodies not only his physical structure but also all other attributes which have made him what he is: it involves the progressive development of standards of personal and social ethics and makes the welfare of the human race the highest purpose of the life of the individual and of the community. Material progress is only one aspect of such development, and the world is being reminded every day that it can be used as a destroying agency as well as a civilizing influence. In spite, however, of these prostituted activities, it must be acknowledged that the advance of science has, on the whole, led to the alleviation of human suffering and an increase in the capacity and the facilities for happiness. Any action—whether in peace or war—which makes degrading uses of scientific discovery and invention should be condemned by all who believe that in the evolution of man other factors are involved than those of the race to the swift and the battle to the strong. Prof. Conklin makes a most eloquent plea for the understanding of this high mission of science in the address on "Science and Ethics" delivered before the American Association for the Advancement of Science and published in the present issue of NATURE. The social aspects of scientific teaching and principles were also the subject of an address on "Science and Citizenship" delivered before the Science Masters' Association on January 5. It is only by action in the spirit of these addresses that we may hope for, or expect, any advance in the ethical evolution of man himself or of civilization, which is the expression of his activities.

The Services of Engineering to Mankind

NEARLY a century ago, Dr. Samuel Smiles realized the fundamental importance to civilization of the work of the engineer and correctly estimated the interest it must have for the public. In explaining his books he wrote, "Our engineers may be regarded in some measure as the makers of modern civilisation", and he records that in a letter to him Cobden wrote, "it cannot be doubted that each succeeding generation will hold in higher estimation those discoveries in physical science to which mankind must attribute henceforth so largely its progress and improvement". These views are brought to mind by the announcement made as to its aims by the Engineering Public Relations Committee, which has recently been formed on the initiative of the Institution of Civil Engineers acting in conjunction with the leading engineering organizations in London, with Sir Clement Hindley as its first chairman. Its function is to present to the public, in suitable form, information concerning the science and practice of engineering and its service to civilization. Through the ordinary channels of information, prominence is given to the spectacular side of such undertakings as the building of the *Queen Mary*, the construction of the Mersey Tunnel and that of the Sydney Harbour Bridge, to mention only three great works of the last few years, but this treatment tends to obscure from public view the knowledge of the ceaseless efforts being put forth to understand more fully the works of Nature and so to harness them to the service of mankind. It is only thus that such vast undertakings can be attempted with prospect of success.

IMPROVEMENTS in the manufacture of iron and steel and other materials and in the methods of using these products to meet the changing needs of the time, advances in the design and construction of engines and machine tools, new applications of electric, hydraulic and pneumatic energy and of the refrigerating principle are but a few of the lines on which advancement is being made. At the present time, it would appear that an era of the importance of alloy metals is beginning; by their means combinations of properties are being obtained such as open up new possibilities for the engineer. With the extension of the use of metals, more and more of the work of the world comes within his province, and it is therefore most desirable that the accomplishments, purposes and possibilities of the several branches of engineering should be more fully and more generally understood. The Committee proposes by means of lectures for schools and colleges, by exhibitions, and by co-operation with the Press, the British Broadcasting Corporation and the news film companies, to get into touch with the public. Efforts will also be made to work in conjunction with engineering societies outside London and with all bodies interested in engineering. The secretary and public relations officer is Lieut.-Colonel F. H. Budden, whose address is at 1–7 Great George Street, S.W.1.

Selection for Post-Primary Education

DR. W. P. ALEXANDER gave a paper at a meeting in connexion with the recent conference of the National Union of Teachers to members engaged in higher education, on "Methods of Selection for Post-Primary Education". He emphasized the need for basing any system of selection on the capacity of the pupils to profit by the type of education to be followed. As at present arranged, selection is based rather on good work done in the junior school, instead of on the grounds of the child's capacity to profit by the education offered. The first most important factor is general mental energy, expressing itself primarily in words, and this ability should be the basis of selection for the grammar school type of education, or in terms of things, showing itself as practical or technical ability. In addition, however, there is required for success in life the character quality of determination. How these requirements are to be tested is a matter for research, some at least of which has already been done. Dr. Alexander suggested that the first selection need only be very simple tests in English and arithmetic, in order to know if the child has sufficient facility to begin post-primary education. For the second selection we need tests to measure general mental energy in conjunction with verbal ability or with technical ability. Lastly, in the absence of reliable tests for character qualities, the considered opinions of the school staff could be utilized. Not only would this method be simpler than the one now in operation, but it would also free the primary schools from the examination fetish. Having ascertained how many pupils there are who have the capacity to profit by the grammar school or advanced technical instruction, the necessary facilities must be provided. For the others, senior modern schools with sufficient variation to allow for the varying degrees and types of capacities among the pupils are needed.

Research of the Royal College of Surgeons

THE scientific report of the Royal College of Surgeons of England for the past year reveals the extraordinary diversity of work which is being carried out in the Museum, Research Laboratories and the Buckston Browne Surgical Research Farm, in spite of the fact that work has been severely handicapped by a rebuilding programme which will give the College of Surgeons a unique research unit. There has been great activity in almost every field. In the Museum, the Pathological Curator reports considerable progress in the renewing of the pathological series, and in the fields of physical anthropology there have been large accessions of human material from archæological excavations in Great Britain and abroad. As for the purely research activities of the College, these have been carried on, although under difficult conditions, in temporary laboratories at St. Bartholomew's Medical School and at the Buckston Browne Research Farm. To mention only a few of the outstanding investigations which have been pursued in the course of the year, great progress has been made in the development of operative technique for the treatment of certain forms of heart disease, technique which has been most successful in its clinical applications. Work on the physiology of the urinary system has done much to solve the problem of the nervous control of the pelvis and ureter. Experimental research on nerve grafting, begun the previous year, has been continued, and is producing results which are of the greatest interest. Of particular importance from a practical point of view is the work on high blood pressure, which disease has been reproduced in the experimental animal, and has been found to resemble closely in its clinical features and histology arterial hypertension in the human. A fundamental problem which has been tackled is that of the relation of the central nervous system to carbohydrate metabolism and heat regulation, and we look forward with considerable interest to the further fruits of these investigations.

Publications of the Linnean Society

THE first part of the *Proceedings of the Linnean Society* for the 150th session (1937–38) has appeared. It contains the *acta* of the Society at meetings from that of October 28 to that of December 9; it embodies in full three of the papers read at the meetings, and abstracts of the others, whether reserved for printing in the *Journal* of the Society or not. It is exactly a hundred years since the Society began to print the *Proceedings*. At first they appeared two to five times during a session, in sheets of eight or sixteen pages, by which method during the ten years 1838–1848 the average interval between the making of a communication to the Society and its record in print was six months; and during the seven years 1848–1855 it was seven months. In 1856 the Society began to issue its *Proceedings* of an entire year after the end of the session and continued to do so for seventy-four years, except that between 1860 and 1872 they appeared each year in two, three or four parts as ready.

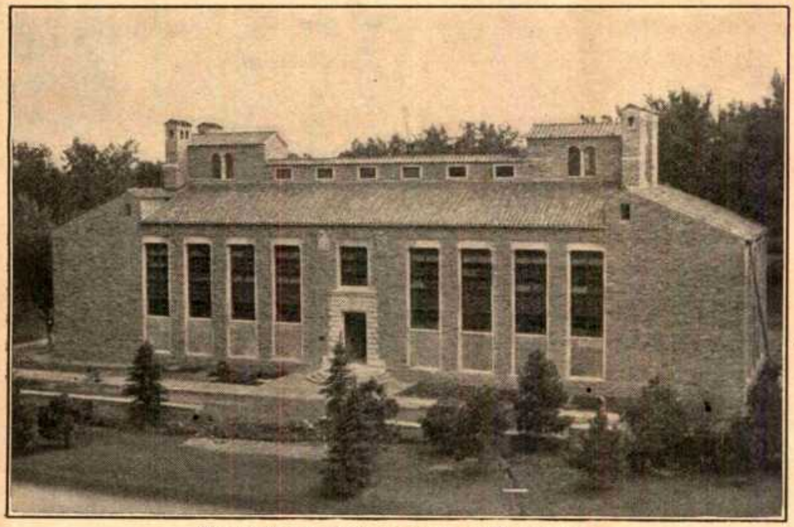
In 1930, the Society reverted to publication by sheets, issuing sixteen pages together or multiples of sixteen. There were nine parts containing the *acta* of the session 1930–31; but, as this entailed excessive charges for postage, the parts were enlarged in order to reduce their number so that they were in the successive years six, five, four and five. In 1935 it was determined that four should be the number of parts in each year; and so it remains. The part just issued is the first part for the session 1937–38. The interval between the reading of the first paper recorded in it and its appearance from the press has been only two months. Slight changes have been made in the format by the use of bold type and spacing so as to make the record fall conveniently into chapters, and to lead the reader quickly to what he wishes to find. The Society is to continue its endeavour to obtain an attractive, as well as a prompt, publication.

Safeguards Against Interruptions of the Electric Supply

THE public and industry now use electricity so largely that any interruption in the continuity of the supply is a serious matter which needs careful consideration. Two factors that accentuate this need are first the increasing growth and interconnexion of generating plant, leading to increased risk of serious damage on the occurrence of a fault, and secondly the increasing tendency to faults occasioned by the extended use of overhead lines for long-distance interconnexion and for supplying rural areas. In a paper on this subject read to the Institution of Electrical Engineers on January 6 by H. W. Clothier, B. H. Leeson and H. Leybourn, a full statement of the problem is given, and the best way of countering the risks run are considered for the various methods of supply. Particulars are given of high-speed small-oil-volume switches capable of breaking the circuit by utilizing in improved ways well-tried principles, and of an automatic reclosing 132 kilovolt oil circuit-breaker with an arc-duration of only one cycle of the current at full rating. It is claimed that when a fault has developed in a component of a supply system provided with protective safeguards of the automatic instantaneous protection type and fast-acting circuit-breakers, very little damage if any is done to the faulty component and there is practically no interruption to the supply. If a fault were to develop in an unprotected component of a supply system, the sustained feeding of power into it would probably lead to a serious breakdown and fire, with the risk of a long-maintained interruption of the supply. Occurrences of this nature have taken place during the last few years due, for example, to leakages from transient faults on overhead lines and leakages due to fires resulting from sustained arcing on unprotected apparatus. These risks are uneconomic and should be guarded against by safeguards of the type described in this paper, adequate to protect the network from damage.

New Museum of the University of Colorado

PROF. T. D. A. Cockerell writes: "When I came to the University of Colorado in 1904, there was no museum. Judge Junius Henderson, a lawyer, but also a very keen amateur naturalist, became honorary curator of the then insignificant collections. Owing to his energy and enthusiasm, the collections grew, and in course of time Henderson was made professor, and giving up his law, devoted his whole time to the Museum. Until recently, the collections were housed in one wing of a building devoted to instruction, and having become very extensive, were crowded so that it was difficult to find room for anything more. The collection of molluscs, in particular, is one of the best in America, and the many fossils include the types of numerous species of insects, shells and plants. The Museum has now moved into a new building, shown herewith. There are fine exhibition galleries for the zoological specimens, for the fossils and minerals, and for the important collections gathered by Earl Morris, representing the work of the ancient inhabitants of south-western North America. It is greatly regretted that Junius Henderson died on November 4, after a very long illness, and was not able to see the fruition of his years of labour in the new building. He has been succeeded by Prof. Hugo Rodeck."



MUSEUM OF UNIVERSITY OF COLORADO

Archæological Discovery at Sakkara, Egypt

THE discovery at North Sakkara, forty miles south of Cairo, of a tomb which it is thought may prove to be that of Menes, the first king of the First Dynasty of Egypt (c. 3300 B.C.), is of exceptional interest, both on account of its historical associations, and also in view of the fact that the tomb of this monarch had been thought to have been discovered many years ago by Sir Flinders Petrie at Abydos. The grounds for this tentative attribution of the tomb now found are the hundred or more clay sealings bearing the name 'Aha', generally identified as that of King Menes, and the fact that no other name appears. The discovery was made by Mr. Walter Emery, who has been engaged in excavation on the site for the past three years. Of all the tombs brought to light here up to the present, this is the largest. It contains five chambers. Its roof had fallen in and it had been plundered; but according to the reports in *The Times* of January 7–8, associated with the skeletal remains of two aged individuals was a large number of antiquities, of which the most important are quantities of stone and alabaster jars, many inscribed with the name of the king. The pottery includes shapes not hitherto recorded in Egypt. In addition to slate palettes there are fragments of funerary furniture, among which are the traditional ivory bull's legs of chairs and parts of a wooden bed similar in design to that already known as belonging to Queen Hetepheres of the Fourth Dynasty. A novel feature of the tomb is the coloured reed matting, which was affixed to the clay walls while they were still wet, forming, it is pointed out, a primitive kind of wall-paper. Many of the sealings bear inscriptions in black ink. Mr. Emery proposes to excavate below the adjoining Third Dynasty tombs in the hope that the discovery of the burial places of the king's servants will confirm the tentative attribution of the tomb to Menes.

Recent Acquisitions by the British Museum

IN the announcement of the additions to the archæological and ethnographical collections of the British Museum (Bloomsbury) during the past month it is stated that the antiquities from Skara Brae, Orkney, which were deposited in the collections on loan in 1933 have now been given to the Museum by the owner, Mr. Walter G. Grant. It will be remembered that this site was excavated by Prof. Gordon Childe, whose careful investigation of this remarkable prehistoric town, or village, revealed a picture of early culture so complete as to constitute on its primitive scale something in the nature of a 'Knossos' of the north. Among other antiquities accruing to the Museum are the remarkable and important collections of bronze knives, spear-heads and bracelets, gold ornaments and pottery acquired by Sir Leonard Woolley in his excavations at Atchana in Syria, including pottery imported from Cyprus and Mycenæ, as well as local ware of about 1650–1450 B.C. in imitation of Cretan pottery of Minoan type. The National Art Collections Fund has given a slab from the stone balustrade of a staircase of the palace at Persepolis, dating from the reign of Darius the Great or Xerxes, somewhere between 520 and 460 B.C. It is carved in relief with the figure of a human-headed lion, winged and wearing a horned headdress. The Christy Trustees have presented a fine and important group of Peruvian pottery from the southern coastal area of Peru in the neighbourhood of Nasca. This Nasca ware, now thought to date from about 200 B.C. to A.D. 200 is an early, though not the earliest, form of Peruvian prehistoric pottery, and is distinguished by the variety of colouring and the fineness of line of its painted decoration.

Television Receivers

IN the General Electric Co.'s (G.E.C.) *Journal* of May and August a description is given by D. C. Espley and G. W. Edwards of television receivers made by the G.E.C. and how they have withstood the tests to which they have been subjected. Since the Commission, formed in May 1934, considered the position of television as a public service, it has come very much to the front. The Commission decided that the standard picture should not be less than 240 lines, with 25 frames per second as the repetition frequency. They further recommended that work should be started on an experimental transmitting station with a 450 line 50 frame per second. The G.E.C. Research Laboratories concentrated, therefore, on the forthcoming transmissions from the Alexandra Palace. It was originally expected that this transmitter would provide good signals within a circular area of 25 miles radius. Results with the receivers have exceeded expectations. At Reading (39 miles), Tunbridge Wells (38 miles), Maidstone (38 miles), Farnham (42 miles) and Brighton (56 miles) the results are entirely satisfactory. Using a modified set, it was found possible to obtain a well-synchronized picture at the G.E.C. Radio Works at Coventry (80 miles), although at this distance the appreciable 'background' noise must produce visible effects on the picture. Apart from the effects of local irregularities, it is now stated that the field strength round the transmitter has an almost circular distribution. The small irregularities are generally due to shadows produced by the proximity of buildings and the contour of the hills. In a few cases it was found necessary to erect aerials with directional properties either for raising low field strength or to avoid local interference when it is excessive.

Agricultural Advice

THE Harper Adams Agricultural College, Newport, Shropshire, has issued a review of its advisory work in the West Midland province during 1936–37 (Adv. Rept. No. 12, pp. 23, May 1937). This is contributed by the advisory staff of the College, and bears the title of "Harper Adams Adviser". Topics of special interest are described, and the most significant tendencies are shown, but no attempt is made to condense the whole advisory activity into this small volume. Mr. F. S. Dennis shows, among other things, the high cost of milk production in Warwickshire, and indicates the lines of heavy expenditure. The correction of heart-rot in sugar beet, and 'Raan' in swedes, by the application of borax, is one interesting feature of Mr. W. Morley Davies's contribution, and the yield of milk deficient in butter-fat and total solids during spring and early summer also receives attention. This is a question vital to dairy farmers, for many cows do not provide milk which reaches the necessary legal standards at this period. "Some Causes of Winter Wheat Failure" is the main topic of Mr. H. C. F. Newton, the advisory entomologist, whilst Mr. N. C. Preston discusses the fungus disease of the same crop, known by the laconic name 'take-all'. Dr. A. Lloyd Provan compares the simple methylene blue test for the number of bacteria in milk, with the more accurate, but cumbersome, plating method. Veterinary investigational work is described by Mr. K. D. Downham.

Australian Science Abstracts

THE Australian National Research Council performs a useful service to its territorial men of science, and to a larger body of workers, by the publication of *Australian Science Abstracts*. This appears quarterly. (Subscription 4*s*. per annum, post paid, from the Editor-in-Chief, Australian Museum, College Street, Sydney.) Sections are devoted to agriculture, anthropology, botany and forestry, chemistry, economics and statistics, engineering, geography, geology, physics, physiology, veterinary science, and zoology. Papers on research findings or communications of general scientific significance are cited, and a short abstract follows most of the titles. Mr. T. Hodge-Smith is the editor-in-chief, and has the assistance of ten honorary abstractors. It is often difficult for the worker in Great Britain to follow research at the Antipodes, but this publication should make such contact possible.

The Reinmuth Earth-grazing Planet, 1937 UB

THIS object was discovered by Herr K. Reinmuth at Königstuhl on Oct. 28^d 22^h $27{\cdot}6^m$ U.T., near o Piscium. Its magnitude was estimated to be 10, but 24 hours later the magnitude was 8, an indication of rapid approach to the earth. As it moved nearly one hour in R.A. in this time, it was obviously fairly close to the earth. Herr Schewick at Sonneberg found images of it on four plates, from October 26 to 29, and orbits were computed from the results. Unfortunately, the short interval rendered the determination of the period very uncertain, and this was found to range between 1·1 and about 4 years. The other elements were computed with as close agreement as could be expected from the data, and the various orbits indicated a small inclination to the plane of the ecliptic—about 6°. On October 31 it made its closest approach to the earth, passing within 400,000 miles—the nearest approach of any minor planet. It reached perihelion about the middle of December, its distance from the sun being then 0·6 unit, that is, 56,000,000 miles. At present it is nearly 1 unit from the sun and about 1·5 units from the earth.

IT is certain that no accurate determination of the time of revolution around the sun is possible from observations over four days, and it is very improbable that it will be seen at the next return, unless by a most fortunate coincidence. Dr. M. Davidson described his computation of the orbit of 1932 HA at the Royal Astronomical Society in May 1932, and predicted that other planets of a similar character, making close approaches to the earth, would be discovered. Since May 15, 1932, when this planet approached the earth within 7 million miles, Adonis came within 1½ million miles in 1936, and now 1937 UB has made a closer approach than either. It is fairly safe to infer that there is a family of these small bodies, their diameter not exceeding 1–2 miles, the orbits of which lie well within the orbit of the earth, and that more of them will be discovered. Probably in the past the earth encountered many of them, but the craters formed, assuming that some of them struck the ground, not the ocean, have been obliterated in the vicissitudes of geological ages. It may be conjectured that our planet has swept up all that could possibly encounter it, for which reason a collision with one of these small bodies is an extremely remote possibility. It is hoped that some light will be thrown on problems of cosmogony through the study of these small planets.

The Night Sky in January

THE planets visible in the south-west sky in the evening are Mars and Saturn, and the approach of the former towards the latter will be noted, until, by February 2, Mars will have passed eastwards of Saturn. On January 20, Mercury is at greatest elongation (24° west) and may possibly be seen about 5° above the south-east horizon on that date at 7^h. In the middle of the month, Sirius souths at 23^h and is one of a conspicuous array of first magnitude stars to be seen southwards near the meridian. In order of apparent magnitude these stars are Sirius ($-1{\cdot}6^m$), Capella ($0{\cdot}2^m$), Rigel ($0{\cdot}3^m$), Procyon ($0{\cdot}5^m$), Betelgeuse ($0{\cdot}9^m$, variable), Aldebaran ($1{\cdot}1^m$) and Pollux ($1{\cdot}2^m$). Two of these stars offer extreme examples of stellar densities. There is Betelgeuse, a super-giant star with a diameter of about 250 million miles, the average density of which is one-millionth that of water. In contrast, the companion of Procyon, an extremely dense white-dwarf star of planetary dimensions, has a mean density more than a million times that of water.

Announcements

PROF. NIELS BOHR, professor of physics in the University of Copenhagen, and Prof. Georges Denigès, formerly professor of biological chemistry in the University of Bordeaux, have been elected *Correspondants* of the Sections of General Physics and Chemistry, respectively, of the Paris Academy of Sciences.

THE honorary membership of the Royal Asiatic Society has been conferred upon Prof. René Dussaud, Secrétaire perpetuel de l'Académie des Inscriptions et Belles Lettres et Conservateur honoraire des Musées Nationaux, Paris, in recognition of his eminent services to Semitic archæology, history and epigraphy.

COLONEL W. B. PURDON, professor of hygiene at the Royal Army Medical College, is to be promoted Major-General and will take over the office of commandant and director of studies at the College in March. He will succeed Major-General W. P. MacArthur, who will assume the appointment of director-general of the Army Medical Service on that date. The new professor of hygiene will be Lieut.-Colonel D. I. Richardson, at present assistant director of hygiene, the War Office.

THE University of Basle has conferred honorary doctorates on Profs. Paul Karrer and Leopold Ruzicka, who hold the chairs of chemistry at the University and Polyclinic at Zurich respectively. The former has investigated the structure of vitamins A and B, and the latter the structure of the sterols including vitamin D and the sex hormones.

THE following appointments and promotions in the Colonial Service have recently been made: Colonial Forest Service: A. R. Barrie (Malaya), J. S. P. Beard (Trinidad), H. A. Douglas (Gold Coast), D. C. Duff (Gold Coast), E. S. Erskine (Malaya), D. B. Fanshawe (British Guiana), F. P. Graves (Malaya), J. H. Nelson Smith (British Guiana); E. Davies, inspector of produce, Nigeria; R. F. Innes, assistant agricultural chemist, Jamaica; B. C. King, chemist and petrologist, Uganda; D. Sturdy (agricultural officer), senior agricultural officer, Tanganyika; Capt. W. S. Aitken, senior veterinary officer, Uganda; Dr. J. Carmichael, senior veterinary research officer, Uganda; R. J. Simmons, senior veterinary officer, Uganda; J. R. V. Smyth, senior agricultural superintendent, Agricultural Chemists' Branch, Jamaica.

A LIST of whole-time awards for scientific research, other than professorships, offered by public and private bodies in Great Britain and Northern Ireland has recently been issued by the Royal Commission for the Exhibition of 1851 (1 Lowther Gardens, Exhibition Road, London, S.W.7. Price 1*s*.). The list comprises fellowships, studentships, scholarships, etc., classified into: (*A*) open awards offered by private and public bodies other than universities or colleges; (*B*) open awards offered by universities or colleges; (*C*) awards restricted to candidates from particular localities or institutions. Particulars concerning each award are given. The list contains much valuable information, and should be kept at hand by heads of research departments and institutions.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

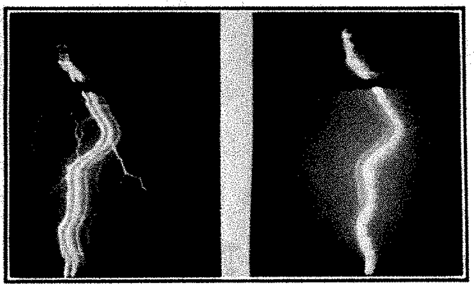
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 123.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Photography of Lightning in Daytime

THE photographic method of studying the luminous processes in the lightning discharge requires the shutter of a Boys or similar camera to be open before the flash occurs, and hence has hitherto been used only at night. Since the majority of land thunderstorms occur by day, I have for some years been trying various methods of recording lightning in the presence of daylight.

A photo-electric cell backed by a large silvered mirror gives successful results on flashes more than twenty miles away, the steady daylight component being cut out by a resistance-capacity coupled amplifier. Its records are, however, not as useful as photographs.



A chlorine-bromine filter in front of a quartz-fluorite lens can give actual photographs of the discharge without much fogging in daylight, since daylight does not contain the wave-length below 2900 A. which it transmits. The discharge is, however, only weakly luminous on these short wave-lengths, and the range of the camera is not more than three miles.

A very much better device has now been developed in which the discharge takes its own photograph, opening the shutter of the camera before the first main or return stroke occurs. The triggering of the shutter is accomplished by the aid of the train of electromagnetic pulsations sent out by the stepped leader which initiates the discharge. These are picked up by an aerial circuit tuned to the range of frequencies which these steps produce (30–10 k.c./sec.), and after rectification and amplification they operate a thyratron which discharges through a relay, the armature of which pulls on the trigger of a Compur shutter. The lag in the system is less than 0·005 sec.—considerably less than the time taken by the majority of stepped leaders to reach the ground—so that the shutter is open before the first return stroke occurs. The closing of the shutter is effected after 0·5 sec. in the usual way.

The accompanying figure shows two strokes which made up a single flash at a distance of about 2 km., and which were recorded by this device two hours before sunset on a camera with a fixed lens and a moving film. The dart leader to the second stroke is visible to the left of its main portion.

The motion of the film aids considerably in reducing the background fogging due to daylight. The camera can be exposed, for half a second, ten or more times before this fogging becomes serious. This is of importance, since the arrangement is sometimes triggered by discharges within the cloud which involve stepped processes.

The instrument has a range of 15 miles. Its first form was made in December 1936, but much better results have followed the development of a more satisfactory relay device which has been constructed for me by Messrs British Electricon Ltd.

B. F. J. SCHONLAND.

Bernard Price Institute of Geophysics,
University of the Witwatersrand,
Johannesburg.
Nov. 30.

Lightning Strokes

MANY years ago I published a discussion of the origins of lightning discharges[1] which affirmed that a discharge would be expected to begin at a place of maximum electric force (not potential) and to bore its way through the atmosphere, without tearing it, initially along the direction of the force. I now add to this a theorem, due, I think, to Clerk Maxwell, that in an electrostatic field the force cannot be maximum anywhere in free space. It follows that discharges must be initiated, most probably at any rate, within the thunder-cloud. If the discharge begins from a conducting surface, similar reasoning would assign its origin to the more convex parts. As the moving camera of Sir Charles Boys has proved its efficiency in various hands in tracing the course of discharges, this theoretical conclusion may be useful in discussion of observations.

As regards the formation of a thunder-cloud by the separation of the positive and negative ions along opposite directions, the discussions in Prof. Townsend's school on the time required to clear a gas of ions by means of an electric field are relevant.

JOSEPH LARMOR.

Holywood,
N. Ireland.
Dec. 20.

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[1] *Proc. Roy. Soc.*, A, **90**, 312-318 (1914); "Math. and Phys. Papers," **2**, 457-467.

Doppler Effect of Nuclear Resonance Level

EXPERIMENTAL and theoretical work has shown the existence of remarkably narrow resonance levels for the absorption of slow neutrons in certain nuclei[1-5]. In the cases of rhodium, silver (group A) and gold, the natural half-value width can be estimated as 0·06 volt, 0·05 volt and 0·12 volt, respectively. These values, however, may include errors of the order of 100 per cent. It has been pointed out by Frisch[5] that these widths are comparable with the Doppler width which such resonance must show in consequence of the thermal agitation of the capturing nuclei. According to Bethe and Placzek[3], the Doppler width is

$$\Delta = 4\sqrt{\frac{kT\ .\ E^r}{M}},$$

E_r being the resonance energy and M the mass of the nucleus. This leads to the following widths at room temperature: 0·07 volt for rhodium, 0·1 volt for silver, 0·12 volt for gold. In the case of silver, the Doppler width seems to be even greater than the natural width. In this case, heating a silver absorber should influence considerably the absorption in the middle of the resonance line. In consequence of the Doppler broadening, the absorption in the middle of the line should decrease with increasing temperature of the absorber. Therefore this effect should be observed with a thin detector, which is sensitive principally to the middle of the line.

We tried to find evidence of this effect in the following way. Between a thin silver detector (0·01 mm.) and a source of slow neutrons (400–700 mC. radon plus beryllium surrounded by water), a silver absorber (0·02 mm.) was stretched. This silver foil absorbed 25 per cent of the resonance neutrons of group A detected by the absorber, the activity of which was measured for 45 seconds after an irradiation of 60 seconds. A cadmium filter (1 mm.) was placed between absorber and detector during all measurements. By passing a current of about 200 amperes through it, the absorber could be heated to about 800°. The foil was always well stretched; the detector was cooled by an air current and the water of the source was kept flowing in order to prevent heating. Counting more than 25,000 kicks, the absorber being hot and cold in turns, we found an increase in intensity of $(5{\cdot}2 \pm 1{\cdot}4)$ per cent when the absorber was heated. Not more than 1 per cent increase can be attributed to thermal extension of the absorber. It can be said, therefore, that a change of intensity of more than 4 per cent, or a change of the absorption coefficient of 25 per cent, must be attributed to the Doppler effect. For a thicker absorber (0·1 mm.) no effect was observed. This might have been expected because radiation transmitted by such an absorber is principally concentrated on the borders of the line where the absorption is but slightly modified.

The observed effect provides a possibility of estimating the breadth of the silver resonance line by a direct experimental method.

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HUGH PAXTON.

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Paris. Dec. 14.

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[1] Amaldi, E., and Fermi, E., *Phys. Rev.*, **50**, 899 (1936).

[2] Breit and Wigner, *Phys. Rev.*, **49**, 519 (1936).

[3] Bethe, H. A., and Placzek, G., *Phys. Rev.*, **51**, 450 (1937).

[4] v. Halban, H., and Preiswerk, P., *J. Phys.*, **8**, 29 (1937).

[5] Frisch, O. R., *Kgl. Danske Vid. Selsk.*, **14**, 12 (1937).

Thomson Effect of Supraconductive Lead

VARIOUS investigations have proved that the thermo-electric force between supraconductors is zero[1]. This might suggest that the Thomson effect in a supraconductive metal is also zero, although it is conceivable that the Thomson coefficients of different supraconductors have the same but finite value. It was therefore decided to determine the Thomson coefficient of supraconductive lead directly.

The experimental arrangement consisted of a ring of lead wire, to which two copper vessels containing liquid helium were attached at the opposite ends of a diameter. On one side of the ring half way between the containers the bulb of a gas thermometer was attached. The whole arrangement was suspended in a vacuum, and a temperature gradient in the ring was kept up by allowing the helium in the containers to boil under different pressures. Persistent currents in opposite directions were successively set up in the ring, and the gas thermometer read in each case. No change in the temperature of the thermometer could be observed, which means that the Thomson coefficient of the metal is zero, or at least smaller than 4×10^{-10} volts per degree.

This result is interesting in connexion with the specific heat of the supraconducting electrons. The existence of such a specific heat is apparent from the heat capacities of supraconducting metals determined in Leyden[2], and we have evaluated the specific heat of a system of supraconductive electrons by direct determination of the difference in free energy between the supraconductive and the normal state[3]. The fact that this specific heat is not zero means that there is an exchange of thermal energy between the supraconductive electrons and the lattice. Although the theory of the free electrons in metals as yet gives no satisfactory results for the Thomson coefficient (except for the alkali metals), it is evident that the Thomson coefficient is to some extent a measure of the specific heat of the electrons[4]. The fact that in one case the specific heat can be observed directly and in the other case it is not apparent in the Thomson coefficient seems to suggest that, in general, electrons in a supraconductive metal exchange thermal energy with the lattice, whereas those taking part in a persistent current do not.

A more detailed discussion of the result in connexion with the other phenomena of supraconductivity will be given elsewhere.

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Dec. 21.

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[1] Borelius, G., Keesom, W. H., Johansson, C. H., and Linde, J. O., Comm. Leiden, **217c**. Meissner, W., *Z. ges. Kälte-Industrie*, **34**, 197 (1927).

[2] cf. Keesom, W. H., and Kok, J. A., *Physica*, **1**, 175 (1933).

[3] Daunt, J. G., and Mendelssohn, K., *Proc. Roy. Soc.*, A, **160**, 127 (1937).

[4] Sommerfeld, A., and Bethe, H., "Handbuch d. Physik", **24**, 2, 356 (1933).

Nature of the Nuclear Field

AN attempt to explain neutron-proton interaction made by Yukawa[1] in 1935 has been brought to general notice[2,3] in connexion with the new experimental evidence for the existence of a 'heavy electron'[4,5,6].

Although it is premature to draw definite theoretical conclusions from the present experimental knowledge, it is certainly suggestive that a Yukawa particle with a mass of the observed order of magnitude (100 m_{el}) does indeed give nuclear forces of the correct range. As nothing is otherwise known about the strength of the interaction of these particles with protons and neutrons, one can also assume it to be so large as to account for the known magnitude of the neutron-proton force.

Unfortunately, a theory based on the scalar relativistic Schrodinger equation, as suggested by Yukawa, cannot explain the experimentally known position of the ^1S level of the deuteron relative to its ^3S ground state.

It has, however, been found that a more satisfactory result can be obtained if one admits a *vector* wave function for the new particle, such as was used by Proca[7] in a different connexion. Proca's equations can be quantized on lines completely analogous to the Pauli-Weisskopf method[8] for the scalar wave equation, and the resulting neutron-proton potential can easily be determined. Using the most general combination of possible interactions of the Yukawa and Proca type, the potential is found to be

$$V(r) = \left\{ A + B(\sigma_N \sigma_P) + C\,k^{-2}(\sigma_N \text{grad})(\sigma_P \text{grad}) \right\} \frac{e^{-kr}}{r},$$

where k is $2\pi c/h$ times the rest mass of the new particle, σ_N and σ_P the spin operators of neutron and proton respectively and r the distance between these particles. A, B and C are constants and are independent with regard to both sign and absolute magnitude. Therefore an interaction can obviously be chosen which gives the correct triplet-singlet separation.

The nuclear potential now considered most adequate for practical calculations[9] has exactly the spin dependence one obtains from the above expression by putting $C=0$, $A:B=3:5$. It further includes the 'isotopic spin' factor ($\tau_N \tau_P$) which can be accounted for in the field theory here proposed exactly on the same lines as in the case of the Fermi field[10], that is, by assuming that the new particle also has a charged and an uncharged state. It is a question yet to be considered whether a complete description of experimental data may also be possible *without* assuming this uncharged state to exist; also whether any specialized type of interaction of greater simplicity than the above general linear combination might perhaps suffice to fit the facts.

In any case, it is possible to give a field theory in which magnitude and range of the nuclear forces, as well as their dependence on spin and charge, are all accounted for equally well. It appears satisfactory to have such a model, even though its relation to experiment is admittedly quite uncertain.

The details of the calculation will be published elsewhere.

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Dec. 8.

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[1] Yukawa, *Proc Phys.-Math Soc Jap*, **17**, 48 (1935)

[2] Oppenheimer and Serber, *Phys Rev*, **51**, 884 (1937)

[3] Stueckelberg, *Phys. Rev*, **52**, 41 (1937).

[4] Neddermeyer and Anderson, *Phys Rev*, **51**, 885 (1937)

[5] Street and Stevenson, *Phys. Rev.*, **51**, 1005 (1937).

[6] Street and Stevenson, *Phys. Rev.*, **52**, 1003 (1937).

[7] Proca, *J. Phys*, (vii), **7**, 347 (1936).

[8] Pauli and Weisskopf, *Helv. phys. Acta*, **7**, 709 (1934).

[9] Heisenberg, *Naturwiss.*, **25**, 749 (1937).

[10] Kemmer, *Phys Rev*, **52**, 906 (1937)

Nuclear Forces, Heavy Electrons and the β-Decay

WE have generalized a theory put forward by Yukawa[1] showing that nuclear forces can be explained by assuming the existence of new particles of mass about two hundred times that of the electron. Our theory is relativistically invariant, and in its present form gives results which we believe are of actual significance for cosmic ray and nuclear phenomena.

Our theory is based on the idea that the proton and neutron are two states of the same particle characterized by the eigenvalues -1 and $+1$ respectively of some operator, τ say, and that transitions may occur from one state to the other with the emission or absorption of a particle of positive charge e and mass M_u. It follows from this that such a particle, which we shall call a U-particle, obeys Bose statistics. In order to explain the β-decay, we must then assume that in certain circumstances an electron may absorb a U-particle by becoming a neutrino or vice versa. Of course, the emission or absorption of a U-particle only takes place observably when it is consistent with the conservation of energy. In other cases the emission or absorption is merely virtual, as an intermediate state, as is the case in the quantum theory of radiation.

The motion of the U-particles is described by a 4-vector U_μ. Denoting by Ψ the wave function for the proton-neutron, which in consequence has two components corresponding to the two states of this particle (each component itself being really composed of the four components belonging to a wave function for a particle obeying the Dirac equation), by ψ the similar wave function for the electron-neutrino, and by φ_μ the electromagnetic potentials, we can derive the complete equations of motion of the whole system in the usual way by the variation of a relativistically invariant Lagrange function with respect to Ψ, ψ, U and φ. Using the methods of the second quantization, the equations can then be written in the Hamilton form necessary for quantum mechanics. Writing

$$G_{kl} = \left(\frac{\partial}{\partial x_k} - \frac{ie}{hc}\varphi_k\right) U_l - \left(\frac{\partial}{\partial x^l} - \frac{ie}{hc}\varphi_l\right) U_k, \quad (1)$$

the equations of motion for the U-particles are

$$h^2c^2\left(\frac{\partial}{c\partial t} + \frac{ie}{hc}\varphi_o\right)G_{ok} + h^2c^2\left(\frac{\partial}{\partial x_l} - \frac{ie}{hc}\varphi_l\right)G_{lk} -$$
$$M_u^2c^4U_k - g\,\overline{\Psi}\,\alpha^k\tau_{NP}\,\Psi - g'\,\psi\,\alpha^k\,\tau_{en}\,\psi = 0, \quad (2)$$

and

$$G_{ok} = -\left(\frac{\partial}{c\partial t} + \frac{ie}{hc}\varphi_o\right) U_k - \left(\frac{\partial}{\partial x_k} - \frac{ie}{hc}\varphi_k\right) U_o, \quad (3)$$

and their conjugate complex equations. $l, k = 1, 2, 3$ and g, g' represent the interaction of the U-particles with the proton-neutron and electron-neutrino respectively, and are the only two arbitrary constants in our theory. τ_{NP} is a matrix representing the change of a proton into a neutron and τ_{en} similarly represents the change of a neutrino into an electron. In addition, exactly as in electrodynamics, the equation

$$h^2c^2\left(\frac{\partial}{\partial x_k} - \frac{ie}{hc}\varphi_k\right)G_{ok} + M_u^2c^4U_o + g\overline{\Psi}\tau_{NP}\Psi$$
$$+ g'\overline{\psi}\tau_{en}\psi = 0, \quad (4)$$

has to be imposed as a boundary condition. The equation of the proton-neutron is

$$\Big[c\,\alpha_\mu\Big(p_\mu - \frac{e}{c}\varphi_\mu\tau_p\Big) + \beta\Big(M_N c^2\tau_N + M_P c^2\tau_P\Big) + g\,\Big(U_\mu\alpha_\mu\tau_{PN} + \overline{U}_\mu\mu_\mu\tau_{NP}\Big)\Big]\,\Psi = 0, \quad (5)$$

where τ_P and τ_N are matrices which are unity only when the particle is a proton or neutron respectively, and zero otherwise. M_N and M_P are the masses of the neutron and proton. A similar equation holds for the electron-neutrino. The charge density of the U-particles is given by

$$\sigma_0 = iehc\,(\overline{U_k}\,G_{ok} - U_k\,\overline{G_{ok}}), \quad (6)$$

and the commutation rules being

$$-\,ihc\,(\overline{G}_{ok}\,(x^1)\,U_l\,(x) - U_l(x)\;\overline{G}_{ok}\,(x^1)\,) = \delta_{kl}\,\delta\,(x-x^1) \quad (7)$$

and the conjugate equations, the existence of U-particles of positive and negative charge follows automatically as in the case of the Klein-Gordon equation treated by Pauli and Weisskopf[2].

The purpose of this note is to point out the following consequences of the theory.

(1) A positive U-particle at rest may disintegrate spontaneously into a positive electron and a neutrino. This disintegration being spontaneous, the U-particle may be described as a 'clock', and hence it follows merely from considerations of relativity that the time of disintegration is longer when the particle is in motion. We believe that this may have to do with the fact observed by Blackett and others that below 2×10^8 e.v. most cosmic ray particles are electrons, above this energy heavy electrons. In a previous paper[3] we have shown that the experimental evidence requires that heavy electrons can apparently turn into ordinary electrons. Our U-particles are then to be identified with the heavy electrons, and it follows that most of the heavy electrons have been created either in the earth's atmosphere or not very far from it.

(2) The U-particles will suffer large energy losses in addition to the ionization and the *Bremsstrahlung*, due to collision with neutrons in which they are absorbed and re-emitted with less energy (analogue of the Compton effect).

(3) On colliding with a neutron they may be absorbed to form a fast proton, but only in the presence of other particles.

(4) It gives a relativistic interaction between a proton and a neutron which in the non-relativistic case reduces to the Heisenberg-Majorana exchange force of the type $-g^2e^{-M_u cr/\hbar}/r$.

(5) It may be objected that the use of the Dirac equation to describe the proton-neutron is incorrect inasmuch as it gives a wrong value for the magnetic moment. This objection, however, fails if the magnetic moments of the proton and neutron can arise through their interaction with the U-particles. It is quite easy to see without any calculation that our theory gives magnetic moments of opposite sign to the proton and neutron, as is required by experiment.

(6) When the maximum energy of the β-ray spectrum is not too large, it can be shown that our theory reduces exactly to Fermi's. In the general case, however, characteristic differences will appear which may improve the agreement with experiment.

Lastly, we would remark that the U-particles being charged, they cannot explain the close-range proton-proton interaction. To formulate this, we would have to introduce a neutral particle N of about the same mass M_u, which obeys similar equations to those for the U-particles and can be absorbed and emitted when a proton jumps from one energy state to another. The introduction of such a particle may not seem very arbitrary when we consider that it would give us a symmetrical state of affairs, with all the particles falling into three groups with masses of the order $M_P \simeq 1840\ m_e$, $M_u \approx 200\ m_e$, and m_e, there being positive, negative and neutral particles of each group. The introduction of the N-particles would give, in addition to the processes mentioned above:

(7) The absorption of a positive U-particle by a neutron and the re-emission of an N-particle, and vice versa. This would give rise to a type of chain U–N–U, etc., such as we have already discussed[4] in connexion with the proton-neutron interaction.[5]

The detailed calculations are being published elsewhere.

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Dec. 13.

[1] Yukawa, H., *Proc. Phys-Math Soc Japan*, **17**, 48 (1935)

[2] Pauli and Weisskopf, *Helv phys Acta*, **7**, 709 (1935)

[3] Bhabha, H. J, *Proc Roy. Soc*, in the press.

[4] Bhabha, H. J, NATURE, **139**, 1103 (1937)

[5] Some of the points noted above were also mentioned by Dr. Heitler in a conversation with me on the original Yukawa theory. Cf. also Wenzel, G, *Z. Phys.*, **104**, 34 and **105**, 738 (1937) for a different introduction of new Bose particles.

Sulphur Content of the Intercellular Phase of the Wool Fibre

RECENT advances in the chemistry of wool and wool textile processes have been based on the simple view that the fibre consists of peptide chains bridged by cystine and salt linkages. The differences between the constituent phases of the fibre and its cells were reserved for investigation until the significance of main structural features had been determined. In connexion with a detailed study of the reactivity of the sulphur linkage in animal fibres[1], however, we have found it necessary to determine whether the intercellular phase of the fibre differs in sulphur content from the cortical and cuticular cells.

The investigation was in progress[2] when Stakheyewa-Kaverznewa and Gavrilow[3] reported that the cells isolated from wool by means of pancreatin possessed a sulphur content of 3·05 per cent compared with 2·91 per cent for the original wool. This result suggested that the intercellular phase was deficient in sulphur, in agreement with Astbury and Woods' hypothesis[4], but some doubt remained because Stakheyewa-Kaverznewa and Gavrilow did not restrict their attention to non-medullated fibres, and took no account of the action of light in reducing the sulphur content of the tips of the fibres. Preferential isolation of intact cortical cells from fibres which have been damaged by exposure to light and contain sulphur-free medulla, would give the observed result whether or not the intercellular phase is deficient in sulphur.

We have, however, been able to show that Stakheyewa-Kaverznewa and Gavrilow's conclusion is correct, although when intact non-medullated fibres are used, the difference in sulphur content between the fibres and their constituent cells is higher than they report. The root ends of non-medullated, Australian 64's merino wool staples were used for the investigation. After purification by extraction with alcohol, ether and water, the wool was retted at 35° C. in 1 per cent trypsin solution at pH 8·6[5]. Although the fibres retained their original form at the end of fourteen days, they crumbled readily when rubbed with water on a glass plate. The cells isolated in this way were washed repeatedly by decantation until the wash-water had a pH of 6·9 and gave only a faint ninhydrin reaction after concentration. Part of the material so obtained was retained for sulphur determinations, and the remainder treated with fresh trypsin solution for a further sixteen days. At the end of this time, the cells were again washed, separated and dried. The sulphur contents of the various materials, dried to constant weight *in vacuo* over phosphorus pentoxide, were determined by the Carius method and are given below.

Material	Time of retting (days)	Sulphur content (per cent)	Ash content (per cent)
Original wool .	—	3 52 3 50	0 63
Cells	14	3 61	0 26
Cells (treated with HCl to reduce ash content)	14	3 65 3 65	0 16
Cells . .	30	3·87 3 86	—

From these results, it seems clear that the amorphous intercellular phase of the fibre has a smaller sulphur content than the cells. The sharp rise in sulphur content of the latter, after the second treatment with trypsin, is probably due to more complete removal of the amorphous phase from the separated cells, but the possibility of attack on the cells, with isolation of more crystalline components, is under examination.

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Dec. 17.

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[1] Speakman, NATURE, 132, 930 (1933), *J Soc. Dyers and Colourists*, **52**, 335, 380, 423 (1936), **53**, 236 (1937); *J. Text. Inst*, **27**, P231 (1936), NATURE, **138**, 327 (1936)

[2] McMahon, Ph D. Thesis, University of Leeds, June 1937.

[3] *Bull Soc. Chim.* (*Mémoires*), **4**, 647 (1937)

[4] *Phil. Trans. Roy Soc.*, A, **232**, 333 (1933)

[5] Burgess, *J. Text. Inst*, **25**, T289 (1934).

Vitamin C and Phosphatases

THE influence of vitamin C on enzymes offers a new approach to the mode of action of the vitamin in plant and animal life. The presence of vitamin C in green leaves and storage organs of plants in which the synthesis and cleavage of organic phosphorus compounds play an outstanding part has suggested the investigation of a possible biochemical relationship between the vitamin and phosphatases. The present note relates to a study of the influence of vitamin C, either alone or in presence of other substances of physiological importance, on the enzymic splitting of phosphorus compounds by highly active preparations of phosphatase prepared from sprouted soybean as described by me[1].

It was found that the oxidation of vitamin C by metallic catalysts like $Cu^{\cdot\cdot}$ and other oxidizing agents brings about the inhibition of the activity of the phosphatase. The inhibition by the vitamin C-copper complex was annulled by glutathione, cysteine, cystine, hydrogen sulphide and reducing agents like potassium cyanide and sodium hydrosulphite. Oxidizing agents like potassium ferricyanide in presence of vitamin C inhibit the activity of the enzyme. The rate of oxidation of the vitamin appears to control the degree of inhibition. Substances which prevent the oxidation of vitamin C or decrease its rate of oxidation prevent inhibition or decrease the extent of inhibition of the activity of the phosphatase.

The hydrolysis of pyrophosphate was less affected by the vitamin C-copper complex than that of glycerophosphate. This difference in behaviour of pyrophosphate is found to be due to its stabilizing action on the vitamin against catalytic oxidation[2]. The results, therefore, suggest that pyrophosphate may have a physiological function in protecting the vitamin against oxidation, thereby regulating the activity of the phosphatase. Dehydroascorbic acid either alone or in presence of $Cu^{\cdot\cdot}$ was found to have no influence on the activity of the phosphatase.

Hence it may be stated that the regulation of phosphorus metabolism in plants, by the interaction of phosphatases, vitamin C and glutathione, in the sense of hydrolysis on one hand and synthesis on the other, possesses a physiological significance. The opposite actions of vitamin C and glutathione suggest, therefore, a possible means by which the action of phosphatases may be controlled in plant life.

It is hoped to extend these studies to animal phosphatases and to determine the relation between glutathione, vitamin C and phosphatolysis. Full details of the work will be published elsewhere.

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Dec. 15.

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[1] Giri, K. V., *Z. physiol. Chem.*, **245**, 185 (1937).

[2] Giri, K. V., *Ind J Med. Res*, **25**, 443 (1937)

Formation of Radio-Phospholipid by Isolated Tissues of the Rat

IN a forthcoming paper[1] will be published the results of a study of phospholipid formation in the living rat by means of radioactive phosphorus. The content of labelled phospholipid sampled at various intervals suggested that certain tissues of this animal, namely, the liver, intestine and possibly kidney, engaged in synthesis. Similar observations have been reported by Artom *et al.*[2]. The possibility, however, that one tissue carried on this synthesis while other tissues concentrated phospholipids could could not be ruled out. Warburg's method for the study of the metabolism of surviving tissues suggested a direct attack on the relative roles of the various tissues of the body in phospholipid formation. The experiments described below were performed to test the possibility of this synthesis by tissues surviving after excision from the body.

The tissues, as sections or slices, were treated after the manner of Krebs[3] with the modified phosphate buffer in the presence of oxygen. Both phosphate solutions contained radioactive phosphorus. Phospholipid was extracted from the tissues and substrate by means of alcohol and ether. The petroleum ether extract of the alcohol-ether soluble fraction was shaken vigorously for three hours, with an aqueous solution of inactive sodium phosphate, to remove water-soluble phosphorus compounds. This procedure was repeated twice. The absence of radioactivity in the last aqueous extract indicated that the removal of the contaminants was complete. The phospholipid of the petroleum ether extract was then precipitated in the usual manner and its radioactivity determined by means of a small Geiger counter. Egg lecithin was added to the petroleum ether solution to serve as a carrier for the labelled phospholipid.

For controls, tissues killed either by hot alcohol or by boiling for several minutes in Krebs solution, were treated in the same manner as the surviving tissues. The values for the controls were zero within experimental error.

The formation of labelled phospholipid by surviving liver, intestine and kidney is recorded in the accompanying table. The results show that phospholipid formation is not confined to one tissue. The high activity of the kidney is of particular interest in this regard. The synthesis effected *in vitro* by these tissues is comparable with that found in the same tissues of the intact animal[1]. The results suggest that glucose stimulates phospholipid formation, but further work on this point as well as other tissues involved in synthesis is in progress. It should be noted here that the term formation or synthesis does not permit differentiation between the various ways in which phosphorus may become incorporated into the phospholipid molecule. The possibility of interchange has not been ruled out[4].

Tissue	Experimental period	Per cent labelled phosphorus as phospholipid (per gm. dry defatted tissue)	
		No glucose	Glucose
	hours		
Liver	2	0·52 (single result)	0·65 (single result)
	3	0·83 (average of 2 results)	1·80 (single result)
	4	1·31 (single result)	
Intestine	0·75	0·12 (single result)	
	1·25	0·19 (single result)	
	1·5	0·24 (single result)	
	2	0·34 (average of 2 results)	1·24 (single result)
	3	0·38 (single result)	0·55 (single result)
Kidney	1	0·58 (average of 2 results)	
	2	1·25 (single result)	
	3	1·79 (average of 3 results)	

The detection of the minute quantities of phospholipid (so low as 10^{-4} gm. of phosphorus were studied) synthesized by the tissue slices was made feasible by the use of a sensitive indicator such as radioactive phosphorus. Our thanks are therefore due to Prof. E. O. Lawrence and the members of the Radiation Laboratory for the preparation of the radioactive phosphorus used in this study.

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I. PERLMAN.
S. RUBEN.
I. L. CHAIKOFF.

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Mode of Dissemination of Potato Virus X

VIRUS X is the commonest and most ubiquitous of all the potato viruses, but every attempt to discover an insect vector or other natural method of spread has failed. It has now been found, as a result of three experiments carried out in 1937, that it spreads freely from potato plant to potato plant under controlled experimental conditions by leaf contact, especially that brought about by air currents, without the intervention of instruments or human agency, and in circumstances excluding insect participation.

In the first experiment, four lots of X-free tuber portions (derived from 14 quartered tubers, and 13 halved ones in addition in (*A*) and (*B*) below) were interplanted under different conditions with X-infected tubers. The first lot of 27 pieces (*A*) was grown in pots on one side of a small insect-proof glass-house compartment with the haulms of the healthy and diseased plants in contact, and 14 of the healthy plants were in the same pot as a diseased plant, and 13 in separate pots. In order to increase leaf contact, an oscillating electric fan was allowed to play on the plants from a distance of 3 ft. for about nine hours per week. The second corresponding lot (*B*) was grown on the opposite side of the same compartment 3 ft. away, under exactly the same conditions in all respects but two: (1) the haulms of the diseased and healthy plants, whether growing in the same or separate pots, were separated by cylinders of ½-inch mesh wire netting surrounding the former; and (2) the fan did not play on them.

The third lot (*C*), consisting of 14 pieces, was planted in three drills in the field with the diseased and healthy plants alternating at a distance of one foot from each other, and three of the healthy tubers and the adjacent diseased ones were planted in 9-inch pots sunk in the ground to minimize root contact. The fourth corresponding lot (*D*) was grown 4 ft. away under the same conditions in all respects except that the haulms of the diseased plants were enclosed in two cylinders of ½-inch wire mesh one inside the other with a space of about 1 inch between. The haulms were isolated in this way so as to maintain the usual spacing and root contact, without making insect access more difficult above or below ground.

The presence of virus X was determined by inoculation to *Datura Stramonium* at intervals. All the plants from healthy tubers proved to be free from virus X at first, but infection afterwards appeared in some, and the following were the final results on *Datura*:

A	House :	haulms in contact (fan)	8/27 infected
B	House :	haulms separated	0/27 ,,
C	Field :	haulms in contact	2/14 ,,
D	Field :	haulms separated	0/14 ,,

Of the eight plants infected in the house, three were in separate pots and five in the same pot as a diseased plant. There was no evidence of infection through root contact either here or in lot *B*.

A further experiment was later carried out in the house on the same general lines to assess the effect of the fan, the plants being in separate pots. All the plants from X-free tubers proved healthy in the first three tests, but they afterwards developed X infection to the following extents:

House :	haulms in contact (fan)	4/16 infected
House :	haulms in contact	1/16 ,,
House :	haulms separated	0/16 ,,

The fan set up an air current of 6 m.p.h. at a distance of 3 feet, which did not injure the leaves. The results are interpreted as showing that virus X is readily disseminated within a potato crop by leaf contact, probably mainly under the influence of wind. This is in harmony with observation, for the virus is a universal one, which spreads even in the best districts, and demands a universal agency, unlike the aphid-borne viruses, the distribution of which is limited by ecological factors. It is likely that no insects are involved, and the danger of infection underground is slight or absent. The question is not prejudged whether the foliage must be in actual contact or whether any other agent may be able to convey the virus from a greater distance.

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Paul A. Murphy.

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Dec. 16.

Cytology of Spruce Sawfly and its Control in Eastern Canada

In the autumn of 1930, serious defoliation of some 2,000 square miles of spruce forest by a species of sawfly was discovered in the interior of the Gaspé Peninsula, Province of Quebec, Canada. This has now increased to about 8,000 square miles of heavy infestation. The insect, previously unreported in America, was identified as *Diprion polytomum* Hartig, a species known in Europe for more than a hundred years.

The 'typical' European and Canadian forms are very similar in appearance but differ primarily in their type of parthenogenetic reproduction. In the absence of fertilization, eggs of the former develop into males, while those of the latter almost invariably produce females. The rare males (1 in 1,200) are almost always sexually functionless. Further, the Canadian form spins its cocoons in the moss and litter below the tree, and in general the larvæ remain dormant for more than a year, whereas the European form as a rule spins in the lower foliage or herbaceous growth above ground, and the larvæ appear to develop without going into diapause.

As the spruce is by far the most important forest tree in Canada, the suppression of such a destructive insect is clearly of vital importance. That the physiological characters which distinguish it from the European form are of considerable advantage to it is self-evident. Moreover, native parasitic insects are almost non-existent. In an attempt at control, large numbers of European parasites are being introduced. By co-operating with the Farnham House Laboratory, the Belleville Laboratory in Ontario has been able to breed and release during 1937 alone more than 47 million insects capable of attacking the sawfly in the feeding and dormant stages.

If, as entomologists are led to assume, this insect was originally introduced from Europe, the physiological differences are either secondarily acquired or already exist side by side in different European strains. To settle this question the Dominion Entomological Branch has provided facilities and financial aid for a cytogenetic investigation.

The chromosomes have been studied in both sexes of *Diprion polytomum* collected from Eastern Canada and Hradec u Opavy, Czechoslovakia. In the Hradec male and female there are six and twelve chromosomes respectively; in the Canadian form there are seven and fourteen. Despite the difference in the type of parthenogenesis shown by the two, the sex-determination in both is of the haplo-diploid type common in the Hymenoptera.

In males of the two forms no difference was found during spermatogenesis. The chromosomes of the first spermatocytes, during prophase, fail to synapse and the whole complement passes towards the centrosome of the unipolar spindle. At second metaphase each chromosome splits longitudinally and the halves migrate towards the poles of the bipolar spindle. The second spermatocyte cleaves into two equal-sized spermatids possessing the same number of chromosomes as the soma.

In the females the oogonia are diploid. In both forms the oocyte chromosomes pair to form the haploid number of tetrads, and their chiasmata entail an orientation of the chromosomes such as must lead to a reduction in number at the first division of meiosis. It is obvious that, in the Canadian form, the diploid number must be restored by some form of auto-fertilization.

These preliminary results do not eliminate the possibility of the two forms occurring together in Europe, for if they overlap in distribution, and their progeny mix, this would mask the fact that parthenogenesis in one of them leads to the production of females. To test this possibility material was obtained from different bio-climatic regions in Czechoslovakia.

Females from five distinct regions laid unfertilized eggs which developed into 36 larvæ. These all gave small-sized cocoons which were spun up in the foliage, and upon reaching maturity proved to be males; two from different mothers were found to possess the male complement of six chromosomes. On the other hand, a virgin female from another region produced 13 cocoons which were not only large (presumably female) but were buried in the debris on the floor of the rearing-globe. Their chromosome number has not yet been established, for the significant reason that the larvæ have gone into diapause.

Clearly then a form exists in Europe which (at least under laboratory conditions) resembles the Canadian form and differs from the European form hitherto recognized in three of the four essential characters. If, in addition, this new European strain is found to possess the fourth characteristic, the chromosome number fourteen, the probability of introduction from Europe will be considerably strengthened. Such a count has already been obtained in a female from Czechoslovakia, but its type of parthenogenesis was not determined.

A fellowship awarded by the Royal Society of Canada is enabling this work to be continued.

Stanley G. Smith

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and
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Dec. 15.

The Zodiacal Light at a Total Solar Eclipse

In connexion with the interesting note[1] from Prof. F. J. M. Stratton concerning the eclipse observations of Mr. Honda at Hokkaido on June 19, 1936, may I point out that S. P. Langley and S. Newcomb apparently observed a similar phenomenon at the eclipse of July 29, 1878. In his description of this eclipse in "The New Astronomy", Langley says: "The most extraordinary thing, however, was a beam of light, inclined at an angle of 45 degrees, about as wide as the sun, and extending to the distance of nearly six diameters on one side and over twelve on the other; on one side alone, that is, to the amazing distance of over ten million miles from its body. Substantially the same observation was made, as it appeared later, by Prof. Simon Newcomb at a lower level. The direction, when more carefully measured, it was interesting to note, coincided closely with that of the Zodiacal Light and a faint central rib added to its resemblance to that body."

At the eclipse of June 8, 1937, I have recorded this phenomenon photographically. From Callan, Peru, a pass in the Cordillera Negra of the Andes at an elevation of 14,000 feet above sea-level, using a Schmidt camera of four inches aperture and of focal ratio $f/1$, three photographs were taken. The first exposure was of 50 sec. duration on a green-sensitive film especially prepared for me by the research laboratory of the Eastman Kodak Co.; the second was 40 sec. on a super-sensitive panchromatic emulsion, and the third 20 sec. on a double-coated orthochromatic emulsion. All these films with the exception of the first show, in addition to the usual coronal streamers, a double-wedge-shaped region along the ecliptic (the points of the wedge meeting at the sun) faintly brighter than the remaining region around the sun. This region extends from the visible horizon to the edge of the film, a distance of about twelve degrees.

The sky was very transparent in the neighbourhood of the eclipsed sun. Streamers of the corona could be seen clearly for three solar diameters from the limb of the sun, with some uncertainty for four diameters. These streamers were recorded photographically only as far as they were observed visually, this despite the fact that 30-sec. exposures on the night sky on similar films recorded stars too faint to be seen by the naked eye.

It may be added that a thorough investigation of the camera employed and of the films used indicates that this is not a photographic fault. The circular disks of film were developed in a round tray, with agitation from all directions. The wedge-shaped areas stop sharply at the clear edge of the film which had been hidden by the film-holder, and at the silhouette of the mountains on the horizon.

I hope to photograph this phenomenon again at the total solar eclipse of October 1, 1940, from near Recife, Brazil.

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Nov. 27.

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[1] NATURE, 140, 682 (Oct. 16, 1937)

Molecular Shape and Size of Thymonucleic Acid

A STUDY has been made of the viscosity and the double refraction of flow of thymonucleic acid in water solution. The sodium salt of the acid was prepared according to the method of Hammarsten[1], and by high-pressure filtration cleared of the remaining few particles of denatured protein[2], so that the solution could be studied by optical methods. The hydrodynamic relations between internal friction and particle size of rod-suspensions[3] and the observations on double refraction of flow[4] permit the following conclusions from the data:

(1) The molecules of sodium thymonucleate have in solution the form of thin rods, the length of which is approximately 300 times their width.

(2) The molecular weight of the preparation studied lies between 500,000 and 1,000,000, in agreement with previous indications from filtration experiments[2] and from preliminary studies in the ultra-centrifuge, made by The Svedberg, that the molecular weight must be high.

(3) The molecules are optically negative; that is, their great polarizability is perpendicular to the longitudinal axis.

(4) The optical anisotropy is very great. The macromolecule must contain strongly double-refracting components arranged in a definite pattern. Apparently the purine and pyrimidine rings lie in planes perpendicular to the longitudinal axis of the molecule.

These results will, it is hoped, be useful with reference to the chemical analysis of chromosome structure[5,6].

A discussion is deferred for the present.

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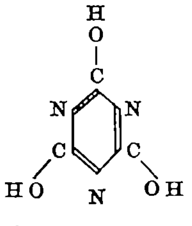
[5] Hammarsten, E and H, and Caspersson, T, *Trans. Farad. Soc*, 31, 367 (1935).

[6] Caspersson, T., *Skand. Arch. Physiol.*, 73, Suppl. 8 (1936)

Crystal Structure of Cyanuric Acid

CYANURIC acid crystallizes in pseudo-rhombic prisms. Rotation and Sauter photographs round the three axes show that two projections have real rhombic symmetry whilst the third shows pseudo-symmetry caused by the fact that in this nearly exactly rectangular projection the atoms lie pseudo-symmetrically with respect to the two (at 82°) intersecting diagonals of equal length.

All atoms lie in planes, thus giving the molecule a planar configuration as is to be expected from the structure



The intermolecular forces are, as is shown by a determination of atomic parameters, hydrogen bonds linking together a nitrogen atom from one molecule to an oxygen atom of another molecule.

Full details will be given in the *Zeitschrift fur Kristallographie*.

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N. F. MOERMAN.

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Amsterdam. Dec. 2.

The Apparent Size of the Sun

THE illusion described by Dr. Vaughan Cornish in NATURE of December 25, 1937 (140, 1082) can be seen if the sun is looked at for an instant and then the observer turns and looks towards the horizon. An after-image will be seen. Carry this up in the sky, and it will be seen to shrink.

Another trick to play with this after-image is to stare at the setting sun; shut your eyes and turn them through about ten or fifteen degrees; open them and turn them slowly and *as regularly as possible* towards the sun and beyond it. The after-image will not be a streak but a row of separate images.

A. P. TROTTER.

Greystones,
Teffont,
Salisbury.
Jan. 1.

Axial Spin and Weapons of the Ancients

I THINK the answer to Mr. L. J. D. Richardson's query[1], "Does an arrow rotate?", is that some do and some do not.

A toxophilite may assure us that, by the feathering of his arrows, a slow rotary motion is imparted, and, from an examination of some modern examples, it would appear to be a just claim. But there is no evidence that the arrows of the ancients closely resembled the modern types. Many of the flint heads of great antiquity are of such a shape and size that their use would be likely to prevent sustained rotation and, as is well known, the feathers may be tied to, as well as inserted in, the butt-end. Sometimes pieces of leaf or skin were used in place of feathers, so that there was diversity of type as well as crudeness in construction.

In the crude examples, the feathering could serve only as resistance to that portion in rear of the centre of gravity, as Sir Gilbert Walker states, but I should prefer to describe it as a definite aeronautical device whereby any deviation from the true flight path was automatically corrected by reason of the fact that some of the surfaces (there were usually three set at angles of 120° to one another) were presented to the air at an angle and a righting force thus exerted.

M. J. B. DAVY.

Science Museum,
S.W.7.

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[1] NATURE, 140, 1016, Dec. 11, 1937

Points from Foregoing Letters

A NEW device for obtaining photographs of lightning in daylight is described by Dr. B. F. J. Schonland. The electromagnetic pulsations sent out by the 'leader' stroke which initiates the lightning discharge are picked up by an aerial circuit and used to pull a trigger opening the camera shutter. The lag is less than 0·005 sec., so that the shutter is open before the first return stroke of the lightning occurs.

Drs. H. von Halban and H. Paxton have found evidence of broadening of the absorption line for slow neutrons in silver when the absorber is heated. This effect is identified with the Doppler broadening resulting from the thermal motion of the capturing nuclei.

No change in temperature (Thomson effect) is observed at a given point in a supraconductor in which a temperature gradient exists, when a current is reversed, according to Dr. J. G. Daunt and Dr. K. Mendelssohn. The authors suggest that this, together with the fact that the specific heat is not zero, indicate that, in general, electrons in a supraconductive metal exchange thermal energy with the lattice, whereas those taking part in a persistent current do not.

Dr. N. Kemmer suggests a modification of Yukawa's theory of the nuclear field which, it is claimed, describes completely the known exchange character of nuclear forces as well as their range and magnitude.

On the same subject, Dr. H. J. Bhabha gives equations and describes the properties of 'U-particles' bearing positive charge and having a mass about 200 times that of an electron. The existence of a neutral particle N, of the same mass, is also allowed for, so that nuclear physics would then have three symmetrical groups of particles, each having a neutral, a positive and a negative constituent. The particles of the first group have mass equal to that of an electron, those of the second group being 200 times heavier, and the third group (protons and neutrons) 1,840 times heavier than the electron.

Further evidence that the cortical and cuticular cells in the wool fibre contain more sulphur than the total wool (from which they are obtained by the action of trypsin) is adduced by Dr. J. B. Speakman and Dr. P. R. McMahon. This indicates that the intercellular phase contains less sulphur than the cells.

K. V. Giri reports that in a system containing vitamin C, glycerophosphate and phosphatase, when the vitamin C is oxidized by metallic catalysts like copper ions and other oxidizing agents the activity of the phosphatase is inhibited. Glutathione and other reducing agents remove this inhibition.

A group of workers from the University of California presents results, obtained with radioactive phosphorus as indicator, showing that phospholipids are synthesized by surviving liver, intestine and kidney.

J. B. Loughnane and Dr. Paul Murphy report that they have obtained free transmission of potato virus X by leaf contact, especially under the influence of air currents, and they suggest that this explains the ubiquity of this virus, the distribution of which probably does not depend on biological agents.

Serious effects of infestation of Canadian spruce forests by the sawfly, *Diprion polytomum*, and steps taken for its control, are reported by Dr. S. G. Smith. The Canadian variety of sawfly differs from the European in that the unfertilized eggs give rise to females instead of males. Also the basic chromosome number is seven instead of six. The author suggests that the Canadian variety may exist in small numbers in Europe, whence it may have been introduced into Canada.

From hydrodynamic relations between internal friction and particle size and from observations on double refraction of flow, R. Signer, Prof. T. Caspersson and Prof. E. Hammarsten deduce that the molecules of sodium thymonucleate, a constituent of chromosomes, have, in solution, the form of thin rods, and a molecular weight of between 500,000 and 1,000,000.

Research Items

Vaulted Tombs of Knossos and Ras Shamra

SIR ARTHUR EVANS in *Man* of December reviews the evidence bearing on the dating of the vaulted tombs of Knossos in relation to those of Ras Shamra, Syria. In the second report on the tombs of Knossos (1914), the smaller built tomb at Isopata was assigned to the last Palace Age on account of the Late Minoan II ceramic content and a gold signet ring. The chronological succession of Minoan engraved gems now established counteracts this evidence. A chalcedony bead seal from the covered part of the cist belongs to a class now shown to be characteristic of the second and third phases of the Middle Minoan, barely surviving into Late Minoan I a. The sepulchral relics thrown out at the opening of the dromos undoubtedly belong to Middle Minoan III. The 'Royal Tomb' itself supplied a very fine series of Late Palace vases (L. M. II); but here, too, conflicting data were apparent in the early character of stone vessels of the Eighteenth Dynasty, Middle Kingdom and even a strong tradition of Fourth Dynasty influence. Ritual signs on the blocks themselves correspond, it had already been noted, with those on the earliest structures of the Late Palace at Knossos. It is now known that the practice of incising such signs on Palace blocks was not followed in Late Minoan II. The makeshift character of the concluding palatial phase does not fit in with the fine architectural construction and massive masonry of the Royal Tomb. A viaduct and bridge on the east slope of the Palace site have now afforded a parallel in splayed blocks like the Isopata vaulting. These structures belong to an even earlier phase than the Isopata tombs, and centre rather in Middle Minoan II. The use of the horizontal arch and vault, in fact, go back to the earliest Palace period, or approximately the twentieth century B.C. As a result of the last campaign at Ras Shamra, it may be taken as demonstrated that there was an actual Minoan colonization there so early as the second Middle Minoan period, which was already reacting on north Syrian culture. It will be seen from the Knossian evidence that the parallel between the vaulted tombs and those of Ras Shamra (Ugarit) ought to be carried back to that epoch.

Otomi of Central America

THAT important, but little-known, group of Indians of Central America, the Otomi and their affinities, are the subject of a study by Dr. Jacques Soustelle ("La Famille Otomi-Pame de Mexique centrale". *Tr. et Mém. de l'Inst. d'Ethnol. Univ. de Paris*, 26; 1937). This study embodies the results of investigations, undertaken at the suggestion of Dr. Paul Rivet, lasting over a period of two years and some months. Conclusions are based mainly on the linguistic evidence, as culture has been affected profoundly by European contacts, while language to a large extent has retained its original characteristics. At the same time the evidence of history and of the geographical distribution of the tribes supports the findings from linguistic evidence, and the data of physical anthropology, ethnography and recorded history have therefore also been taken into account. The Otomi—the name is Aztec or Nahuatl—were regarded by the early Spaniards as a typical mountain-dwelling tribe; and this still holds good. Of seven divisions here recognized, four are in the *terras frias*, the cold lands of high altitude, and three in the *terras templadas*, the temperate lands, while no Otomi are found in the *terras calientes*, the low-lying hot lands of the coastal area. In 1921, the Otomi numbered 210,873 and the four related tribal groups in all just over 67,000. Briefly, it would appear that in the pre-Cortesian era the members of this linguistic family belonged to two groups of very different cultural level, the first being sedentary agriculturists, the second, to which belonged the Chichimecs, nomad or semi-nomad hunters. According to Sahagun the Otomi cultivated maize and agave and were makers of the drink *pulqué*. They lived in villages. The standard of living of the food-gathering hunting tribes was poor. They lacked salt and the Chichimecs lived in caves. The Otomi originally were without pottery. It was natural that to the Aztecs, who conquered and drove them to the hills, excluding them from the stream of cultural development, the culture of these tribes should appear low.

Osteology of *Varanus*

Varanus monitor is a large and well-known lizard; but in spite of this, the accounts of the skull given in many of the ordinary text-books are often incomplete or actually incorrect. This deficiency is made good by K. N. Bahl (*Rec. Indian Museum*, July 1937), who has provided a very full and well-illustrated account of the skull. It is well ossified, but important cartilaginous structures still remain. It is truly streptostylic, that is, the quadrate bone is freely movable at all its articulations. It is metakinetic, and the occipital segment is movable on the maxillary segment at four places, not three as is sometimes stated. The foramen internum is present, but it transmits the sixth cranial nerve and not a branch of the internal carotid artery as was supposed by Siebenrock, its discoverer. The soft parts, nerves and blood vessels related to the skull have been fully taken into account in the description.

Insects Affecting Stored Products

IN the *Annals of Applied Biology* of November, 1937, Mr. H. Hayhurst gives an annotated survey of the species of insects, etc., found by him on the L.M.S. Railway during the past ten years. They were found infesting commodities stored in warehouses and in transit, etc. He mentions that all imported commodities and those liable to infestation were examined prior to transit and to being warehoused. The great majority of insects commented upon are Coleoptera (beetles), with some seven species of moths and a few mites, etc., and the greater number of them are cosmopolitan pests, well known to economic entomologists. An enormous variety of different substances may be infested by a single species of insect; this is especially noticeable in the case of the beetles *Ptinus tectus*, *Tribolium confusum* and *castaneum*; the moths *Borkenhausenia pseudospretella* and *Endrosis lactella* and the mite *Tyroglyphus farinæ*. An article of this kind serves to emphasize the fact that too little attention is paid to pests of stored products in Great Britain. Furthermore, in the event of any large accumulation of such products becoming necessary as a reserve in the event of war, heavy losses from pests are certain to supervene unless proper measures are adequately formulated beforehand. Among the various means of protection one of the most important is the construction of properly built granaries and stores which readily admit of the sterilization of the contained products when necessary.

Rock-Burrowing Organisms and Coral Reefs

MR. G. W. OTTER describes many interesting facts with regard to rock-borers in his monograph "Rock-Destroying Organisms in Relation to Coral Reefs" (Great Barrier Reef Expedition 1928–29, 1, No. 12; 1937. British Museum (Natural History)). Most of these are molluscs, but Crustacea, worms, sponges, and to a certain extent echinoderms and some plants burrow more or less into the corals; but molluscs are by far the most important in actual destruction. The mode of life is varied and the different forms may bore by mechanical means as in *Petricola*, *Gastrochœna*, *Tridacna* and *Arca*, or may use some form of acid as in *Lithophaga*. The barnacle *Lithotrya valentiana* is also a mechanical borer. The formation of the burrows is described in detail for many forms, feeding and rate of growth in relation to rock-boring is discussed and also the distribution and ecology of rock-burrowing organisms including geological nature of the rocks available for attack. Finally the author describes the effects of rock-burrowers in relation to coral reefs. There is no doubt that these various factors of destruction affect the reefs to such an extent that it is often difficult for them to hold their own against them; many are completely destroyed and few, if any, are appreciably growing. Mr. Otter's work gives us a good summary of all the causes of such destruction.

Trout-marking in Massachusetts

ON the populous Atlantic seaboard of the United States the streams are so intensively fished that a stock sufficient to meet the needs of anglers can be kept up only by the frequent and extensive introduction of trout of legal size. These may be placed in the river in autumn or in spring, and doubt has existed as to which is the more satisfactory time. To settle the question, if possible, 2887 rainbow trout and 4830 brown trout, 6–10 inches long, were marked by the internal tagging method, and released, some in November and some in the last week of March. The trout season opened on April 15 (R. A. Nesbit and J. A. Kitson in *Copeia*, 168; 1937). The recoveries indicate that if fish are planted in the autumn, the over-winter losses are so great that five times as many fish are required to provide a given catch as are needed if the fish are held in the hatchery until spring. Against this advantage must be reckoned the cost of keeping the fish in a hatchery over winter, and the less easily reckoned consideration that autumn fish are said to yield better sport. In the course of their experiments, the authors discovered that the method of internal tagging with a celluloid belly tag, or with a soft rubber tag which they later substituted for the celluloid tag, was not satisfactory for trout, and they recommend that in future experiments the jaw method of marking described by Shetter in 1936 and 1937 should be adopted.

Effect of Bio-azotized Peat on Plants

BIO-AZOTIZED peat differs from ordinary organic manures, such as farmyard manure, in that the microflora is mostly ærobic, cellulose and nitrogen-fixing bacteria being especially prominent. Again, the latter build up nitrogen compounds from free nitrogen, while, in most organic manures, complex nitrogenous compounds are broken down. The activity of the microflora, in bio-azotized peat, results in a multiplication of nitrogen-fixing organisms, an accumulation of nitrogen, and a conversion of the unavailable portion of the peat into more readily assimilable compounds. Experiments have recently been carried out by Makinov, both in pots and in the field, to test the effect on yield and nitrogen content of crops; in order to reduce the number of unknown factors, a 'synthetic' soil was used in one series of pot trials ("Effect of Bio-azotized Peat on the Growth and Nitrogen Content of Plants. *Nature* (translated title), 140, 51–57, August 1937. Leningrad). The bio-azotized peat proved as effective in small doses as mineral nitrate in raising yield, and, in larger application, proved more effective than the latter; applications representing less than 2 per cent of the weight of soil did not yield satisfactorily because of the insufficiency of energy-providing material for the activities of the cellulose and nitrogen-fixing bacteria. The bio-azotized peat raised the nitrogen content of the crop by an unexpectedly large amount, as compared with unactivated peat; thus, with equal quantities of both, the percentage of nitrogen in the dry matter of oat plants amounted to 1·537 in the former and 1·061 in the latter. This large increase, of the order of 50 per cent, may be contrasted with the increments of the order of 5–10 per cent noted in Great Britain in grasses manured with nitrogen.

Control of Insect-Transmitted Virus Diseases

Two virus diseases attack the henbane plant, *Hyoscyamus niger*, which is grown for the preparation of pharmaceutical compounds. Both viruses are transmitted from diseased to healthy plants by the aphid *Myzus persicae*. Dr. Marion A. Watson (Hamilton) (*Ann. App. Biol.*, 24, No. 3, 557-573, Aug. 1937) has experimented upon the possibility of controlling the spread of the maladies by eradicating the insect vector. The aphid can be controlled by treatment with nicotine sprays, and its removal substantially reduced the incidence of the virus. There was, moreover, an increase of 30 per cent in the third crop of leaves, harvested in the second year of growth.

Take-All Disease of Wheat

'TAKE-ALL' is the expressive name given to a disease of wheat and other grasses, caused by the fungus *Ophiobolus graminis*. The attacks of this organism are often very severe, and result in the production of grainless heads of corn. Mr. Geoffrey Samuel has lately summarized our knowledge of this disease (*J. Mins. Agr.*, 44, 3, 231–241, June 1937). He describes the symptoms and life-history of the fungus in detail, and discusses the persistence of mycelium in the soil, after the removal of a diseased crop. It has been shown that soil conditions affect the longevity of the fungus to a considerable degree. The disease is more to be feared on light soils than on heavier ground; it is favoured by soils with alkaline reaction, and flourishes where organic matter is abundant. Many wild grasses are also attacked, but oats and rye-grass are resistant crops which may follow wheat in the rotation. Other methods of control are set forth in the paper.

Formation of Large Hailstones

AT the meeting of the Royal Meteorological Society held on November 17, Mr. T. E. W. Schumann gave a mathematical analysis of the generally accepted theory that the formation of large hailstones is due to the constant collection by the stone of supercooled water drops that lie in its path. The problems that received particular attention were, first, how it is possible for a hailstone to remain suspended long enough in the clouds to collect enough drops to enable it to reach the very large size sometimes attained, 10 cm. and more in diameter, and, secondly, how the hailstone gets rid of the latent heat of condensation of the supercooled water that freezes on it. It was shown that the main factors that determine the size to which a hailstone grows are its average density (which will depend on the amount of air entrapped in it), the height at which the nucleus is formed, the average upward velocity of the air and the amount of liquid water present in unit volume of air in the regions with temperature below 0° C. The connexion between these various factors was shown by a series of graphs. It was found that the probable values of the water content and of vertical velocity are sufficient to account for hailstones at least 8 cm. in diameter. The disposal of the latent heat was examined in considerable detail, and it was demonstrated that this heat can be disposed of partly by the absorption of heat from evaporation from the surface of the hailstone and partly by conduction to the surrounding air, although in the neighbourhood of 0° C. the mechanism of heat disposal is reduced in efficiency to such an extent that the rate of growth and therefore the final size of the stones is more restricted than at lower temperatures.

Higher Oxides of Lead

As is well known, the preparation of pure lead dioxide, PbO_2, is very difficult. This oxide is present in the positive plate of the accumulator, and X-ray examination has given evidence of highly characteristic distortion in the lattice under certain conditions. It has been shown that the tetragonal lattice persists from PbO_2 down to $PbO_{1 \cdot 66}$. G. L. Clark, N. C. Schieltz and T. T. Quirke (*J. Amer. Chem. Soc.*, 59, 2305; 1937) have examined the formation of PbO_2. By heating lead dioxide, sodium hydroxide, water and a trace of manganese dioxide in a bomb, crystals of Pb_2O_3, Pb_3O_4 and a new oxide Pb_5O_8 have been prepared at the temperatures of 260–275°, 355–375° and 295–310°, respectively, the compounds being identified by microscopic examination and X-ray diffraction patterns. The crystals supposed to be PbO_2 obtained by this process were shown to be Pb_2O_3 mixed with PbO_2. It appears, therefore, that this process does not give pure lead dioxide.

Stereochemistry of Cobalt and Manganese

THE ion $CoCl_4$ in Cs_3CoCl_5 has been shown to possess tetrahedral configuration, whilst the existence of two forms of $Co(NH_3)_2Cl_2$ suggests that they are *cis*- and *trans*-isomers of plane configuration. Stereochemical studies of the two forms of $CoPy_2Cl_2$ (Py = pyridine), which are monomolecular, have been made by E. G. Cox, A. J. Shorter, W. Wardlaw and W. J. R. Way (*J. Chem. Soc.*, 1557; 1937). The X-ray measurements show that in the α-compound the four groups linked to the central cobalt atom have a *trans*-planar configuration. The corresponding compound with manganous chloride is isomorphous with the α-dipyridino-cobaltous chloride, and in this compound the four covalencies of bivalent manganese also have a planar configuration. The β-dipyridinocobaltous chloride is isomorphous with the only known forms of dipyridinocobaltous bromide and iodide, and their stereochemistry is still uncertain. These results are of interest in providing a definite example of a metal, cobalt, in the same valency state which has both planar and tetrahedral quadricovalent derivatives.

Artificial Radioactivity Produced by α-Particles

THE cyclotron method of accelerating particles makes possible the production of energetic α-particles in numbers equivalent to the particles from many grams of radium, and the energy of the cyclotron particles may be considerably higher than those from radioactive elements. L. N. Ridenour and W. J. Henderson (*Phys. Rev.*, 52, 889) have used a beam of 9 Mev. α-particles to produce artificial radioactive elements by bombarding B, N, Mg, Al, P, Cl, Cr, Ni, Co, Cu, As, Br. The majority of the radioactive nuclear species produced are already known, having been produced by other nuclear reactions with neutrons. In most cases, the radio-elements were identified by chemical methods, and the nuclear reactions were found to involve the absorption of an α-particle with emission of a proton or more commonly a neutron.

Meteors at Great Heights

MR. J. G. PORTER has written a paper (*J. Brit. Astro. Assoc.*, 48, 2, December 1937) which is a continuation of others previously published, in which the true paths of meteors doubly observed at Stowmarket and Peterborough are given. A large number still remain to be computed, and up to the present Mr. Porter has only been able to deal with those observed up to the end of October 1934. Among the 30 observed in that month at the two stations referred to, there is one of great interest observed on Oct. $15^d\ 23^h\ 31^m$, of magnitude about 5·5. Its heights at the beginning and end are 257 and 248 kilometres, respectively. As there was a very close agreement between the figures for the two observers, the results must be accepted as accurate. The Rev. Dr. M. Davidson pointed out at a discussion of the paper that occasionally such great heights had been found previously, but had always been considered inaccurate. Meteors in the higher regions should throw some light on the conditions of the atmosphere in those parts.

Protection for Telescopes

MR. F. R. CLARK describes (*J. Brit. Astro. Assoc.*, 48, 2, December 1937) how he made and utilized a movable roof to cover an observatory for a 3½-inch refractor, and in the same journal Mr. F. O. Smith describes how he made a garden hut for a 6-in. Wray equatorial for the small sum of £10 10*s*. It is impossible in the limited space to give a summary of these two papers; amateur astronomers are recommended to read them carefully if they contemplate erecting simple and inexpensive observatories.

Ancestry of the Tetrapods

By T. Stanley Westoll, University of Aberdeen

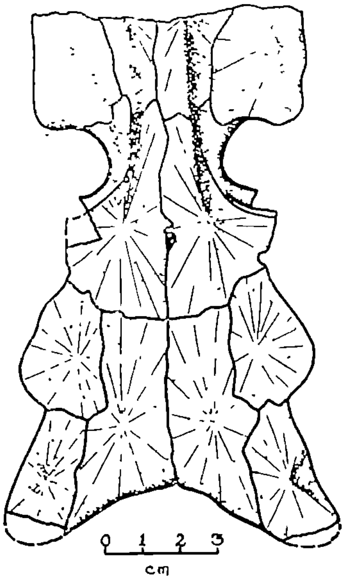

Fig. 1.

Dermal skull-roof of *Elpistostege watsoni*, gen. et sp. nov. The specimen is incomplete anteriorly.

During the last few decades it has become increasingly clear that the Tetrapods were derived from a group of fishes having their closest affinities with the Devonian Crossopterygii and Dipnoi. In 1932, Säve-Söderbergh published a valuable description[1] of some fossils, from the "Upper Devonian" of East Greenland, which afford a valuable bridge between the Crossopterygii and the Carboniferous Stegocephalians. These forms, the Ichthyostegalia, are much closer to the Stegocephalians than to the Crossopterygii in structure. The homology of most of their bones, in terms of the normal Tetrapod skull, is clear; but Säve-Söderbergh, when comparing the Ichthyostegid skull with that of the Crossopterygii, found it necessary to adopt a very cumbersome modification of the terms used in the description of the latter group. The nomenclature adopted had a praiseworthy intention, to indicate the homologies of the comparatively specialized Tetrapod skull on the basis of the structure of generalized fossil fishes. Unfortunately, the nomenclature of the fishes concerned is based on Tetrapod names, which have largely been misapplied in fishes. As a result of this, the Tetrapod parietal and post-parietal were regarded by Save-Söderbergh as "fronto-parietal" and "parieto-extrascapular", and a number of other changes was suggested. Säve-Söderbergh recognized two bones in the place of the Tetrapod pre-frontal, and his attempts to find these elements in higher Stegocephalia[2] have led to further complications. I have suggested[3] that the Tetrapod parietal contains no part of the Crossopterygian "parietal", but is represented in the "frontal" of such a fish as *Osteolepis*; and more recently I have directed attention[4] to the probable errors in homology made by Säve-Söderbergh in the supra- and pre-orbital regions.

During the summer of 1937, in company with Mr. W. Graham-Smith of the University Museum of Zoology, Cambridge, I visited certain Devonian vertebrate-yielding horizons in eastern Canada, including the famous sections at Scaumenac (Escuminac) Bay, P.Q. Among the material acquired from a local collector was a skull-roof, which was only partly exposed and seemed to belong to a Crossopterygian. Preparation has disclosed a

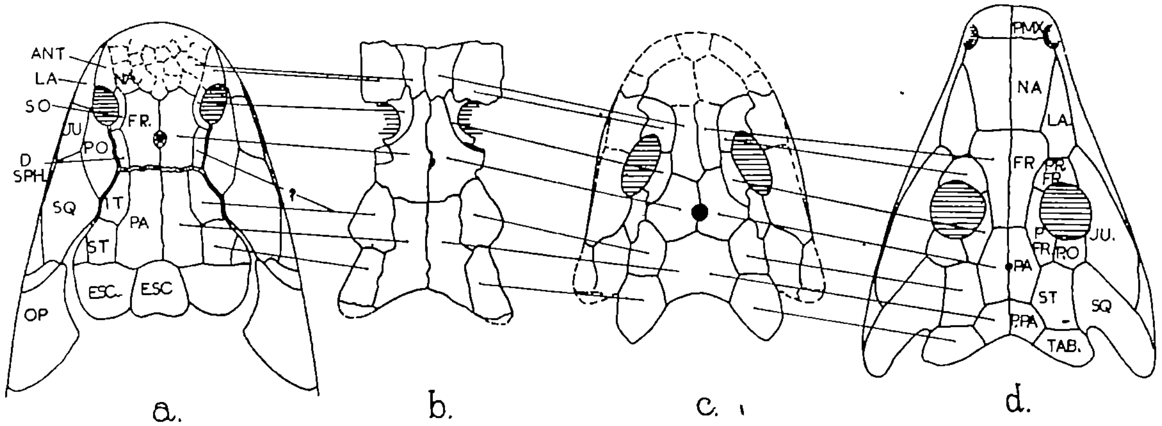

Fig. 2.

Comparison of skulls of (*a*) *Diplopterax* (Mid. Devonian), with Crossopterygian names. (*b*) *Elpistostege* (lowest Upper Devonian). (*c*) *Ichthyostegopsis* (high Upper Devonian or ? early Carboniferous). (*d*) *Actinodon* (Lower Permian), with Tetrapod names. Homologous bones linked throughout series.

ANT., "posterior antorbital"; D.SPH., "dermosphenotic"; E.SC., extrascapulars; FR., frontal; I.T., intertemporal; JU., jugal; LA., lacrimal; NA., nasal; OP., opercular; PA., parietal; P.FR., post-frontal; P.MX., premaxillary; P.O., post-orbital; P.PA., post-parietal; PR.FR., prefrontal; S.O., supra-orbital; SQ., squamosal; S.T., supratemporal; TAB., tabular.

fairly well preserved dermal skull-roof, lacking the snout; it provides a perfect transition between the Crossopterygian and Ichthyostegid patterns of dermal bones.

The bones are exposed mostly from the visceral aspect, and have the arrangement shown in Fig. 1. The bones in front of the orbit are probably flattened out rather more than in life. Between the orbits the skull-roof was markedly concave from side to side, with a sharply depressed median groove. The specimen is clearly a new form and may be named *Elpistostege watsoni*[5], gen. et sp. nov. (from ’ελπιστός, hoped-for; στέγη, a roof. The trivial name is a token of my indebtedness to Prof. D. M. S. Watson). A more detailed description, with an account of other material (some of which may perhaps be referred to this form) will be published elsewhere in a general work on the Scaumenac Bay Devonian fish-fauna by Graham-Smith and myself.

In Fig. 2 the skulls of *Diplopterax* (a primitive Crossopterygian from the Middle Old Red Sandstone, restored by me), of *Elpistostege* (from the lowest Upper Devonian[5]), of *Ichthyostegopsis* (from the *Remigolepis*-series high up in the Old Red Sandstone facies in East Greenland, modified after Säve-Söderbergh), and of *Actinodon* (from the Lower Permian, modified from Lydekker) are compared. There is an unmistakable homology between elements as follows:

Usual Crossopterygian names		Tetrapod names
Parietal	=	Post-parietal
Supratemporal	=	Tabular
Intertemporal	=	Supratemporal
Dermosphenotic	=	Intertemporal
Frontal	=	Parietal
Nasals (posterior)	=	Frontal
Supraorbital	=	Post-frontal
Posterior antorbital	=	Pre-frontal

In most Stegocephalia, as in *Ichthyostega* and *Elpistostege*, the separate intertemporal of such forms as *Trimerorachis* and many Loxommids and Anthracosaurs is apparently usually fused with the supratemporal, though in some cases it may possibly be reduced. The Crossopterygian extrascapulars have apparently been lost in Tetrapods.

It seems clear that the differences between the bone-patterns in the forms figured are, with the exceptions noted above, rather a matter of changes of proportions of the skull than of reshuffled elements or differential fusions such as Säve-Söderbergh suggested. The present study completely confirms my previous revisions of homologies, which were the results of different lines of investigation.

The following points may be noted. (1) The pineal foramen is absolutely homologous in position in all the forms discussed. (2) The single median post-parietal of Ichthyostegids can be paralleled occasionally in Crossopterygii; I have a skull of *Eusthenopteron* showing this feature. It represents a pair of bones in related animals. Analogous cases from other groups could be quoted. (3) The cheek in *Elpistostege* was not united to the table of the skull by suture. (4) It now seems possible that the transverse division of the Crossopterygian cranium is no bar to regarding that group as ancestral to the Tetrapods. The division is a retention of the separate trabecular and parachordal chondrifications of the embryos, perhaps because of some special mechanical necessities of the extremely wide gape in Crossopterygians. (5) Although the Ichthyostegids may not be directly on the line of evolution to the known Stegocephalia, they provide a very good morphological ancestry in many ways. (6) The Stegocephalia quickly lose the primitive appearance of Ichthyostegids, being even more shortened posteriorly, and having the orbits with their surrounding bones moved forwards, so that the primitive pattern tends to be distorted. (7) It now seems likely that the evolution of the Tetrapods from fish-ancestors may have taken place very rapidly in the early Upper Devonian; the state of the paired limbs of *Eusthenopteron* and *Sauripterus*, and the structure of the vertebral column of some Crossopterygian fishes of this period offer a good ancestral type.

These matters will be more fully discussed elsewhere. I wish to acknowledge grants from the Royal Society of London, and the Geological Society, and a Senior Research Award from the Department of Scientific and Industrial Research, which were in force during the visit to Canada. I am also much indebted to my companion in the field, Mr. W. Graham-Smith.

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[1] Save-Soderbergh, G., *Medd. om Grønland*, **94**, nr 7 (1932)

[2] Save-Soderbergh, G., *Medd. om Grønland*, **98**, nr. 3 (1935)

[3] Westoll, T. S, *Geol. Mag.*, **73**, 164 (1936).

[4] Westoll, T. S, *Geol. Mag*, **74**, 517 (1937).

[5] Westoll, T. S., *Geol. Mag*, **74**, 520 et seq (1937).

The Science Masters' Association

ANNUAL MEETING

THE thirty-eighth annual meeting of the Science Masters' Association, held on January 4–7 in London, was attended by more than six hundred members. There were as usual exhibitions by leading publishers and manufacturers of scientific apparatus and the customary exhibition of apparatus devised and made by members themselves.

The meeting opened with the presidential address by Sir Cyril Ashford. Sir Cyril was one of the founders of the Association and was its first secretary, and, rather naturally, contrasted the state of science teaching as he knew it in the early days of the Association and as he found it to-day. The whole address was of a delightfully domestic nature, and at the conclusion Sir Cyril was thanked by two of his fellow pioneers in the forming of the Association—Mr. Archer Vassall and Dr. T. J. Baker.

A new feature of the meeting was the holding for the first time of a lecture on "Science and Citizenship". Since the last London meeting, the Association has accepted the trusteeship of certain funds the purpose of which is to endow a lecture on the subject named. The Association was fortunate to obtain Sir Richard Gregory as the first lecturer under the scheme, and a crowded attendance listened to an extremely interesting and informative lecture.

Sir Richard began by referring to the loss sustained by the Association in the deaths of Lord Rutherford and Prof. H. E. Armstrong, whom he described as closely similar in their devotion to science, but markedly different in their personal characteristics and in the scope and manner of their work. Lord Rutherford was a supreme example of a modern scientific investigator, fertile in conception, ingenious in experiment, with brilliant insight into the relation between causes and consequences of phenomena in a sublime field of physical inquiry. Prof. Armstrong, on the other hand, though his original work belongs mainly to the field of organic chemistry, had extensive interests in much wider fields such as geography, geology, natural history and agriculture. He took a great and active interest in educational matters, though he was critical—and sometimes caustic—in his comments on science teaching and science teachers.

The comparison of these two great men of science led Sir Richard to his main theme, which was that the scientific worker must not subordinate his citizenship to his science. If he does, society may itself take measures to prevent the perversion of science to destructive purposes. Our national leaders and administrators need wide knowledge and keen foresight to enable them to make the most effective use of the scientific forces which are shaping the conditions of modern life. Science can render the fullest service to the community by harnessing the relations between the scientific workers and the general citizen so that a nobler type of citizenship becomes possible, adequate to defend us against the dangers to which civilization is exposed.

Education may be defined as the deliberate adjustment of a growing human organism to its environment, and therefore preparation for citizenship must involve instruction in the principles of human biology: a course of general biology should open and close with man in the centre of the picture. In schools and universities there is still a tendency to teach science only as a specialized study and not as an essential part of a general education. As science is responsible for the industrial developments and economic changes which have caused violent disturbances in our social structure and provided the means by which civilization may commit suicide, it has a right and a duty to occupy a position of authority in the government or control of the powers it has created. Men of science are citizens as well as scientific workers, and they are beginning to realize their special responsibilities for securing that the fruits of scientific knowledge are used for human welfare. It would be a betrayal of the scientific movement if scientific workers failed to play an active part in solving the social problems which their contributions to natural knowledge have created. They must promote the extension of the application of scientific method to the consideration of social, economic and political questions, so that accurate knowledge may be obtained upon which sound conclusions may be based and progressive policies established.

Other lectures at the meeting were varied in type. Prof. P. M. S. Blackett talked on cosmic rays; Mr. W. D. Seymour on the heating, lighting and ventilation of schools; Dr. Sherwood Taylor on the origins of chemistry; Prof. Allan Ferguson on capillarity; Mr. J. Z. Young on "Brain Waves" (dealing with the regular rhythmical changes of electrical potential recorded for numerous parts of the brain); Mr. A. Rodger talked on vocational guidance and Dr. C. C. Paterson on the appraisement of lighting.

Two discussions were also held. The first dealt with the problem of laboratory assistants in schools. The Committee of the Association is in the course of preparing a memorandum on this matter, and the opinions expressed at the meeting will be incorporated therein and will be published. The second discussion dealt with the relations between school and university science teaching. Discussions of this type almost invariably lead to the difficulties of university scholarship examinations, and this was no exception.

At the business meeting, Prof. James Gray of Cambridge was elected as president for next year. In succession to Mr. F. R. Snell (Eastbourne College), Mr. W. Ashhurst (Stretford Grammar School), Mr. L. G. Smith (Trowbridge Grammar School) and Dr. W. G. Davies (Royal Grammar School, Newcastle), who retired from the Committee, the meeting elected Mr. J. W. Cottingham (Barnsley), Mr. R. E. Williams (Oxford), Mr. G. Fowles (Latymer Upper School) and Mr. R. P. Ayres (Leys School). Mr. S. V. Brown (Liverpool Institute) was re-elected general secretary, Mr. B. M. Neville (William Ellis School), honorary treasurer and Mr. W. Ashhurst (Stretford) as annual meeting secretary.

S. V. B.

The Mathematical Association

ANNUAL MEETING

AT the annual meeting of the Mathematical Association, which was held at the Institute of Education, London, W.C.1, on January 4 and 5, Prof. E. H. Neville, in taking the chair, explained that he occupied that position in consequence of the sudden death of the president, Prof. L. N. G. Filon, which took place on December 29. After the members had stood in tribute to the late president, the business meeting took place, at which Mr. W. Hope-Jones was elected president for the following year. The existing officers were all re-elected and Miss M. A. Hooke and Mr. F. J. Swan were elected to the Council in succession to Miss G. K. Stanley and Mr. C. T. Daltry, who retired under the regulations. A presidential address, prepared by Prof. Filon previously to his illness, was read by Prof. G. B. Jeffery. The address, which was entitled "Mass and Weight in Newtonian Mechanics", and contained an analysis of the fundamental ideas of dynamics, will be printed in full in a forthcoming issue of the *Mathematical Gazette*.

Prof. D. R. Hartree then spoke on "The Mechanical Integration of Differential Equations". Prof. Hartree referred first to the need for mechanical contrivances for carrying out extended calculations in pure and applied science. So far as purely arithmetical calculations are concerned, this need has been largely met, but the use of machinery for dealing with problems relating to rates of change is not yet widespread. He explained, illustrating by lantern slides, the mathematical and mechanical principles of the differential analyser, a type of machine invented by

Dr. Bush of Boston, U.S.A. Only four complete machines are at present in existence, two others being in the course of construction. He showed a number of slides illustrating the machine in use at the University of Manchester and explained that this machine contains some devices which represent an English improvement on the American model, notably in regard to the solution of equations involving a time-lag. Some results, including those of problems arising from practical and technological sources, were shown.

At the first session on January 5 a discussion on "The Relative Value of Pure and Applied Mathematics" was opened by Dr. W. G. Bickley. Dr. Bickley put forward a case for the wider inclusion of applied mathematics in the school curriculum. He laid stress on the fact that the performance of university students in pure mathematics is invariably superior, on the average, to their performance in applied mathematics. Mr. C. G. Nobbs, while agreeing with Dr. Bickley, pointed out that this discrepancy of results may be due, at least in part, to difficulties inherent in the experimental nature of the subject and the close interplay of principles involved. Miss K. I. Sayers pleaded for a closer association between physics and mathematics and issued a warning against premature specialization to the exclusion of literary and artistic subjects.

Mr. N. R. C. Dockeray read a paper on "The Law of Quadratic Reciprocity". Mr. Dockeray first gave an introductory series of results on quadratic residues and then passed to the consideration of Gauss's Law. He gave an exposition of the third of the six proofs which Gauss constructed. This proof (as modified by Eisenstein) can be cast into a geometrical form suitable for discussion with a Sixth Form. Mr. N. M. Gibbins read a paper on "The Feuerbach Quadrilateral", namely, the figure formed by the four tangents at the points where the nine-points circle touches the inscribed and escribed circles. The subject was approached by areal co-ordinates, and many interesting and elegant results were given.

In the afternoon, at a crowded meeting, Mr. M. Black spoke on "The Relevance of Mathematical Philosophy to Mathematical Teaching". He defined mathematical philosophy as an attempt to analyse the nature of mathematics and its relation to other branches of knowledge. Mr. Black outlined in some detail the system of symbolic logic proposed by Boole and, after referring to other systems, dealt with some famous paradoxes arising out of the attempt to construct such systems. The attempt to avoid, or explain, these paradoxes led Russell to the theory of types. Mr. Black demonstrated how, if this were adopted, certain types of mathematical proof would be rendered invalid and pointed out that these considerations all seem to point to the fact that mathematics would be for ever an 'unfinished system'.

The last meeting was devoted to a discussion on "Teaching the Complete Duffer". This was opened by Mr. B. L. Gimson, who denied the existence of a *complete* duffer. He said that in the attempt to rouse the dormant interest of backward pupils in mathematics, one should appeal to both curiosity and utility. In the former case he stressed the use of magic squares, dissection puzzles and historical considerations, while the latter might well lead to a treatment of such topics as accounts, arithmetic of citizenship, insurance, etc. He emphasized the need for small classes in this work. Mr. F. C. Boon stated that the 'duffer' as well as the brilliant boy ought to have a 'fair deal'. For this purpose 'duffer' classes must be small, their pace slow and their atmosphere right, so that these children may not be deterred from asking questions which might appear obvious by the fear of ridicule. He referred also to the difficulties arising out of the misinterpretation of common words.

Dr. F. H. Dodd commenced by stating that he approached the problem from the angle of the psychologist. Cases of 'duffers' may be attributed to (*a*) educational or environmental failures, (*b*) emotional disturbance. He went on to consider various types of these failures, illustrating his remarks by comments on cases from his own experiences. He added some interesting remarks on the discovery of the precise 'point of failure'. In cases of emotional disturbance, he said that he had frequently noticed that mathematics is the first subject to be affected. An interesting discussion followed.

A publisher's exhibition was held in connexion with the meeting. A full report of the proceedings will be published in later issues of the *Mathematical Gazette*.

Thyrite Surge Diverter

WHEN a lightning flash takes place near overhead lines, it starts an impulsive rush of electricity in them which, unless it is diverted in its path, may damage or even smash costly machinery with which it is connected. Electricians, first in connexion with communication circuits and afterwards in connexion with power transmission circuits, have sought for many years for a substance which is an insulator at the working pressure but at high pressures is a conductor. Connecting a cylinder of this substance between an overhead conductor and earth does not interfere with the ordinary working of the line, but when a surge of electricity raises the pressure the conducting power of the substance leads the surge safely to earth and so protects the machinery. These devices were formerly called 'lightning arresters' but are now known as surge diverters.

The discovery of thyrite provided the desired material. It is a dense, homogeneous inorganic compound of a ceramic nature, perfectly stable, mechanically strong and is an insulator at one voltage and an excellent conductor at a higher voltage. Its electrical resistance increases 12·5 times each time the voltage is doubled. It appears to conform to this law indefinitely without change, regardless of the rate at which the voltage is applied for either continuous or alternating pressures or fast impulses. In a list (Thyrite Surge Diverters, No. H. 4506–1) issued by the British Thomson-Houston Co., Ltd., of Rugby, a descriptive account of these diverters is given for alternating current circuits not exceeding 220,000 volts working pressure.

A complete diverter consists of a number of standard size units stacked in series, the number depending upon the voltage rating. Each unit has a normal rating of 11,000 volts and has its own built-in series-gap. It is 11 in. in diameter, 15 in. high and weighs 75 lb. Cathode ray oscillograms are shown which show the impulse protecting characteristics of the standard 11,000 volt unit. When the crest of the impulse wave is 40,000 volts the insulation breaks down. The impulse voltage attending a 1,500 ampere surge current across the diverter unit is only 34 kv. crest. The surge voltage permitted by the thyrite diverter increases in direct proportion to the number of diverter units from line to earth.

Science News a Century Ago

Prof. Moll

IN various papers and in the annual report of the Royal Astronomical Society are to be found notices of Prof. Moll, of Utrecht, who died at Amsterdam on January 17, 1838. Moll was born on January 18, 1785, and as a youth spent some time as a clerk in a business house in Amsterdam, his native place, devoting his leisure to the study of mathematics and astronomy and other subjects. When about twenty-one years of age, his father allowed him to relinquish business and he became a student first at Amsterdam under van Swinden, and then at Utrecht and Paris, and in December 1812 was made professor of mathematics and natural philosophy in the University of Utrecht. While holding this post he was placed in charge of the "Waterstaat" on which fell the responsibility of preventing inundations, and also had care of the chronometers for the Navy.

In 1824 Moll contributed a paper to the *Philosophical Transactions* on the velocity of sound, and in 1831 published a comparison of British, French and Dutch weights. That same year he published a pamphlet entitled "On the Alleged Decline of Science in England", in answer to Babbage's work "Reflections on the Decline of Science in England, and on Some of its Causes". Three years later he received an honorary degree from the University of Edinburgh and was also made an honorary freeman of the city. In 1835 he was charged by the King of Holland to make a series of observations on the tides around the Dutch coast, his report being sent to Whewell.

Henry Earle (1789-1838)

HENRY EARLE, one of the most distinguished surgeons of his time, who was born on June 28, 1789, came of a celebrated medical family, his father, Sir James Earle, being surgeon to St. Bartholomew's Hospital and a skilful lithotomist, and his maternal grandfather the illustrious surgeon Percival Pott. From an early age, he showed a striking predilection for surgery, so that at the age of sixteen years he became an assistant to his father. He qualified in 1808, when he was made house surgeon at St. Bartholomew's Hospital, and three years later set up in independent practice. In 1813, he won the Jacksonian prize of the Royal College of Surgeons for an essay on diseases and injuries of nerves, and in 1819 he was awarded two prizes by the Royal Society of Arts for the invention of a bed for fracture of the legs.

In 1815 Earle was appointed assistant surgeon to St. Bartholomew's Hospital and twelve years later full surgeon on retirement of Abernethy, when he started a series of clinical lectures which continued until his death in 1838. In 1822 he was elected fellow of the Royal Society. In 1833 he was appointed professor of anatomy and surgery at the Royal College of Surgeons. Two years later he was elected president of the Royal Medical and Chirurgical Society and held this office for two years. On the accession of Queen Victoria in 1837 he was appointed surgeon-extraordinary to Her Majesty. In addition to twelve surgical papers in the *Medico-Chirurgical Transactions* and two in the *Philosophical Transactions*, he published a book entitled "Practical Observations in Surgery" in 1823. He died in his fiftieth year, on January 18, 1838.

A Severe Frost in England

IN January 1838, Airy visited Sedgwick at Norwich, whence he wrote to his wife on January 21: "I do not know what degree of cold you may have had last night, but here it was (I believe) colder than before—thermometer close to the house at 3°." According to the "Annual Register" for 1838, the frost set in on the evening of Sunday, January 7, and continued for more than a fortnight. On January 20 at 6 a.m. the thermometer at the receiving-house of the Royal Humane Society in Hyde Park stood at $-3°$ F. and on January 20 and 21 the Thames was completely blocked with ice, "the navigation was stopped *in toto*, and a spectacle which has not presented itself for many years was observed. Several men passed over the ice in safety from one shore to the other, below bridge, and during the whole of the day there was a regular communication between the vessels lying in the middle off the Tower and the shore over the ice. . . . There was a complete block at Blackwall. . . . No steamers came in or went out of the river on the 20th and it appears that the various reaches below Greenwich were as full of ice as the upper and lower pools. Even at Gravesend the business was suspended. . . . On Thursday the 25th a sheep was roasted whole on the ice near the centre of the river, near the Suspension Bridge, Hammersmith. Three skittle-grounds were formed on the ice opposite the east corner of the Custom House, and the game was played by great numbers all day. . . ."

The Continental Universities

IN the January number of the *Gentleman's Magazine*, 1838, was an article entitled "Statistical Accounts of the Continental Universities", by a German.

When speaking of the Russian universities, it was said: "Writers have boasted that the Russians are making rapid progress in science, owing to the excellent management of the government with respect to the universities; but a proper description of, and an examination into, the systems by which they are upheld would lead to a very different result." In the six universities of Russia the number of students was: Charkow 342, Dorpat 536, Kasan 252, Kiew 120, Moscow 419 and Saint Petersburg 285. In these several institutions are employed and paid by the Government no fewer than three hundred and thirty-eight professors and functionaries . . . the latter, however, we may state to be no better than spies, each holding his particular office, and all appointed for the special purpose of keeping a strict guard over the political dispositions of the students; a system that cannot be too much censured."

Referring to the German universities, which boasted a total of about 16,000 students, the writer said: "In our sketch of the German Universities, we shall have no difficulty in drawing a picture which will display a very remarkable contrast to that already before the reader. . . . Germany is *par excellence* the land of universities, and famous not only for their numbers but also their good organisation." At that time the number of students at Berlin was 1746, at Munich 1300, at Göttingen 823, at Breslau 768, at Bonn 701, at Tübingen 664 and at Heidelberg 456.

Societies and Academies

Dublin

Royal Dublin Society, November 23.

H. H. Dixon and L. A. T. Ballard: A simple method of showing tension in the sap of a plant. If a branch of *Vitis striata* is clamped sufficiently tightly to close the vessels and to crush the cells around them, and is then cut off from the plant below the clamp and allowed to wilt completely, on afterwards cutting the stem above the clamp under water, the recovery of the shrivelled leaves and sagging petioles will be a matter of hours. Transpiration has caused the water-columns to break with the formation of bubbles in the vessels, and on cutting, atmospheric pressure partially refills the vessels so that the capillary forces around the remaining bubbles lead to their gradual complete solution. The water supply is re-established, and the observed tardy recovery brought about. If, however, the clamped stem is cut under water as soon as the petioles have sagged into a vertical position, but before the leaves show shrivelling, an immediate recovery will be noted, being complete within 10–12 minutes of the cutting. That complete recovery is not instantaneous seems to be due to delay in the release of the tension, owing to the resistance experienced by the water in entering the cut tracheæ, and to semi-permanent deformation of the tissues. The fact that the movements of the petioles at successive nodes are simultaneous is further justification for regarding these immediate movements as due to the release of tension in the water-columns.

J. H. J. Poole: The theoretical efficiency of cylindrical ionization chambers when used for estimating radon by α-particle counting. When finding the radioactivity of rocks by counting the α-particles due to the resultant radon and products of rapid decay, the number of particles per min. per 10^{-12} gm. of radium may be found by direct experiment. A useful check is afforded by comparing this with the theoretical value. This depends on the dimensions of the chamber, the minimum range within the chamber which the counter can detect, and the distribution of the active deposit. By the use of approximate methods of integration, it is shown that the efficiency of the chamber used should be about 58 per cent. The experimental figure is only slightly below this, indicating fairly complete de-emanation of the rock in the furnace used.

December 14.

Robert McKay: Conidia from infected bud-scales and adjacent tissue as a main source of primary infection with the apple scab fungus. A definite relation was shown to exist between the severity of apple scab on the trees in 1936, and the number of infected buds occurring in the dormant season, and also between the number of such infected buds and the outbreak and development of the disease in 1937. Such centres of infection explain the appearance of apple scab in the spring of the year on varieties like Bramley's Seedling, in the absence of both scabbed wood and dead over-wintered leaves.

Paris

Academy of Sciences, November 29 (*C.R.*, 205, 1021–1112).

Lucien Cayeux: The anomalies of the structure and composition of the Albian phosphates of the Paris basin, and some consequences.

Georges Giraud: New properties of certain equations in which principal values of integrals appear.

Marc Krasner: The number of superbodies of a given degree of a body of p-adic numbers.

W. Kozakiewicz: The necessary and sufficient conditions of stochastic convergence.

Lucien Godeaux: The points of diramation of multiple algebraic surfaces.

David Wolkowitsch: The role of the quadrics of inertia in the theory of elliptical co-ordinates.

Georges Kurepa: Monotone transformations of partially ordered ensembles.

Alberto Gonsalez Dominguez: The integrals of Laplace.

Isaie Maximoff: A continuous and essentially increasing function.

Jacques Solomon: The quantum mechanics of systems of electrified particles.

Hervé Fabre: The displacements of the nodes and apsides in planetary systems.

René Lucas: The radiation tensions of transversal waves of inertia and of viscosity of liquids.

Aurel Potop: Contribution to the study of a method for the comparison of the specific heats of gases at temperatures much higher than the surrounding temperature.

Ouang Te-Tchao and André Langevin: The state of equilibrium between large and small ions in a gas.

Fernand Gallais: The magnetic properties of the mercury double iodides. Mercury keeps its usual diamagnetism in the double iodides. The view of P. Pascal that these salts may be paramagnetic is not confirmed by these experiments.

Henri Muraour and Albert Michel-Lévy: A new method for obtaining the spectra of metals. The pulverization of a metal in contact with a powerful explosive gives high temperature spectra closely connected with Anderson spectra obtained by the exploded wire method.

L. Herman and Mme. Herman-Montagne: Remark on a possible interpretation of the bands of ozone.

Serge Nikitine: Theoretical considerations on the dichroism of flow.

Jean Crussard and Serge Gorodetzky: Stimulation function of the nuclear reaction Be(α, n). The possibility of determining the mass of the neutron by a new method. The method is based on the disentegration of boron by neutrons slowed down in paraffin.

Mladen Paić: The action of dilute alkaline hydroxides on cupric hydroxide.

Lévy Herman: The polymerization of gases and the equations of state.

Paul Renaud: A new conception of chemical inertia.

Victor Auger: Crystallized molybdenum blue. The exact conditions for the production of the crystals are given: Mo_8O_{23} and Mo_9O_{26} are possible formulæ.

Mlle. Yvonne Garreau: Some addition compounds of the diphenols.

René Truchet: The valencies of carbon.

Jean Wyart: A case of polymorphism by the progressive passage of a crystalline arrangément to a more symmetrical one, observed on leucite.

Robert Laffitte: The Trias and Lias of Menaa in Aurès (Algeria).

Jean Lacoste: The nature of the deep dislocations in the central part of the Prerif (Morocco).

Jean Feldmann and Mlle. Geneviève Mazoyer: The identity of *Hymenoclonium serpens* and the protonema of *Bonnemaisonia asparagoides*.

Georges Déjardin, Albert Arnulf and René Falgon: The atmospheric absorption and the coefficients of absorption of ozone in the visible spectrum.

Antoine de Cugnac: The experimental synthesis of the hairy form of *Bromus sterilis* by double interspecific hybridization.

Marc Simonet: The caryological study of some species of *Cistus*.

Jean Louis Vidal: The primary causes of chlorosis on limestone soils. Experiments supporting the view of P. Mazé, Ruot and Lemoigne that chlorosis on limestone soils is due to an iron deficiency, caused by the precipitation of the iron in an insoluble form by the lime.

André Paillot: New researches on the histophysiology of the fat body and of the ectodermal tissues of the mulberry tree silkworm during the change of skin.

Marc de Larambergue: Pigmentary varieties of *Bulinus* (*Isidora*) *contortus*; their interest in the genetic analysis of fecundation.

Philippe L'Héritier and Georges Teissier: A hereditary physiological anomaly in *Drosophila*.

Emile Rousseau: The isolation of an oxidizing factor from the blood of cancerous patients and of normal subjects. The deficiency of cancerous blood in this factor.

Jean Loiseleur: The mode of action of pepsin. Measurements of the electro-kinetic potential of a protein submitted to the action of pepsin confirms the hypothesis according to which proteolysis is preceded by fixation of the pepsin on the protein.

Jean Le Calvez: The spiral chromosomes of the first schizogonic mitosis of the foraminifer *Patellina corrugata*.

Constantin Levaditi and Aron Vaisman: Anti-endotoxic chemotherapy.

Amsterdam

Royal Academy (*Proc.*, 40, No. 9, Nov. 1938).

E. Cohen, W. A. T. Cohen-de Meester and J. Landsman: Acute tin pest. The presence of small traces of bismuth greatly retards the transformation of white tin into grey tin at – 50° C., but that of small traces of aluminium has the contrary effect.

L. G. M. Baas Becking and E. A. Hanson: Note on the mechanism of photosynthesis.

J. G. van der Corput: Weyl's method in the theory of numbers (2).

R. Weitzenböck: Trivectors (2).

P. E. Verkade, J. van der Lee, A. J. S. van Alphen and M. Elzas: Researches on fat metabolism (8). Feeding experiments on dogs with sodium salts of normal saturated dicarboxylic acids.

A. G. van Veen and J. C. Lanzing: Analysis of provitamins A in blood serum.

G. Broersma: Preliminary records of the velocity fluctuations in a boundary layer before and after the transition to turbulent motion.

J. C. van Hille: Influence of magnesium on the relation between chlorophyll content and rate of photosynthesis.

Miss W. A. E. van de Geyn: Age of the Elsloo beds. The Elsloo conglomerate and the overlying thin glauconiferous sandy bed examined in the excavation of the Juliana canal are of Lower Pliocene age.

J. Schmutzer: Triangular sugar crystals. Some remarkable crystals obtained from sugar solution which had been treated many times with charcoal and filtered. They showed the same crystallographic angles and optical properties as ordinary cane sugar crystals but had an entirely different habit.

J. Roos and C. Romijn: The oxygen dissociation curve of the cow's blood during pregnancy and the dissociation curve of the blood of the new-born animal during the time immediately after birth.

Vienna

Academy of Sciences, November 11.

E. Clar: Structure of the southern Radstädter Tauern. The results suggest the operation of two distinct processes in the formation of this region. The first consisted of folding under high pressure. The second consisted of displacements along planes intersecting obliquely the structural elements formed during the first phase.

J. Pia, S. R. N. and K. S. Rao: *Dasycladaceæ* from the intermediate sedimentary layers of the Deccan trap at Rajahmundry in South India.

W. Fleischmann and Susanne Kann: Rapid test for sex hormones. The Loewe and Voss test for male sex hormone, which uses mitosis of the mucous membrane of the vesicular gland of the mouse as an indicator, has been improved. Colchicin is injected 39 hours after the injection of the hormone. This arrests mitosis at the metaphase, and thus a larger number of mitotically dividing cells are made visible.

A. Steuer: Determination of the species of *Harpacticus nicæensis* Claus.

A. W. Reitz and R. Sabathy: Studies of the Raman effect (80). Nitrogenous substances (9). Nitriles. Nitriles of unsaturated acids and dicyanide.

November 18.

O. Pesta: Freshwater crabs (*Potamonides*) of southern Greece. From the geographical distribution it is concluded that *Potamon fluviatile* is a direct descendant of *P. potamios*.

F. Eirich and R. Simha: Viscosity of solutions.

W. Knapp: Phenyl-(2-methyl-naphthyl-1)-amino-*o*-carboxylic acid.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 561–593, Nov. 15).

A. V. Manza: (1) Some North Pacific species of articulated corallines. (2) New species of articulated corallines from South Africa.

S. Chandrasekhar: The stability of the radiative gradients in the interior of a star. A mathematical discussion.

H. B. Tukey: Plant parts of deciduous fruits which give evidence of being favourable for tissue culture. Micropylar region of the integuments at time of full bloom, and entire integuments and placental region of the inner wall of the carpel of the peach excised after full bloom, are easily removed aseptically and develop well on culture media.

A. Gleyzal: Transfinite real numbers.

G. A. Miller: Groups which contain a Hamiltonian subgroup of odd prime index.

A. D. Michal and D. H. Hyers: Differential invariants in a general differential geometry.

Forthcoming Events

Monday, January 17

ROYAL GEOGRAPHICAL SOCIETY, at 5.—A. E. Smailes: "Population Changes in the Colliery Districts of Northumberland and Durham".

Tuesday, January 18

EUGENICS SOCIETY (in the Rooms of the Royal Society, Burlington House, W.1), at 5.15.—Dr. G. F. McCleary: "Population Problems in the British Commonwealth".

KING'S COLLEGE, LONDON, at 5.30.—S. M. Reisser: "Arc Welding Developments and Applications" (succeeding lectures on January 25 and February 1).

Wednesday, January 19

ROYAL MICROSCOPICAL SOCIETY, at 5.30.—Annual Meeting.

Dr. R. S. Clay: "A Review of the Mechanical Improvements of Microscopes in the Last Forty Years" (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.15.—D. M. T. Morland: "Recent Investigations into Bee-keeping at Rothamsted".

ROYAL METEOROLOGICAL SOCIETY at 7.30.—Annual General Meeting. Dr. F. J. W. Whipple (Presidential Address).

Thursday, January 20

ROYAL SOCIETY, at 4.30.—Prof. D. Keilin, F.R.S. and Dr. E. F. Hartree: "Mechanism of the Decomposition of Hydrogen Peroxide by Catalase".

H. J. A. Dartnall, Dr. C. F. Goodeve and Dr. R. J. Lythgoe: "Effect of Temperature on the Photo-Chemical Bleaching of Visual Purple Solutions".

J. W. Hughes: "The Monaural Thresholds Effect of a Subliminalcontralateral Stimulus".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

RESEARCH ENGINEERS (grades II and III) to the B B C—The Engineering Establishment Officer, B B C., Broadcasting House, W.1 (January 17)

ASSISTANTS (grade III, male) at the Chemical Defence Experimental Station, Porton—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, London, S.W.1 (January 19).

ORGANIZER OF AGRICULTURAL EDUCATION in West Suffolk—The Chief Agricultural Officer, Shire Hall, Bury St. Edmunds (January 22)

JUNIOR CHEMIST in the Midland Agricultural College, Sutton Bonington, Loughborough—The Principal (January 24)

PRINCIPAL of the Chesterfield Technical College—The Director of Education, County Education Officer, St. Mary's Gate, Derby (January 31).

ASSISTANT NATURALIST and a BACTERIOLOGIST at the Laboratory of the Freshwater Biological Association, Wray Castle, Ambleside, Westmorland (January 31)

CHEMIST in the Department of the Government Chemist—The Government Chemist, Clement's Inn Passage, Strand, W.C 2 (February 1).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Saorstát Éireann: Roinn Talmhaiochta (Department of Agriculture): Brainse Iascaigh (Fisheries Branch). Report on the Sea and Inland Fisheries for the Year 1936. (P. No. 2766.) Pp. 32. (Dublin: Government Publications Sale Office.) 9*d*. [612

East African Agricultural Research Station, Amani. Ninth Annual Report, 1936–37. (Colonial No. 144.) Pp. 47. (London: H.M. Stationery Office.) 1*s*. net. [612

Contribution to Progress: an Account of the Aims and Activities of the Electrical Association for Women. Pp. 12. (London: Electrical Association for Women.) 3*d*. [612

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1937, with Report of the Director of Fuel Research. Pp. ix+213+5 plates. (London: H.M. Stationery Office.) 3*s*. 6*d*. net [612

Scottish Marine Biological Association. Annual Report, 1936–37. Pp. 23. (Glasgow: Scottish Marine Biological Association) [612

Royal Meteorological Society. Bibliography of Meteorological Literature Prepared by the Royal Meteorological Society with the collaboration of the Meteorological Office. Vol 4, No. 3 (January to June 1937) Pp. ii+117–170 (London: Royal Meteorological Society.) 2*s*. 6*d*. [612

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1937, with Appendices. Pp. 45 (London: H.M. Stationery Office.) 9*d* net. [712

Empire Cotton Growing Corporation. Cotton Pest Control Work in Southern and Central Africa and the Rhodesians. By Prof. J. W. Munro. Pp. iii+87. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d* [712

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Convocation during the Academical Year 1936–7. Pp. 17. (Durham: University of Durham) [712

Technical Publications of the International Tin Research and Development Council. Series A, No. 65. Stannic Oxide as Opacifier in Wet Enamels. By Dr. L. Stuckert. Pp. 81 (London: International Tin Research and Development Council.) Free. [812

Other Countries

Transactions of the American Philosophical Society. New Series, Vol. 28, Part 2: The Mammalian Fauna of the White River Oligocene. By William Berryman Scott and Glenn Lowell Jepsen. Part 2: Rodentia. By Albert Elmer Wood. Pp. 153–269+plates 23–33 (Philadelphia: American Philosophical Society, London: Oxford University Press) 9*s*. net [612

Addresses at the Exercises and Science Symposium during the Dedication of the New Building of Mellon Institute, Pittsburgh, Pennsylvania, May 6 and 7, 1937. Pp iii+71. (Pittsburgh, Pa.: Mellon Institute.) [612

Western Australia. Annual Progress Report of the Geological Survey for the Year 1936. Pp. 51+7 plates. (Perth: Government Printer.) [712

Havsforskningsinstitutet. Istjansten i Finland. Pp. 65 (Helsingfors: Havsforskningsinstitutet) [712

Conseil Permanent International pour l'Exploration de la Mer Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par D'Arcy Wentworth Thompson. Vol 25, pour l'année 1935 Pp xxiv+47 3.00 kr. Rapports et procès-verbaux des réunions. Vol 105, 3ème Partie Appendices (1936–1937) Pp. 74. 3.00 kr. (Copenhague: Andr Fred. Høst et fils) [712

University of Illinois Engineering Experiment Station Bulletin No 296: Magnitude and Frequency of Floods on Illinois Streams. By Prof George W. Pickels. Pp. 62. (Urbana, Ill: University of Illinois.) 70 cents [712

Meddelelser om Grønland. Band 102, Nr 3 Treaarsexpeditionen til Christian den X's Land, 1931–34—Permische Ganoidfische aus Ostgronland Von Hermann Aldinger. Pp. 392+44 plates. 22.00 kr. Band 104, Nr 19: The Scoresby Sound Committee's 2nd East Greenland Expedition in 1932 to King Christian IX's Land—A Contribution to the Investigation of the Fauna of the Blosseville Coast, East Greenland, with special reference to Zoogeography By Magnus Degerbøl Pp. 36. 1.75 kr. Band 108, Nr. 3: 6 og 7 Thule Expedition til Sydøstgrønland 1931–33—Contributions to the Animal Ecology of the Fjords of Angmagssalik and Kangerdlugssuaq in East Greenland By E. Bertelsen. Pp 58+2 plates. 3 00 kr. Band 108, Nr. 4. 6 og 7 Thule Expedition til Sydostgrønland 1931–33—Spiders (Araneina) from Southeast Greenland. By Jens Braendegaard. Pp. 15 0 75 kr. Band 112, Nr 2 De Østgrønlandske Expeditioner til Kong Christian den X's Land udført i aarene 1926–27 og 1929–30—The Fossil Flora of Scoresby Sound, East Greenland Part 5 Stratigraphic Relations of the Plant Beds. By T M. Harris. Pp. 114 4 75 kr. Band 113, Nr. 1 Geologiske Undersøgelser i Sydgrønland—A Sedimentary Petrological Investigation of a Number of Sand Samples from the South Coast of Greenland between Ivigtut and Frederiksdal. By R. D. Crommelin. Pp. 32. 1.50 kr. Band 116, Nr. 1: Treaarsexpeditionen til Christian den X's Land 1931–34—Über die Metamorphose der Ceratopogoniden und Chironomiden Nordost-Gronlands. Von Frode Søgaard Andersen. Pp. 95. 4.00 kr. Band 116, Nr. 3. Treaarsexpeditionen til Christian den X's Land 1931–34—Studies on the Food of the East Greenland Ptarmigan, especially in its relation to Vegetation and Snow-Cover. By Paul Gelting. Pp. 196. 9.00 kr. Band 118, Nr. 8: Lichens from West Greenland, collected chiefly by Th. M. Fries. By B. Lynge. Pp 225+10 plates. 11.00 kr. Band 118, Nr. 9: Remarks on the Greenland Eel; its Occurrence and Reference to *Anguilla rostrata*. By Ad. S. Jensen Pp. 8. 0.50 kr. Band 119, Nr. 8: De Østgrønlandske Expeditioner til Kong Christian den X's Land udført i aarene 1926–27 og 1929–32—On the Lower Ordovician Faunas of East Greenland. By Chr. Poulsen. Pp. 72+8 plates. 4.00 kr. Band 121, Nr. 1: The Zoology of East Greenland—Gephyreans. By Elise Wesenberg-Lund. Pp. 25. 1 25 kr. (Copenhagen: C A. Reitzels Forlag.) [712

Carnegie Institution of Washington. Publication No 489: Lipogenesis in the Animal Body, with Special Reference to the Physiology of the Goose. By Francis G. Benedict and Robert C. Lee. Pp. ix+232. (Washington, D.C.: Carnegie Institution.) [712

Memoirs of the Malayan Meteorological Service. No. 2: The Movement of Air Across the Equator. By A. Grimes. Pp. ii+14+3 plates. (Singapore: Malayan Meteorological Service.) [812

Observatoire de Paris: Section d'Astrophysique, à Meudon. Cartes synoptiques de la chromosphère solaire et catalogue des filaments de la couche supérieure. Par L. D'Azambuja. Vol. 1, Fasc. 5, Année 1935. Pp. 32. (Meudon: Observatoire de Paris) [812

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Realistic Social Studies

IN so far as it will be concerned with realistic study of contemporary issues, the new Institute of Economic and Social Research under the direction of Prof. N. F. Hall, the formation of which was announced in NATURE of January 8, is a venture which has the warm support of many scientific workers. The joint contributions of the Halley Stewart Trust, the Pilgrim Fund, the Leverhulme Fund and the Rockefeller Foundation should guarantee enough for starting a modest programme, which will rehabilitate the prestige of social research in Great Britain, if the personnel and problems are wisely chosen.

Thirty years ago the voluminous and pioneer studies of the Webbs, and the foundation of the London School of Economics, aroused high hopes of a new temper of inquiry. The sequel has been disappointing. Since then, social studies in Britain have been dominated by the dreary and barren dialectical tradition of deductive economics. Like astronomy in the medieval universities, political economy in our leading centres of higher education is still following the trail of self-evident principles. This being so, it is not surprising that responsible bodies which administer funds for research have been loth to make large allocations to university departments, or have refused to renew temporary grants such as the Rockefeller subsidy to the London School.

In his recent farewell address to the latter, Sir William Beveridge compared the state of the social sciences to anatomy before Harvey. Without immodesty, he might have drawn a moral from the generation which followed Harvey's work. The most conspicuous example of healthy growth in contemporary social research is the study of population on the lines initiated by three men whose names appear on the list of original fellows of the Royal Society. The pioneers of British demography were Graunt, Sir William Petty and Halley. Graunt figures as the "ingenious author of the Mortality Bills" in the first history of the Society by Sprat, Lord Bishop of Rochester. Halley published the first life table, in the *Philosophical Transactions* of 1693. Since the first meetings of the 'Invisible College' were in Petty's rooms, the author of the "Politicall Arithmetick" shares with the "father of chemistry and the uncle of the Earl of Cork" the honour of being one of the first parents of the Society. Thus quantitative and realistic social inquiries shared in the efflorescence which followed Harvey's death.

After the lapse of little more than a century, Bentham exclaimed, "compare the state of chemistry then and now!" He might well do so. Chemistry in Bentham's time had just thrown off the self-evident principles involved in phlogistonism, and demography had taken up the self-evident principles of the gloomy parson. In his own day, Bentham's appeal for the reunion of naturalistic and humanistic inquiry made no ripple on the complacency of classical humanism in the established seats of learning, where the teaching of natural science prompted Babbage, Lucasian professor in the Newtonian succession, to write "The Decline of Science in England". No twentieth-century Babbage has appeared to compose a new "Economy of Manufactures".

Still, there are new signs of uneasiness about humanistic studies, and researches on population have become the focus of a new *rapprochement* between natural science and social studies. As in the times of Graunt, Halley and Petty, the new school of research draws its personnel from workers trained in the former. Revival of interest in population problems in Britain was initiated by the influence of two men. Sir William Beveridge graduated in astronomy: Carr-Saunders, his successor at the London School, was a professional biologist at an earlier stage in his career. The most challenging investigation of the British prospect has been that of Dr. Enid Charles in the Department of Social Biology of the School.

Such reflections might well justify the hope that the new Institute will welcome advice from men of science and recruit its personnel from scientific workers. So far, we have had no indication that it will. This is the more curious in view of the place which Sir Josiah Stamp occupies as its new president In his British Association address, Sir Josiah urged, and rightly urged, that the "Impact of Science on Society" is the central theme of fruitful inquiry into current affairs. To his recently published volume of addresses he has added an appendix on research finance prepared for him by one of his scientific friends. None should know better the relevance of naturalistic knowledge to contemporary social research, and none should know better the value of closer co-operation between those engaged in realistic social inquiries and those who have a wide experience of the financial needs of large-scale research work. If the new Institute is going to tackle the fundamental problems arising from the way in which expanding technical resources react upon, and are used by, existing social institutions, the existing departments of economics in our universities will not supply the recruits which it needs most. If it is not going to tackle these problems, it will do little to reinstate confidence in social research under academic auspices.

Elementary Geometrical Optics

(1) Practical Physics for Inter. B.Sc. Students
By Dr. H. M. Browning and L. Starbuck. Pp. x + 146. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 3*s*. 6*d*. net.

(2) A Textbook of Light
By L. R. Middleton. Second edition. Pp. viii + 288. (London: G. Bell and Sons, Ltd., 1937.) 6*s*.

(3) Light
By Vivian T. Saunders. Third edition. Pp. vii + 328. (London: John Murray, 1937.) 6*s*.

(4) A Textbook of Light
By G. R. Noakes. Pp. viii + 355. (London: Macmillan and Co., Ltd., 1937.) 6*s*.

(5) Elementary Physics:
for Medical, First Year University Science Students and General Use in Schools. By G. Stead. Fifth edition. Pp. xv + 559. (London: J. and A. Churchill, Ltd., 1936.) 12*s*. 6*d*.

(6) College Physics
By Prof. John A. Eldridge. Pp. x + 616. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 18*s*. 6*d*. net.

IN 1934 a committee of the Physical Society published a valuable report on the teaching of geometrical optics. The committee made a unanimous recommendation with regard to the convention to be observed for the sign of the power of an optical system. This convention is universal among opticians, and may be expressed briefly by saying that a positive lens tends to converge and a negative lens to diverge the light. A more difficult problem to solve is that of obtaining agreement as to the sign conventions to be adopted when discussing the relations between object and image. Two alternative methods were advocated, which may be called the Cartesian and the non-Cartesian systems.

The committee expressed the opinion that the preference for one or other of these systems in elementary teaching should rest on experience with both in the schools. It is accordingly a matter of interest, and indeed of considerable importance, to determine to what extent older conventions have been discarded and which of the proposed alternatives seems likely to be adopted. Most of the school text-books, and those used in junior university courses, formerly agreed in assigning a negative focal length to a converging thin lens. Distances on one side of the lens were considered positive, those on the other side negative, and distances were considered positive when measured in a direction towards the source of light.

(1) This 'old' convention, which we shall call convention *A*, is still employed in the recently published "Practical Physics" for Intermediate Science students written by Browning and Starbuck. (2) In the second (revised) edition of his "Textbook of Light", Mr. Middleton, of Latymer Upper School, has done a useful piece of work

by showing side by side the results of using three sign conventions. He retains the 'old' or A convention, and also introduces the new sign conventions recommended in the report of the Physical Society with the view of giving a positive focal length to a converging thin lens. The convention which he calls B differs from A in that distances are counted positive when measured from the pole in the same direction as that in which the incident light travels. Thus A corresponds to Group I, Case 2, of the report, and B to Group I, Case 1. Both of these conventions are based on the Cartesian framework. The third convention, which Mr. Middleton calls C, corresponds to Group II, Case 1, of the report. "Distances are measured from the mirror or lens and are counted positive if actually traversed by the light, but negative if the light only appears to travel in that direction. Thus for a real image v is positive, and for a virtual image v is negative. Also concave mirrors and convex lenses have positive focal lengths, while convex mirrors and concave lenses have negative focal lengths "

In the report the last method of dealing with optical problems is described as a "non-Cartesian" system. In view of the fact that stress is laid on a clear distinction between "object space" and "image space", I suggest that this may be called a "spatial" system, and convention C (that is Group II, Case 1) the "spatial" convention. It should, however, be noted that it is possible to develop the relations between object and image without express reference to these "spaces" (which may confuse a beginner), and this is the plan adopted in the above and some other books.

As illustrating Mr. Middleton's presentation we may quote his equations for a thin lens. It is, of course, obvious to the teacher that equations involving only reciprocals of a distance must have the same form under convention A as under convention B, since the sign of each distance has been reversed.

Convention *A*

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$

$$1 = (\mu-1)\left(\frac{1}{r_1}-\frac{1}{r_2}\right)$$

Convention *B*

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{f}=(\mu-1)\left(\frac{1}{r_1}-\frac{1}{r_2}\right)$$

Convention *C*

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{f}=(\mu-1)\left(\frac{1}{r_1}+\frac{1}{r_2}\right)$$

For a spherical mirror all three conventions lead to the same general formula:

$$\frac{1}{v}+\frac{1}{u}=\frac{2}{r}=\frac{1}{f}.$$

The author emphasizes the fact that it is only necessary for the student to know, and understand, one of these conventions. The value of the comparisons will be appreciated rather by the teacher, who wishes to make his choice between the conventions, than by the beginner, who may feel some alarm at their abundance.

(3) In the third edition of "Light", by Mr. Saunders, of Uppingham School, the sign convention used in geometrical optics "conforms to the convention used in algebraic graphs" and makes a convex lens have a positive focal length. The diagrams are drawn with the light moving from left to right across the paper (Convention B). Incidentally, mention may be made of the very interesting historical references in this book, and also of the chart of electromagnetic waves included by permission of the Royal Society.

(4) Mr. Noakes, of Giggleswick School, has written a "Textbook of Light" for the use of sixth-form students who are specializing in science. He has adopted many of the suggestions of the 1934 report, and in particular uses one of the two alternatives there recommended (Convention C). All real distances are reckoned positive, and all virtual distances negative; the focal length of a converging lens is thus positive. His conclusion is: "My experience with this sign convention has so far been that pupils consider it much less artificial than the Cartesian system, employed in most older text-books, and that the average careful worker makes fewer slips".

In view of the opinion of the committee of the Physical Society that actual experience in schools should be a deciding factor between the two alternatives, Cartesian or spatial, this conclusion is of special importance, and it is very desirable that it should be confirmed by other teachers. It agrees with the remarks of Mr. Vinycomb in the Physical Society discussion (p. 77), who found that elementary students were more successful with conventions of sign depending upon the real or virtual character of the object and image.

Why, it may be asked, should fewer mistakes occur when the "spatial" convention is employed by beginners? One reason is that the distinction between the object space and the image space itself takes care, to a large extent, of the question of sign. This is shown by the fact that the formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$ applies to both mirrors and lenses. With the older (Cartesian) conventions a separate formula $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$ is required for lenses, and it is necessary for the pupil to remember which formula applies to the lens and also to associate the letter u with the object and v with the image. There are thus two distinct possibilities of confusion in the mind of the beginner.

(5) In the fifth edition of Stead's "Elementary Physics", in which stress is laid on medical applications, the author states that he has adopted a new sign convention for lenses partly because of the support for the proposals of the committee of the Physical Society given by many members of the Science Masters' Association. "I confess that I have done this with some reluctance, as I am not altogether convinced of the wisdom of the change, so far as elementary students are concerned, but it has at least the advantage of giving the same standard formula for lenses and mirrors, and of bringing the signs of lens powers into line with those used by opticians and ophthalmic surgeons". The convention as to signs for thin lenses is expressed as follows (§ 232): "All distances are measured from the centre of the lens *C*. The distance from *C* of a real object or image is counted as positive, and the distance of a virtual object or image is negative. Since a convex lens has a real focus its focal length is positive; similarly the focal length of a concave lens is negative." The convention is essentially the same as that adopted by the author for mirrors (§ 215).

The curvature method advocated several years ago by Dr. C. V. Drysdale is both interesting and instructive, but my experience in teaching first-year university students has been that lack of time prevents more than a very brief reference to this method of treatment. It seems probable that schoolboys beginning the subject of light will think more easily in distances than in curvatures, and more advanced students can take up the curvature idea at a later stage after having had a taste of wave theory.

A stimulating, and in places provocative, book on "Physics for Medical Students" has been written by Mr. W. H. White, "one who has had time to learn how". On page 416 he writes: "The study of thin lenses is commonly carried on under the shadow of an algebraic convention as to 'sign' which makes distances measured opposite ways from the lens opposite in sign. That sounds simple and rational enough, and so it is from the point of view of geometry, but it has not the slightest physical basis". He aims at giving a physical meaning to + and − by picturing plane waves of sunlight falling on a lens (burning glass) and becoming curved to circular ripples which all close in on the burning focus *F*. Translated into 'rays', parallel rays become convergent radii which all pass through *F*. A concave lens has the effect of making parallel rays divergent. This leads up to the explanation of the focal power of a lens.

(6) It is interesting to find that in a new American book, "College Physics" by Prof. John A. Eldridge of the University of Iowa, the wave method is applied for finding the focal length of a double convex lens, and the rule of signs employed for mirrors and lenses corresponds fairly closely with convention *C*. This is a useful book for a student with only a general interest in physics, and yet should give a solid foundation for those intending to take a professional training at a later stage.

Which convention ought to be adopted?

Apart from the fact that such a phrase as 'Cartesian co-ordinate system' is alarming to a beginner, too rigid an adherence to a Cartesian framework may defeat its own aims, as, for example, when two students are working on opposite sides of a laboratory table, one having the source of light on the right, the other on the left!

In favour of convention *A*, as against convention *B*, it may be argued that this makes the co-ordinate u of the object, the first quantity to be dealt with, positive. The more negative quantities there are in u,v,f, the greater is the chance of error. In the greater number of problems set the object is given and either v or f is required. There is an advantage, therefore, in having u positive. Again, in the simple case of a real image formed by a concave spherical mirror (usually one of the first to be treated) the distances u, v, f are all positive according to convention *A*, but with convention *B* they are all negative.

If we consider the choice of our convention from the point of view of the teacher of elementary students, it would seem that convention *C* is to be preferred to convention *B*, in so far as there is less risk of mistakes in sign. The spatial convention does, however, strictly involve distinction between real and virtual spaces and so may cause confusion. The 'existence' of virtual images does present a difficulty to some minds, and there is the additional trouble that the student does not always know whether the image is going to be virtual or not. The difficulty is even greater to such minds when problems involving a 'virtual object' come to be dealt with.

Under present conditions, with so many methods of treatment in use, the outlook for a student or a science master who is transferred from one school to another is not an inviting one, and the task of an examiner who has to mark questions in optics answered by candidates from different schools becomes well-nigh impossible. It is to be hoped that teachers of physics will speedily reach agreement as to the convention to be used by elementary students. Personally I began the examination of this question with a prejudice, shared by many others, in favour of the 'old' convention *A*, but if we are compelled to follow the opticians' terminology the present survey points towards the adoption of *C*, the "spatial" convention, rather than *B*, the "Cartesian" convention.

H. S. ALLEN.

The Experimental Production of Mutations

Experimentelle Mutationsforschung in der Vererbungslehre

Beeinflussung der Erbanlagen durch Strahlung und andere Faktoren. Von N. W. Timoféeff-Ressovsky. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 42.) Pp. x + 181 + 6 plates. (Dresden und Leipzig: Theodor Steinkopff, 1937.) 15 gold marks.

THE last decade has seen remarkable activity in the experimental production of mutations in animals and plants, chiefly through the agency of X-rays but also by the application of various other radiations, as well as by chemicals and by temperature effects. When the range of dosage was determined within which the cell and particularly the chromosomes could be bombarded without an immediate lethal effect, the way was open for unlimited experimentation in the production of new genetic types through a direct effect on the germ-plasm.

So early as 1907–8, experiments were published showing the effects of X-ray treatment on the sperm of toads and rabbits, and Gager obtained evidence of mutations resulting in plants from the action of X-rays and radium. But success on a large scale first came from the work of Muller on *Drosophila* in 1927. The subsequent literature of the subject has become extensive, as indicated by the 27 pages of bibliography in the present volume. This experimental work has contributed much to the development of the conception of the gene, although, of course, natural mutations are of at least equal value in this respect.

Timoféeff-Ressovsky has contributed to all aspects of this work during the past ten years, and he has shown special interest in the nature of the gene from a physico-chemical point of view. It is therefore natural that he should have produced a book on this subject which is of great interest and analytical value. The work contains ten chapters. After four chapters of an introductory and general character, three are devoted to analysis of the processes by which mutations are produced by short wave-length radiation. Here *Drosophila* naturally looms large as having been most intensively studied, but the work of Stadler on cereals, Stubbe on *Antirrhinum*, and many other results are also considered.

Another chapter, on the effects of temperature, chemical treatment and other factors, is followed by one on gene structure, in which step-allelomorphism and the 'position-effect' are discussed, and the process of mutation is subjected to biophysical analysis. Evidence is produced for the conclusion that some mutations are the result of a very small rearrangement of the genes (position-effect), similar to inversions and translocations but on a smaller scale.

A final chapter considers the applications of the results to theoretical genetics, the chromosome theory and the phenomena of somatic induction, as well as the practical applications to experimental breeding and to man. The author may be assured that his book will be of much service not only to those engaged in this experimental field but also to all who are interested in modern genetical theory.

R. Ruggles Gates.

Tables for Air Navigation

The Air Almanac

Prepared by H.M. Nautical Almanac Office on behalf of the Air Ministry. (Air Publication 1602.) Pp. 16. 2*s*. 6*d*. net. Ephemeral Sheets for 1937, October 1 to December 31. (Air Publication 1602A.) Pp. 92. 2*s*. 6*d*. net. (London: H.M. Stationery Office, 1937.)

THE growing importance of astronomical observation in air navigation, as a result of the increasing range of aircraft, is reflected by the recent publication of an "Air Almanac", specially designed to meet the requirements of air navigation. The "Abridged Nautical Almanac" already gives to the surface navigator the astronomical data required to an accuracy of 0·1′ or 0·2′, but involves certain interpolations and conversions that can be avoided in an almanac catering only for one tenth of this accuracy, which is that appropriate to the conditions of observation with a bubble sextant in aircraft. This lower degree of accuracy gives the air navigator his position with all the precision that he needs. His prime requirement is rapidity in the working up of a sight.

The most interesting feature of the "Air Almanac" from this point of view is the tabulation of the Greenwich hour angle in arc, instead of the right ascension in time, thus giving directly the quantity that the navigator desires, without subsequent conversion. This method of tabulation normally involves large differences and heavy interpolations; but the small intervals of tabulation adopted, namely, one hour for the sun and moon, six hours for the planets and ten minutes for the sidereal time or Greenwich hour angle of the First Point of Aries, have made possible considerable simplification.

The "Air Almanac" has been designed to give all essential information in light, compact and easily readable form, with page references and interpolations reduced to a minimum. This has been achieved by issuing the "Almanac" in two parts, one of which consists of a stout permanent binding containing all the permanent data and tables, together with short explanations and illustrations; and the other consisting of loose sheets, each of which contains all the necessary ephemeral data for two days for the sun, moon, Venus, Mars, Jupiter, Saturn and fifty bright stars. The ephemeral sheets are punched for easy attachment to a loose hinge in the permanent cover. When one of these sheets is in position, the necessary astronomical data together with suitable interpolation tables are available in the space of a few pages. This reduces the bulk and greatly facilitates reference. Thus, though the ephemeral sheets for one year considerably exceed the "Abridged Nautical Almanac" in bulk, in consequence of the method in which the data are presented it is never necessary for the air navigator to carry more than a few sheets at any time.

Apart from the primary use for air navigation, it is certain that considerable interest will be expressed in the possibility of using the "Air Almanac" for surface navigation and also for incorporating afterwards similar ideas in the "Abridged Nautical Almanac". For the traveller in remote parts, a small bubble sextant in conjunction with the "Air Almanac" will suffice to fix his position with the accuracy that he usually needs.

The "Air Almanac" has been produced by H.M. Nautical Almanac Office to the general requirements of the Air Ministry, by agreement with the Admiralty. It is published by H.M. Stationery Office under the Code Air Publication 1602 for the permanent portion and 1602A for the ephemeral sheets. The first issue of the ephemeral sheets was for the period October 1–December 31, 1937. These sheets are to be issued in advance at first quarterly, later at intervals of six months, and finally annually.

Theory of Statistics

An Introduction to the Theory of Statistics
By G. Udny Yule and M. G. Kendall. Eleventh edition, revised throughout and re-set. (Griffin's Scientific Text-Books.) Pp. xiii + 570. (London: Charles Griffin and Co., Ltd., 1937.) 21*s*. net.

MR. UDNY YULE'S "Introduction" was the first book on statistics that came into my hands. This was about 1916. I liked it then and learned a lot from it. I like it even more now in its eleventh edition, when it appears in a revised and supplemented form. In fact, in my opinion, this is the best book on the theory of statistics that was ever written. We may regret only that it is an elementary introduction to the theory of statistics and not the theory itself. This still remains to be written.

The authors make a distinction between books on the 'theory of statistics' and those on 'statistical method'. They do not discuss this distinction in the text but emphasize its importance in classifying the existing literature (p. 496). The words "Theory" or "An Introduction to the Theory", etc., suggest a system of conceptions and theorems properly defined and proved. Some of the results thus obtained may be directly used for applications; but the main purpose of the whole is to broaden the horizon of the reader and to make him understand the purpose and the real meaning of 'recipes' that he may find in books on "Methods". It is true that the classification of the existing literature from this point of view could not be objectively distinct, since every book "on Methods" does give, or attempts to give, some explanation of what the reader is recommended to calculate. Whether these attempts are sufficient in any particular case is a matter of opinion, and it is possible that the classification as offered by Yule and Kendall will not be generally accepted. But the idea of the distinction itself and also the desirability of more books on the 'theory' seem to be important.

However difficult it is at present to write a book on the theory of statistics, it is still more difficult to produce an elementary "Introduction to . . ." "The Theory" implies a unicity of the basic ideas, in fact a system, as we have systems of geometries, Euclidean, Lobatchevsky-Boliay'an and Riemannian. Such a unified system of statistics, including all the recent advances, does not exist yet, and the writer on the subject must first produce one and then describe it in an intelligible way. These are the difficulties in writing a "Theory".

When writing "An Introduction", these difficulties are somewhat diminished by the fact that the system to be produced and described need not be so broad and may omit the more recent results. But there are other specific difficulties, to present the system without elaborate tools of higher analysis.

In this task the authors have succeeded admirably. They have produced a system of conceptions and their consequences, reaching as far as some of the quite modern tests of significance. They insist on definitions and are careful to use the words in their defined meaning. They even produce lists of defined terms used by other writers. When leaving out some results which are too difficult to be produced or omitting some proofs, they do it in a way which permits the reader to distinguish between what he knows and what he does not. This may seem only conventional praise. To understand its importance the reader may wish to consult some of the popular books on the "Methods" where, instead of properly ordered definitions and deductions, he will frequently find a sort of mystic gospel full of mysterious terms and impressive formulæ.

The new edition of the "Introduction" differs considerably from the preceding ones. The difference consists mainly in numerous smaller additions disseminated abundantly throughout the book and of several new large chapters. As stated in the preface, one of them, on interpolation and graduation, is due to Mr. Udny Yule himself. The others, on sampling, including an introductory chapter on small samples, on moments and measures of skewness and kurtosis and on the method of least squares have been written by Mr. Kendall. Probably owing to a close collaboration between the two authors, their respective contributions fit very well together and form a harmonic whole.

A noteworthy innovation in the book is a set of the most important numerical tables and a diagram (pp. 531–541) which are needed in any serious statistical work.

As in former editions, there are numerous examples discussed in the text and also "exercises". There are various problems attached to every chapter, which the student will find useful. The solutions of these problems are given in a special section at the end of the book.

The list of references given in the book contains 680 entries. It goes as far as 1932 and is not considered by the authors as complete. It seems, however, a pity that while quoting twelve books on probability, the authors do not refer to the work of the very important present-day French School. There is no reference to E. Borel's "Traité du Calcul des Probabilités", composed of about a dozen volumes, contributed either by Borel himself or by his various collaborators. There is no reference either to the important book by Paul Lévy.

There are a few minor points on which I am inclined to disagree with the authors. Of these it may be perhaps worth while to mention the definition of the word statistics. The authors write (p. 3), "By Statistics we mean quantitative data affected to a marked extent by a multiplicity of causes. By Statistical Methods we mean methods specially adapted to the elucidation of quantitative data affected by a multiplicity of causes. By Theory of Statistics or, more briefly, Statistics, we mean the exposition of statistical methods".

Naturally every author may choose the definition he likes, but it seems to me that the whole book under review has been written as if the authors had in mind another definition of statistics, that suggested by the German term *Kollektivmasslehre*. In fact, whatever they discuss is either the properties of some *Kollektivmass* (= collective character ?), such as the frequency distribution, measures of contingency, that of skewness, etc., or the means by which such a *Kollektivmass* of an inaccessible universe may be estimated from the sample available. The question of the "multiplicity of causes" seems to arise only before and after a statistical inquiry in the strict sense of the phrase.

Instances of this are given in a very interesting chapter (xv) on illustrations and practical methods. Having to solve some particular social (or any other, agricultural, physical, etc.) problem, we start by discussing the multiplicity of causes and, as it were, translate the problem into statistical terms. Then follows the statistical work proper and, when it is completed, we return again to draw conclusions concerning the causes. But these two phases of the inquiry, the first and the last, seem to belong rather to sociology, economics, agriculture or whatever may be the branch of science to which statistical methods are applied, but not to the statistics itself.

We may conclude by expressing the hope that the book in its new form will have a very wide circulation.

J. NEYMAN.

Gold Deposits of the World:
with a Section on Prospecting. By Prof. William Harvey Emmons. Pp. vii+562. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 36*s*.

PROF. EMMONS'S name is sufficient guarantee that a book from him merits serious consideration. In this work, an "Introduction", which is rather fuller than such chapters are wont to be, will be found helpful to many students and to some who have passed the student stage, especially in the elucidation of bathyliths and their relation to gold deposition. Excluding this and the index, which occupies eighteen pages, half the book is taken up in descriptions of American gold occurrences, and the balance is left for the remainder of the world. It is this latter half that is open. to criticism. For so dominant a producer as the Rand, more up-to-date figures might have been given for individual mines as regards values, widths, working costs and tonnage. For example, one diagram is based on assays made in 1913: the recent developments in which West Witwatersrand Areas, Ltd. has so prominently figured are almost passed over, and the plan of the Rand printed on p. 421 is too small and confused to be of much value. The absence of recent data is noticeable throughout this part of the book; thus it is stated that, "No production is reported for Sierra Leone", whereas the Colonial Report for 1935 gives "32,947 ozs. (crude)"; that in Tanganyika Territory the area north-east of Mwanza is unmapped, whereas excellent geological maps were published a few years ago.

In dealing with America, Prof. Emmons is on surer ground and writes fully with an authoritative hand. The descriptions of the mines are backed by an immense series of facts and figures, and throughout, with rare exceptions, the maps and diagrams, of necessity small, are admirable and sufficiently clear. Plentiful references to earlier works are given. The chapter on "Prospecting" contains some useful notes on controlling structures and references to examples in the text, but the author has not extended this part of his subject to descriptions or discussions of mechanical or geophysical methods. Despite the relatively small defects mentioned, this comprehensive volume will undoubtedly prove of great value to all interested in the geological and economic aspects of its subject. J. P.

The Fauna of British India, including Ceylon and Burma
Edited by Lt.-Col. R. B. S. Sewell. (Published under the authority of the Secretary of State for India in Council.) Protozoa: Ciliophora. By Dr. B. L. Bhatia. Pp. xxii+493+12 plates. (London: Taylor and Francis, 1936.) 30*s*.

THE present volume, one of the latest in the series on "The Fauna of British India, including Ceylon and Burma", though devoted only to those members of the sub-phylum Ciliophora, or ciliate infusoria, which have been recorded from the countries named, will be of more general interest to zoologists, in view of the cosmopolitan distribution of the majority of these Protozoa, and also because there is no recent publication in the English language dealing with this group in a comprehensive manner. This work represents a systematic survey of the Ciliophora, of which 310 species, including several new ones, are briefly described. The classification of the group adopted by Dr. Bhatia is up to date. Keys are provided for the identification of families (including those hitherto not recorded from India), genera and species. A useful "Systematic Index" combines a résumé with a classified list of the organisms dealt with. The ciliate species are also arranged in groups, according to their geographical distribution, while cross-reference lists are given for the parasitic forms and their hosts. A brief description is given of the general morphology of the Ciliophora and of the methods employed in their study.

There is an exhaustive bibliography occupying 46 pages and an alphabetical list of the ciliates referred to in the book, as well as a map of the Indian Empire. The volume is abundantly illustrated by text-figures and twelve plates. The latter represent the Ophryoscolecidæ found in the Indian ox and are reproduced from Kofoid and MacLennan's studies on these ciliates. It is somewhat surprising to find that, in a book devoted to the entire sub-phylum Ciliophora, all the plates are allocated to the representatives of a single family. C. A. HOARE.

The Scenery of England:
a Study of Harmonious Grouping in Town and Country. By Dr. Vaughan Cornish. Second edition. Pp. xvi+144+15 plates. (London: Alexander Maclehose and Co., 1937.) 6*s*. net.

DR. VAUGHAN CORNISH is an eminent example of the type of observer who not only appreciates the best characteristics of the works of Nature and of man but also interprets them with scientific understanding. The first edition of his charming little book was noticed in NATURE of November 19, 1932 (130, 760); and we are glad to direct attention to this new issue, which contains an appendix by Mr. H. G. Griffin, secretary of the Council for the Preservation of Rural England, on the aims and objects of the Council. The book has been enlarged and revised, and ten of the fifteen full-page plates in it are entirely new. The picture of the tidal bore of the Trent at Knaith, above Gainsborough, a subject to which Dr. Cornish has given particular attention, is remarkably fine. Every intelligent lover of 'open-air' scenes in town or country will find the book a source of real pleasure.

Earth-Lore:
Geology without Jargon. By Prof. S. J. Shand. Second edition, revised and enlarged. Pp. viii+144+16 plates. (London: Thomas Murby and Co., 1937.) 3*s*. 6*d*. net.

"GEOLOGY WITHOUT JARGON" aptly describes Prof. Shand's entertaining and informative little book. The second edition has been improved by the addition of a number of plates and other illustrations; and there is a new chapter on Atlantis and other "Lost Continents".

Exploration of the Electric Field in Clouds

THAT there is electricity in the clouds has been realized since 1755, when sparks were drawn from the insulated rod set up by D'Alibard and from Franklin's kite, but the problem how to determine with certainty where the electrification was situated had been left unsolved until a method was suggested by Sir George Simpson three years ago and developed at Kew Observatory by Mr. F. J. Scrase.

There has, it is true, been much speculation on the subject, speculation depending on the records of potential near the ground and especially on measurements of the change of gradient produced by lightning flashes. The problem, given the distribution of electricity, deduce the strength of the electric force at a certain point, is easily solved; but the converse problem, given the electric force at a single point, find the distribution, is not soluble. Even if we knew the electric force at every point on the ground, we could not determine the distribution of electricity in the clouds and in the air below the clouds. That is why the interpretation placed upon his records by an investigator has not necessarily been acceptable to his colleagues, and there has been much room for controversy. To gain more intimate knowledge of the state of things in the clouds it was necessary to send up into the clouds apparatus suitable for the purpose. I do not think that this was fully appreciated by anyone until we had tried at Kew Observatory to learn the meaning of the potential gradient records obtained in disturbed weather and had to admit that we were baffled by the ambiguities.

Electrometers had already been sent up in sounding balloons. In 1926 and 1927, Idrac measured the potential gradient in fine weather by means of a valve electrometer and a milliammeter, the indications of which were photographed, but none of his soundings was made through big clouds, and after his untimely death the investigation, which had been carried out at Trappes, was discontinued. For the work at Kew it was anticipated that numerous instruments would be required and they had to be as simple as possible. Sir George Simpson pointed out that it was more important to find the sign of the potential gradient than to measure it, and suggested the use of pole-finding paper. That idea was speedily developed, and the first alti-electrograph was sent up a few weeks later. This rapid advance was possible because Mr. L. H. G. Dines had already designed for Sir George Simpson a meteorograph which was intended to detect the presence of vigorous vertical air currents in the clouds. It was only necessary to put on the same spindle as the disk on which the pressure was recorded another disk carrying a piece of prepared paper. During the next two years, some seventy alti-electrographs were sent up from the Observatory.

During an ascent, the electrograph is in series with a pendant wire about twenty metres long, from the end of which there is point discharge whenever the electric field is strong. Two pin-points make contact with paper impregnated with a solution containing potassium ferrocyanide, and a blue trace is made by one pin or the other as the potential gradient is positive or negative. It was soon found that the thickness of the trace depended on the strength of the gradient, so the records are to a certain extent quantitative as well as qualitative. Most of the ascents were made during thunderstorms or thundery showers, the voltameter not being sensitive to the potential gradients in the clouds which yield moderate rain. To diminish the risk of the alti-electrograph being carried out to sea, a Baker release was used so that the apparatus would be carried down by a parachute from a height of a few kilometres.

The records have been analysed by Sir George Simpson and Mr. Scrase, and their conclusions are set out in a paper recently published by the Royal Society (*Proc. Roy. Soc.*, A, **161**, 309–352, August 1937). Some of the balloons sent up were not recovered, and in many cases the electric field was not strong enough to be recorded; but for the period up to the end of 1936 there were thirty-one records available for discussion. Most of the soundings had reached heights of about 7 km. as was intended, but in two cases the balloons had ascended to much greater heights, 15 km. and 17 km., and recorded strong gradients in the stratosphere.

At first glance there is much diversity in the records, but the analysis has yielded a number of valuable generalizations. The first is that in practically every ascent there is a change in the sign of the potential gradient. This is an indication that the balloon passed from below to above a region of concentrated charge. The second generalization is that the location of the charges is related to the temperature of the cloud. These two conclusions are illustrated in a very instructive diagram (Fig. 1).

In this diagram the ascents were arranged in order according to the height at which the

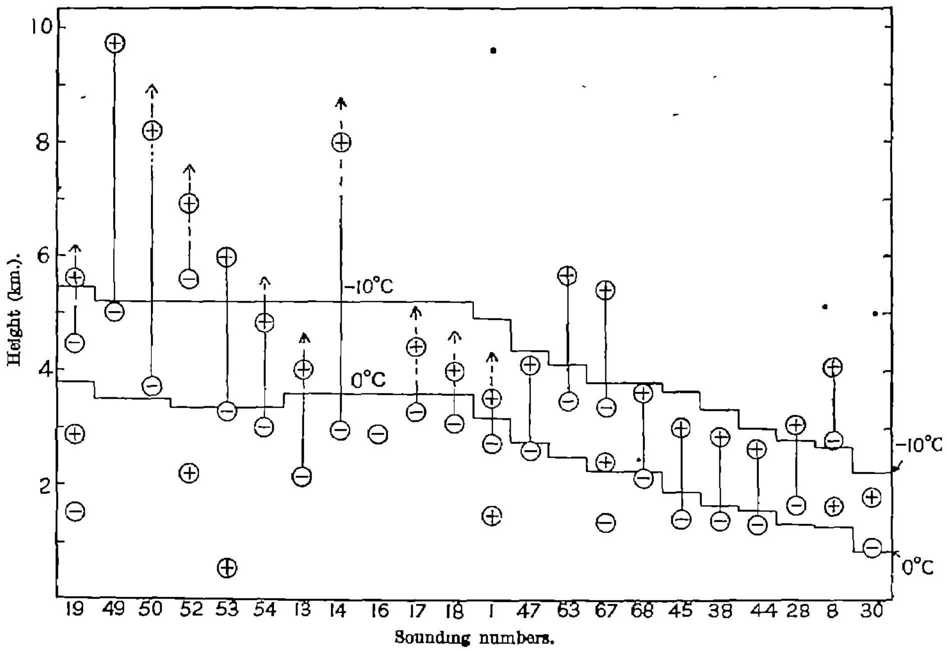

Fig. 1.

HEIGHT OF CENTRES OF RAIN ELECTRICAL CHARGES. FROM *Proc. Roy. Soc.*, A, 161, 309–352 (1937).

temperature (calculated by assigning reasonable values to the lapse-rate below and in the cloud) was −10° C.

It will be seen that in every case there was evidence for a positive charge near the greatest height reached by the sounding, and, moreover, this positive charge was always in a region where the temperature was below the freezing point. Clearly, positive electrification is developed in the part of the cloud where there is snow and possibly hail. The complementary negative charge is generally near the bottom of the cloud. There are, however, a few cases in which there is a concentration of positive electricity at a low level, an indication that there is a second process at work in the part of the cloud where the snow has melted into raindrops.

Hitherto, in most discussions of the possible ways of generating electricity in the clouds, attention has been concentrated on the behaviour of raindrops, in spite of the fact that the thunder-cloud is usually capped by false cirrus and in spite of the general acceptance in recent years of the doctrine, strongly advocated by Bergeron, that rain is nearly always melted snow. The discovery that electrification is produced in the region in which there is snow recalls, however, the early theory of thunderstorms developed by L. Sohncke, of Munich, in a pamphlet published at Jena in 1885 (cf. *Met. Z.*, 5, 413–425; 1888). Sohncke maintained that the electrification was produced by friction between ice and water, the ice acquiring a positive charge, the water a negative charge. If this theory had been correct, the negative charge on the cloud particles would have been carried upwards by convection currents and the snow would have carried a positive charge downwards. Actually the positive charge is found at the top of the cloud, so Sohncke's theory cannot be valid.

Simpson and Scrase remark that when there is driving snow near the ground, a strong positive gradient is developed. This was demonstrated by Simpson in the Antarctic and confirmed by Sverdrup during the voyage of the *Maud* in the Arctic

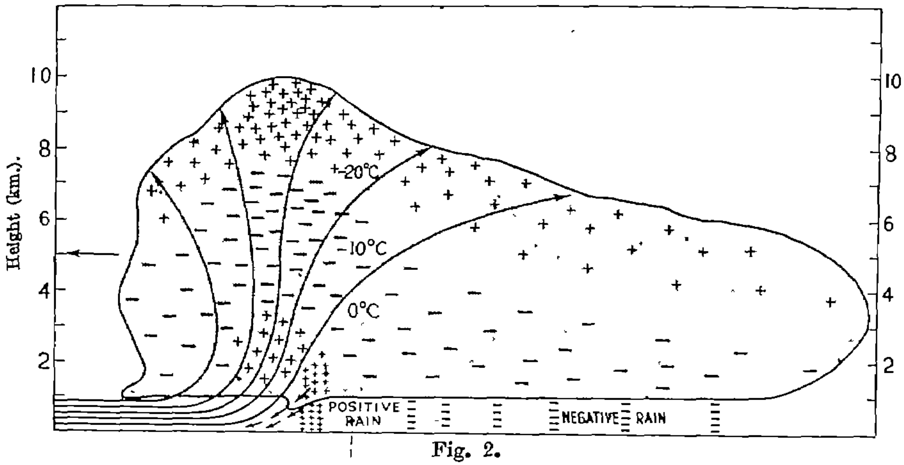

Fig. 2.

GENERALIZED DIAGRAM SHOWING AIR CURRENTS AND DISTRIBUTION OF ELECTRICITY IN A TYPICAL HEAT THUNDERSTORM. FROM *Proc. Roy. Soc.* A, 161, 309–352 (1937).

Ocean. It is likely that when snow particles collide, the particles acquire a negative charge, whilst a positive charge is given to the air. The snow falls to the ground and a positive space charge remains in the air and may extend to a considerable height. The process is analogous to what happens in a sandstorm, though the sign of the electrification is reversed. Thus it is to be expected that in the part of a cloud where there are snow particles in violent motion there will be electrification, that the snow will carry down a negative charge and that the air streaming upwards will take a positive charge to the top of the cloud, this charge being communicated rapidly to the cloud particles. It may be added that as the cloud-top is in a region where the conductivity is high, a strong current of positive electricity can flow upwards to the Heaviside layer, so providing (in accordance with Wilson's theory) for the air–earth current of fine weather.

There is some evidence that the regions in which positive electrification is produced low down in the clouds are those where the rain is heaviest, and Simpson and Scrase hold that the breaking-drop theory of the former is the explanation of this electrification. As the snow melts, it forms large drops, and if these are too large for stability they will break up. The rising current of air will carry a negative charge and the positively charged droplets fall or perhaps remain nearly stationary. The hypothesis that this process occurs only where the upward current is strong is embodied in Fig. 2.

Perhaps the most surprising result of the investigation is that no evidence is found for very strong fields in the clouds. The magnitude of the potential gradient is determined by a tentative formula which takes account of the width of the trace on the electrogram and also of the density of the air. It was found that when the gradient exceeded about 100 volts per centimetre, the trace was marked by sparking, but this occurred in only a few of the ascents. In 1925 Wilson put forward the hypothesis that, when a lightning flash is about to occur, the electric field just below a thundercloud is probably nearly 10,000 volts per centimetre, a hundred times the strength near the ground. The hypothesis seemed to be supported by estimates of the space charge produced by point discharge from trees and other objects. The soundings indicate, however, that generally there is little if any increase in the gradient as the cloud is approached. It may be that the estimates are systematically in error, and it is to be hoped that control measurements will be made by some more direct method.

One reason for suspecting such systematic error is that the estimated gradients imply that the charges in the clouds are comparatively small. If the gradients over two planes a kilometre apart are +100 v./cm. and −100 v./cm. respectively the charge is (by Coulomb's law) only 0·2 coulombs per cubic kilometre. This is insignificant compared with 20 coulombs, the quantity of electricity supposed to be discharged by a lightning flash. In what part of a cloud the lightning originates, and why it occurs, we have yet to discover.

The investigation is being continued at Kew and, although the ascents made during 1937 have not led to any striking new discoveries, it may be that in the course of time a record will be obtained which will provide the missing clue.

F. J. W. WHIPPLE.

Heat Production, Nutrition, and Growth in Man: Some New Views*

By Dr. E. P. Poulton

INDIRECT AND DIRECT CALORIMETRY

IN estimating the heat production of an individual, the oxygen intake and the carbon dioxide output are measured. After allowing for protein metabolism the oxygen intake is converted into calories of heat generated, by multiplying it with a factor which depends on the respiratory quotient (volume of carbon dioxide produced/volume of oxygen absorbed). These multiplying factors were calculated originally by Zuntz and Schumburg (1901), and are based upon: (*a*) the heats of combustion of carbohydrate and fat; (*b*) the chemical composition of carbohydrate and fat; and (*c*) the theory that when the respiratory quotient has the value unity carbohydrate alone is oxidized in the body and when the respiratory quotient has a value equal to 0·707 fat only is being oxidized, and at intermediate values of the respiratory quotient corresponding proportions of carbohydrate and fat are being oxidized. This method of calculating the heat produced by an individual is known as indirect calorimetry. The basal metabolism or basal metabolic rate of American authors or 'standard' metabolism of Krogh and Lindhard is at present defined as heat production in the morning before breakfast, fourteen to sixteen hours after the last meal of the previous day (the post-absorptive condition) with the subject lying at rest.

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* Substance of the presidential address delivered to Section I (Physiology) of the British Association at Nottingham on September 2, revised and modified.

The heat output of man and animals, under basal conditions, has been measured directly in a calorimeter by Benedict and Carpenter, DuBois and his colleagues and Murlin and Lusk, and compared with the heat output calculated indirectly by means of the Zuntz-Schumburg figures from the oxygen intake and the carbon dioxide output, which were measured simultaneously. The results obtained have been held by their authors to justify the conclusion from average values that the agreement between the two methods was sufficiently satisfactory to give support to the theory of the 'variable combustion ratio' outlined above. However, this theory has not escaped criticism.

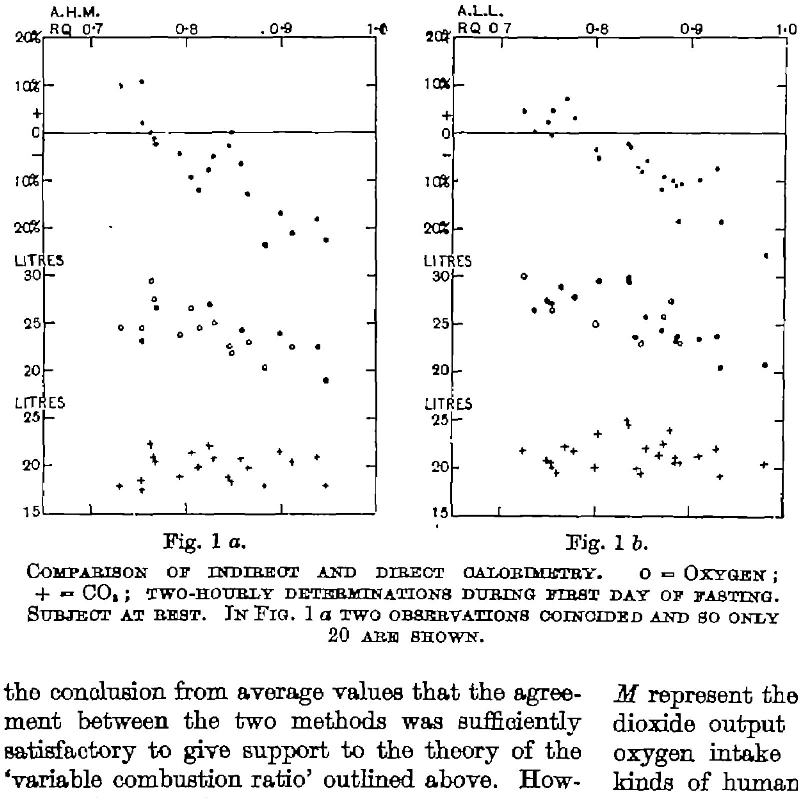

Fig. 1 *a*. Fig. 1 *b*.

COMPARISON OF INDIRECT AND DIRECT CALORIMETRY. o = OXYGEN; + = CO_2; TWO-HOURLY DETERMINATIONS DURING FIRST DAY OF FASTING. SUBJECT AT REST. IN FIG. 1 *a* TWO OBSERVATIONS COINCIDED AND SO ONLY 20 ARE SHOWN.

AN APPARENT ERROR IN INDIRECT CALORIMETRY

The most complete study of direct and indirect calorimetry in normal man under basal conditions is that made by Benedict and Carpenter. Using the data for two subjects, the theoretical heat from the oxygen intake and the respiratory quotient was calculated by the Zuntz-Schumburg method, and this heat (indirect heat) was compared with the heat actually measured by the calorimeter (direct heat). The difference between the indirect and direct heat was expressed as a percentage of the direct heat and related to the respiratory quotient by a graphic method. The result is shown in Figs. 1 *a* and 1 *b*. The horizontal line at zero in the top part of the diagrams represents the condition where the indirect and direct heats are identical; the ordinates represent the percentage differences between the indirect and direct heats. Satisfactory agreement between the heat calculated and the direct heat will depend on the percentage differences, indicated by the black dots, being evenly distributed above and below the horizontal zero line throughout the range of respiratory quotients. This is obviously not the case. The positions of the points suggest a systematic error; for the lower quotients the indirect heat is too high and for the higher quotients too low. DuBois' results tend to show the same thing, though not in such a striking way.

Another way of studying this question is to plot the carbon dioxide and oxygen independently against the heat (Fig. 2). The position of the points in the diagrams shows that there is a linear relation between the carbon dioxide and calories (correlation coefficient 0·950 ± 0·005) and between oxygen and calories (correlation coefficient 0·92 ± 0·008). The carbohydrate line is the relation of the carbon dioxide output and oxygen intake to the heat produced, when pure carbohydrate is burnt in a calorimeter; they were calculated from the value given by Lusk, namely, 5·047 Cal. per litre of oxygen and carbon dioxide. The lines *K* and *M* represent the relation of the heat to the carbon dioxide output on the left-hand side and to the oxygen intake on the right when two different kinds of human fat are burnt. These two fats, from liver and skeletal muscle analysed by Cathcart and Cuthbertson, were chosen because they represent extremes, and the lines of the other nine human fats analysed by them lie in between. Most of the carbon dioxide points lie between the theoretical carbohydrate and fat lines, which are widely spaced; but this is certainly not the case with the oxygen points, as the theoretical limits are much narrower. It is possible to look on the carbon dioxide as the product of combustion of a mixture of carbohydrate and fat, but, because the oxygen points lie for the most part outside the theoretical limits, the oxygen intake cannot, apparently, be entirely used up in combustion, but must in part be concerned in some kind of conversion.

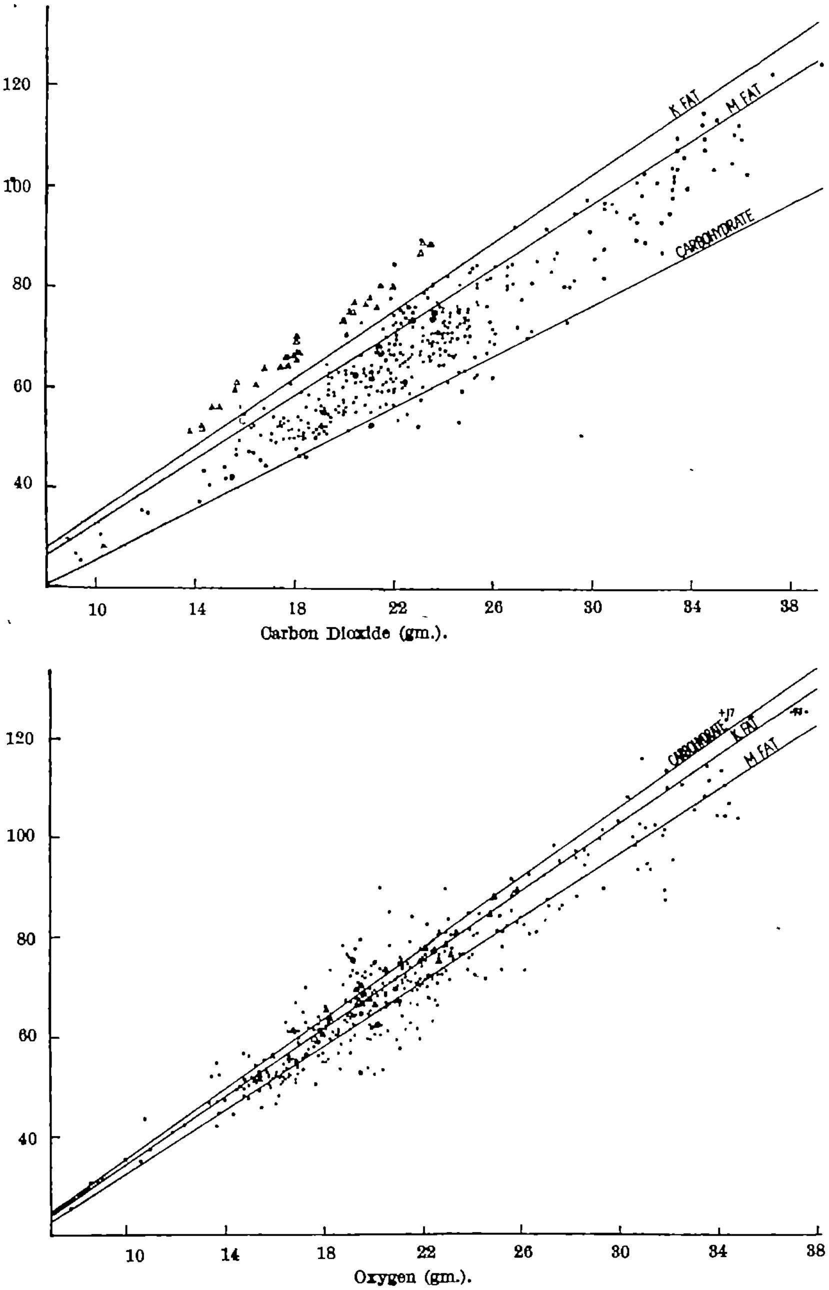

Fig. 2.

Comparison of indirect and direct calorimetry. DuBois' basal values (rectal temperatures not above 37·5° C.). Ordinates: Calories per hour; Abscissæ: Upper diagram—CO_2 gm. per hour; Lower diagram O_2 gm. per hour. ○ Two coincident values. Δ Alcohol control experiments.

However, work since Nottingham has exposed an error in these diagrams. In many of DuBois' results there was a considerable difference in the rectal temperature at the beginning and end of an experiment which was taken to imply a large physical liberation or storage of heat, depending on the temperature difference, the body weight and average specific heat of the body (0·83). But since the rectal temperature can only be a rough measure of the body temperature as a whole, it follows that when there are large differences between the eliminated heat (actually measured) and the direct calorimetry (the value after correction for heat physically liberated or stored), there must be considerable uncertainty about the results. It has been found on plotting heat against carbon dioxide, according to the quotient, that when the differences are greater or less than 10 per cent of the eliminated heat, many points fall a long way from the mean line; the eliminated heat has apparently been overcorrected. These uncertain results also form a high proportion of those outside the theoretical limits for oxygen and calories in Fig. 2, and they also seem to account for the similarity of the results of Benedict and DuBois, when the latter are calculated so as to form diagrams as in the upper part of Figs. 1 *a* and 1*b*. If all the uncertain results are eliminated the points in Fig. 2 lie nearer to the mean line, and now appear compatible with the theory of the variable combustion ratio. There is thus a discrepancy between the results of DuBois and those of Benedict, for the latter are incompatible with the theory.

[*To be continued.*]

Obituary Notices

Prof. J. B. Senderens

THE death on September 26 of Jean Baptiste Senderens, who was born in the village of Barbachen in the Hautes-Pyrénées in 1856, removes from our midst one of the most active workers in the field of contact catalysis.

Together with Sabatier in 1899, Senderens found that finely divided nickel could be employed as a catalyst for the hydrogenation of the vapours of a variety of organic substances, and with this discovery the intrusion of catalytic methods into technical organic chemistry may be said to have commenced. In fact, the first patent for the reduction of an organic substance by hydrogen in the presence of catalytic metals was granted to Senderens (*D.R.P.*, 139, 457, of July 26, 1901) for the production of aniline from nitrobenzene. It is possible that the achievements of Senderens would have left an even deeper imprint on modern chemical industry if he had not confined himself to reactions in the vapour phase and left the treatment of liquids, for example, modern fat hardening, coal and liquid tar hydrogenation, to others. Nevertheless, his technical contributions, especially in the field of fine chemicals, and in association with the firm of Poulenc Frères, are important and varied enough to leave industry permanently indebted to him.

One has only to glance at any text-book on contact catalysis to obtain some idea of the wide diversity of the applications that Senderens made of this new method of contact catalysis in the field of organic chemistry. The preparation of substances such as ketones from acids or of cyclohexane from benzene are indeed too numerous to mention. In respect to the theory of contact catalysis, Senderens was a protagonist of the view that intermediate compounds were formed between reactant and substrate—in more modern terminology, that chemisorption was a pre-requisite for chemical reaction. It may be noted that, in addition to the purely preparational character of his work, he made a number of very significant observations which must eventually find their place when we are in possession of the detailed mechanism of these surface reactions. Thus he noted that whilst benzene could be hydrogenated to cyclohexane, dehydrogenation could be effected at higher temperatures. Thus equlibrium can be obtained from both ends and permits of the accurate evaluation of the free energy changes involved in organic reactions. His work on this reaction renders Senderens a pioneer in what is now an important field of physical chemistry.

Again, Senderens observed that acetylene could be hydrogenated to ethane without the addition of hydrogen, the latter being supplied by simultaneous dehydrogenation of part of the acetylene; this reaction may be regarded as the prototype of important reactions involved in the oil industry, where the fundamental processes consist in the catalytic making and breaking of carbon-carbon and carbon-hydrogen bonds. He noted that nickel was a 'better' hydrogenating catalyst than copper; thus carbon dioxide can readily be converted to methane on the former but only to carbon monoxide on the latter metal; likewise amyl acetylene is converted to heptane on nickel but only to amyl ethylene on copper. Similarly, he pointed out that whilst an active nickel catalyst will hydrogenate both cresol and phenol, a nickel catalyst that had been employed for a long period in hydrogenating phenol was rendered inert for the cresol reaction. Here we are evidently dealing with cases of specificity, one of the most fascinating and mysterious features of contact catalysis.

Senderens' work was not confined to hydrogenation processes; he examined numerous cases of dehydrations, that of alcohol to ether or ethylene being the most important. Finally, we may mention that he initiated investigations in the much more difficult field of catalytic oxidations; for example, isoamyl alcohol to aldehyde and the preparation of benzoic acid from toluene.

Senderens, like several well-known French scientific workers, was a faithful son of the Church, becoming first an Abbé and later a Canon. Together with Sabatier he was made an honorary fellow of the Chemical Society in March 1920, and he was elected *correspondant* of the Paris Academy of Sciences in 1922.

In Grignard's "Traité de Chimie Organique" (Vol. 3, 941; 1936) there is written: "La catalyse n'a pris de l'importance en chimie organique que per les travaux de Sabatier et Senderens" (1897–1905), a statement which cannot fail to find universal acceptance.

E. K. RIDEAL.

Dr. R. O. Hall

WE regret to announce the death on November 28. as the result of an accident, of Robert Oswald Hall,

Hall was born on June 24, 1905, and educated at Wakefield Grammar School from 1916 until 1923. In 1924 he entered the University of Leeds, where he took the honours chemistry course, holding the Lord Kitchener National Memorial scholarship from 1925 until 1929. Later, he took part in a general study of the hygienic properties of clothing, and investigated the laws governing the transmission of water vapour through textile fabrics as a function of their structure and the nature of the component fibres. An account of the work is to be found in the thesis on "The Ventilating Properties of Textile Materials and Fabrics", for which he was awarded the degree of Ph.D. of the University of Leeds in 1930. In the same year, he was elected an associate of the Institute of Chemistry, and was appointed an assistant chemist in the Government Laboratory.

In 1931, Hall was appointed research fellow of the Textile Department, Ontario Research Foundation, Toronto, where he remained for three years. There he carried on a series of investigations relating to the quality and specifications of textile materials as used in the motor car industry. This work led him into a number of separate lines of research of a fundamental character. Thus, in regard to the colour of fabrics, he devised an instrument by which it was possible to determine the fugitivity of dyestuffs under controlled conditions of temperature and moisture but under intense illumination, which greatly accelerated the fading. He was appointed to draw up standards of fastness acceptable to the two branches of industry concerned.

Other aspects of Hall's work were concerned with standards of length measurement in relation to the atmospheric humidity and hence the moisture content of textile materials. In addition to such problems as these, which were undertaken on account of their immediate importance to industry, he found time to pursue inquiries of a more academic character, particularly an investigation of the absorptive behaviour of the wool fibre in relation to the degree of swelling.

Early in 1934, Hall accepted an offer of the position of research chemist with Messrs. C. W. Martin and Sons, Ltd., Bermondsey, London, S.E.1, in connexion with their processes in dressing and dyeing fur skins.

During the past three years, Dr. Hall carried out fundamental research on the behaviour, under different conditions, of the individual fibres constituting the fur and pelt of skins. For these investigations he worked out a special technique in microscopy which led to some extremely novel and interesting results. Other problems investigated by him included 'singeing' of hairs, bleaching of ermine, and unhairing of fur seals. His abilities as a physicist proved of great value in work connected with the conditioning and drying of skins.

Hall represented the best type of scientific worker, logical, clear-thinking and of wide experience; by reason of these qualities his views commanded respect and attention. His loss will be felt not only by scientific workers who had come in touch with him but also by his colleagues and friends, who were attracted by his cheerful disposition and sound judgment. He leaves a widow and one child.

Prof. J. S. Štěrba-Böhm

BY the death of Prof J. S. Štěrba-Böhm, professor of inorganic and pharmaceutical chemistry in the Charles University of Prague, on January 1 at the age of sixty-three years, Czechoslavakia has lost a distinguished investigator of international reputation. After graduating in pharmacy, Štěrba-Böhm left Prague and travelled through Austria to Serbia, and to Italy, France and Germany. In Paris he was fortunate enough to attract the attention of both Becquerel and Moissan, with whom he carried out some original work.

On returning to Prague, Štěrba-Böhm assisted Brauner in some of his investigations on the rare earths, and this work he continued after the latter's retirement. Meanwhile, an opportunity arose in 1913 and Štěrba-Böhm was appointed assistant professor. After the Great War, in 1919, a chair for pharmaceutical and inorganic chemistry was established for him. He had considerable routine work in connexion with pharmaceutical matters and in 1928–29 was dean of the Faculty of Science, but nevertheless was able to continue his researches and published much original work, mostly in Czech and French journals, on the lesser-known compounds of cerium, scandium and germanium. It was characteristic of him that he took the utmost pains to use the purest materials, a precaution which at first gave his collaborators the impression that progress was unduly slow; but it was one that is most essential in researches on the rare earths. Some years ago he prepared a long list of double oxalates of cerium with meticulous care to ensure the greatest possible purity of the salts obtained. More recently he prepared a number of scandium compounds, in particular the formate and its double compounds. Indeed, he contributed much to the chemistry of this rare metal. With a supply of argyrodite he isolated a whole series of pure germanium salts, bringing up to date the early work of Winkler on this element.

Prof. Štěrba-Böhm was of a retiring disposition but was always willing to put his knowledge at the disposal of his students and colleagues. Like many of his countrymen, he had a command of many languages and was an impressive lecturer. He was honorary foreign member of scientific societies in France, Poland, Jugoslavia and Bulgaria. G. D.

Mr. T. Nelson Dale

T. NELSON DALE, a retired member of the United States Geological Survey, died at his home in Pittsfield, Massachusetts, on November 16, nine days short of his ninety-second year.

Courses in mathematics and mineralogy at the University of Cambridge, petrography under Prof. J. Wolf at Harvard University, field trips under the leadership of Dr. Carl Zittel of the University of Munich to Norway, Sweden, France, Germany and Switzerland, and a stratigraphic and palæontological research problem in the Val de Ledro in the Tyrolese Alps, comprised the systematic part of Mr. Dale's early training. The accuracy of this first geological research, praised by Dr. Zittel and by Dr. A. Bittner of the Austrian Geological Survey, characterized all his later structural and petrographic papers written while he was associated with the United States Geological Survey, from 1880 until 1920. This work was mainly concerned with the Taconic and Green Mountain structural problems, which involved some twelve thousand miles of walking and as much of driving in the most rugged section of western New England. The mapping and the structural sections have been found to be, on the whole, extremely accurate within the area studied. The latter phase of his work with the United States Geological Survey was concerned with the investigation of the granite, marble and slate industries of New England and the United States, the results of which work, published in the Survey bulletins, have long been considered standard references among quarry men as well as in colleges and universities.

WE regret to announce the following deaths:

Major E. E. Austen, formerly keeper of the Department of Entomology in the British Museum (Natural History), on January 16, aged sixty years.

Mr. Wilfred H. Parker, director of the National Institute of Agricultural Botany, Cambridge, on January 11, aged forty-nine years.

Prof. Otto Warburg, formerly professor of botany in the Oriental Seminary, Berlin, lately chief of the Institute of Natural History of Palestine in the Hebrew University, Jerusalem, on January 10, aged seventy-eight years.

WE are glad to state that the announcement, printed in NATURE of January 15 (p. 109), recording the death of Prof. Otto H. Warburg, For.Mem.R.S., is incorrect. Prof. Warburg had been confused in press messages with Prof. Otto Warburg, whose death is announced above.

News and Views

A World Association for Science and Society

AT a time when restrictions are being placed upon freedom of scientific work and speech in some countries, and when the nations look to science for the materials of destruction, the momentous pronouncement of the American Association at Indianapolis is a challenge to science and to society (see p. 169 of this issue). No men of science who, in the words of the corporate resolution passed by the Council of the American Association, "regard the suppression of independent thought and of its free expression as a major crime against civilization itself", can ignore that challenge. Nor is the British Association likely to disregard the invitation to co-operate in forming the nucleus of what will be a World Association for the Advancement of Science and Society—an international 'brains trust'—since it was the success of the Blackpool meeting and its concern for social problems which inspired the recent action in the United States. What the American visitors heard there, in the free and constructive addresses delivered by scientific workers on the effects of science on social problems, convinced them that men of science, with unsealed lips, had a great contribution to make to world order. The symposium on "Science and Society", at their Indianapolis meeting, was their first response. The resolutions of their council, proclaiming a Magna Charta of scientific freedom, reaffirming the democracy of knowledge, and inviting all who could subscribe to the free principles of science to join in world co-operation, carried the lesson of the British Association into world affairs.

THE language of the resolutions is forthright and uncompromising. It will not tolerate intolerance. It demands a free trade in scientific knowledge and the recognition that the object of science is the advancement of the well-being of all mankind. As the *New York Times* said in the leading article endorsing the proposals which Mr. Ritchie Calder made in the *Daily Herald* for a Magna Charta and an Anglo-American nucleus, and which led to the American Association taking it up: "He has not exaggerated. To save science his 'World Association' is needed, an organization which shall indicate how the objective attitude of the laboratory may be applied in governing a people, in breaking down prejudices, in preventing war, in solving problems that mean progress not in one country alone but the world over." It is an ambitious project, but the ideals it propounds are those of science itself. Objectivity in a world of misrepresentation and dangerous prejudices is sorely needed. The social inquiries of the League of Nations' Technical Commission on Nutrition, and its parent body the Mixed Commission of the League, are examples of how the principles of science may be universally applied.

WHILE, however, it is important to provide a platform from which men of science throughout the world can proclaim the truths of science, it is also important that a World Association, to fulfil its objectives, must have the means to initiate inquiries, collect data and be prepared to co-operate with the social forces for peace and progress. In all the vicissitudes of the political history of the League of Nations, the International Labour Office and the Health Organisation have carried on their constructive humanitarian work. A similar organization for science, more effective and far-reaching than the Committee for Intellectual Co-operation, would give substance to the spirit of the American proposals. It would be a World Association, safeguarding the independence of scientific workers and of scientific thought, willing to co-operate with all nations which are prepared to work for the good of mankind, but, as an association, subject to none.

Prohibition of NATURE in Germany

THE declaration of scientific freedom made by the American Association in the resolutions referred to above is a gratifying sign that men of science remain true to the essential condition of scientific progress. That it should be necessary to reassert a principle for which science—as a pursuit for truth—has always stood, is a depressing commentary upon twentieth century events. Until recent years it was believed that the battle for freedom of scientific thought and work had been fought and won, but we are now often painfully reminded of reactionary tendencies. An example of this is afforded by the following translation of an order issued by the German Ministry of Education (Reichserziehungs-Ministerium) a couple of months ago, a copy of which has just reached us: "In the scientific weekly journal NATURE, articles have often been published containing unprecedented and base (*unerhörte und niedrige*) attacks against German science and the Nationalsocialistic State. Therefore this journal must be excluded from general use in scientific libraries. I request that appropriate orders be given to the libraries of the Universities, Colleges, Institutes, and Research Departments. Concerning the secret use and restricted access to the journal I refer to my decrees of the 17th September 1934, 3rd April 1935, and 16th December 1936:—U I 22733, W I e 828, and—W I a 2305."

IT is, of course, altogether untrue to assert that NATURE has ever attacked German contributions to scientific knowledge. Never a week passes without the publication in our columns of appreciative reviews of German scientific works and summaries of papers published in German scientific periodicals, while we are glad also frequently to print original contributions in our correspondence columns. We welcome the opportunity of recording worthy additions to the literature of science or to natural knowledge from any country or any race; but we should be false to the traditions of science if we failed to condemn any influence which would make scientific research subservient to political or theological domination. The misrepresentation of our attitude contained in the announcement of the German Minister of Education is hard to bear, but we regret that the penalty involved in the withdrawal of NATURE from libraries and other institutions will be felt more by some of our readers in Germany than by ourselves.

Science for Peace

A RECEPTION was recently given, jointly by the League of Nations Union and the International Peace Campaign, in honour of the Nobel peace prize award to Lord Cecil. Science was officially represented by Prof. Jean Perrin, who spoke as Under-Secretary of State for Scientific Research to the French Government. A number of well-known British men of science, including Sir William Bragg, were also present. Afterwards Prof. Perrin spoke informally to a small group of scientific workers about the work of the Science Committee of the I.P.C. in France. This Committee, which comprises some seventy men of science, among whom are many of the most eminent in France, has concerned itself with the special relations of science to the problems of peace and war. As Prof. Perrin himself put it, in his Armistice Day address at the Sorbonne: "It must be stressed that we scientists, even more than other men, desire peace, because the very fact of our specialization enables us to realize more vividly what we have to lose from war. Let me make myself clear. Other men defend the happiness of mankind, as they know it; we do so too, and this is certainly enough to justify our effort and our enthusiasm. But apart from this we, who because of our profession can see a little further, are also defending the future of mankind. We are defending the city of the future, that city the form of which is as yet uncertain, where progress will be indefinitely maintained, where justice and fraternity will rule without conscious effort, where illness will have disappeared and death have receded, until it becomes a freely accepted rest, and where each human life will unfold in harmony and beauty. I hope that you will see in this a reason for organizing that peace without which we shall never reach the magnificent realization of that which appears to contemporary man to be the highest ideal."

Indian Science Congress at Calcutta

OUR correspondent, writing from Calcutta on January 9, says: "The Indian Science Congress at Calcutta draws to a triumphant conclusion. The founders of the Congress Association must view with pride the successful outcome of their venture, and the founders of the British Association might well have been proud also, for their work has its continuation not only in the British but also in the Indian and other associations over-seas. The opening of the Congress on January 3 by H.E. the Viceroy was a brilliant occasion. It is understood that membership of the Congress has far exceeded that of any previous meeting, and at the popular lectures given by Prof. H. J. Fleure, Dr. F. W. Aston, Sir James Jeans, Sir Arthur Eddington, and Prof. F. A. E. Crew, the attendances have been enormous: for at least one of them, that by Sir James Jeans, the hall was almost stormed. Very generous hospitality has been afforded by Government authorities, the University and the Corporation of Calcutta, many institutions and private hosts. The time of the delegation has been very fully occupied, not only with the proceedings of the Congress but also in making or remaking those personal contacts for which such an occasion as this offers almost the sole opportunity. A considerable number of the delegates will now proceed from Calcutta to various points in India in pursuance of personal scientific interests and engagements. A party of about fifty, however, are about to leave for six days' travel in the south, during which time they will be formally received by the University of Madras and by the Government of Mysore and the University of Bangalore. They will join the R.M.S. *Strathaird* at Bombay on January 15 for the homeward voyage. The extraordinary good fortune of the delegation in the matter of weather conditions, culminating in the brilliant hours of the visit to Darjeeling, has been recorded in a previous note. At Calcutta these conditions have continued, and it is said that the mean daily temperature has been as much as ten degrees above the normal for this time of year."

Broadcasting and Citizenship

AT the North of England Education Conference on January 6 the Central Council for School Broadcasting and the Central Committee for Group Listening were represented by their secretary, Mr. A. C. Cameron, who discussed the principles on which these two bodies are at present shaping their policies and raised a number of questions as to the moulding and educating influences of broadcasting on the citizen of to-morrow and to-day. As regards school broadcasting, for the reception of which, by the way, in England and Wales some 7,000 schools are equipped, he emphasized its importance as fostering the interest of the child in life outside the school and the interest of the parent in the school. As evidence of the growing interest of parents he mentioned that a school broadcast recently brought him three hundred letters from parents who had listened to it. To promote group listening and discussion seven area councils representative of voluntary bodies, local authorities and the universities have been constituted. Many listening and discussion groups have been formed by such bodies as women's institutes, townswomen's Guilds and public libraries, and many are recognized by local education authorities as eligible for grants for "further education". Another speaker at the Conference, a member of the executive of the National Union of Teachers, argued that wireless receiving sets ought to be regarded as essential pieces of equipment for schools and for bodies such as juvenile organization committees and community centres which undertake to promote group listening as a means of adolescent and adult education. It seems open to question whether grants should be made for encouraging such listening and discussion groups without some sort of guarantee that they are conducted by competent leaders. With proper guidance (for which attendance at university extension tutorial classes would provide an excellent training) such groups could be developed into a powerful agency for education for citizenship.

Psychology of International Relations

IN an address at a public luncheon given by the National Institute of Industrial Psychology on January 13, Dr. William Brown said that the psychology of international relations, otherwise the psychology of peace and war, can be adequately discussed only on the basis of a scientific study of the human mind. Dr. Brown is convinced that the latest war was not the last. He compared it with a manic-depressive patient who, after a state of deep depression, passes into one of exaltation and feels that never again will his old symptoms return. Of a patient of this kind it is known that sooner or later he will have another relapse. Although psychological treatment can benefit such a patient, and in some cases produce recovery, the underlying physical and mental causes of the illness remain obscure. So it is with war and peace. Psychologists cannot yet claim that a solution has been discovered. All they can do is to go on and disentangle the various forces which are at work to produce war. Of these forces, one of the most important is the primitive struggle for existence. It is not possible, however, said Dr. Brown, to deduce the social behaviour of a man from his purely individual behaviour. Man still carries with him tendencies towards more primitive forms of mental reaction such as are appropriate to the early stages of national and social evolution. These primitive forms of reaction are very clearly revealed in criminal behaviour, in panic-stricken flight and in certain mass movements. The possibility of mass mental reactions have an obvious bearing upon the problem of war and peace. For such primitive forces as self-preservation and self-assertion, while valuable in many respects, yet if used in certain ways, are irreconcilable with ultimate peace between individuals or between nations.

Chinese Universities Relief Fund

THE damage inflicted on universities in the course of the Japanese invasion has been enormous, amounting in several instances to complete destruction of all the university buildings and equipment. Concerted action has been taken by students, professors and the Chinese Government to combine the relief of distressed students with the maintenance of some form of training in centres remote from the war theatres, such as Changsha in Hunan Province. Appeals to universities in other lands have been organized by International Student Service for the relief of destitute students and for equipping them in their efforts to carry on their studies. In England there has been a response from every single university and the majority of university colleges, the amount raised in this way up to date being £3,000. The English committee has undertaken, in addition to contributing to the international fund, to assist Chinese students in Great Britain whose funds have been cut off. In a letter to *The Times* of January 7, Sir Walter Moberly, chairman of the International Student Service, appeals for at least another £2,000. Contributions may be sent to Prof. Ernest Barker, the Hon. Treasurer of the Chinese Universities Relief Fund, at 49 Gordon Square, London, W.C.1.

Determination of Molecular and Atomic Weights

A COMMITTEE for the study of the determination of molecular and atomic weights of gases by physico-chemical methods, organized by the International Institute of Intellectual Co-operation assisted by the International Council of Scientific Unions and by the International Unions of Physics and Chemistry, met on December 17 and 18 in Neuchâtel (Switzerland). Two reports formed the basis of the discussion, the first on the method of limiting-pressures, established by Prof. R. W. Whytlaw-Gray and Dr. W. Cawood, the second on the method of limiting-densities, established by Prof. E. Moles. Prof. Jaquerod presided over the assembly, which was attended by Profs. Whytlaw-Gray (Leeds), Moles (Madrid), Lepape (Paris), Klemenc (Vienna), Timmermans (Brussels), Keesom (Leyden) and Dr. Cawood (Leeds). Several suggestions were made concerning the improvement of the methods used, and a discussion took place concerning the interpretation of the results obtained. Among the conclusions, the committee emphasized the international importance of the laboratories at Leeds (Whytlaw-Gray) and at Madrid (Moles), on account of the results they obtain, their equipment and the special qualifications of their staffs. This is to be reported to the International Organisation on Intellectual Co-operation of the League of Nations. The full reports and the minutes of the meeting will be published by the International Institute of Intellectual Co-operation. This meeting was a part of the projected scientific activity of the International Organisation on Intellectual Co-operation. Future assemblies of committees of study will be held this year and the following questions will be discussed: "New Vitamins"; "Nomenclature of Genetics"; "New Theories of Modern Physics"; "Co-ordination of Scientific Terminologies" and "The Electric Double Layer".

Scottish Universities Parliamentary Election

On January 20, a writ was issued for the Scottish Universities by-election, made necessary by the death of Mr. Ramsay MacDonald. A group of strong candidates is in the field: Sir John Anderson, former Governor of Bengal, the nominee of the Unionist Associations of the Universities; Prof. A. Dewar Gibb, regius professor of law in the University of Glasgow, a Scottish Nationalist; Dr. Frances H. Melville, formerly mistress of Queen Margaret College, University of Glasgow, an Independent candidate; and Sir Peter Chalmers Mitchell, biologist and former secretary of the Zoological Society of London, standing as an Independent Progressive. Sir Peter Chalmers Mitchell is a graduate of the University of Aberdeen as well as of the University of Oxford, and he has maintained contact, during a life devoted to biological science and administration, with the arts and with educational developments in Great Britain and abroad. He was secretary of the Zoological Society of London for thirty-two years, and for a long period was leader writer and scientific correspondent of *The Times*. At a meeting of Scottish graduates in London he stated that the principle of university seats in Parliament is most difficult to defend if these are simply to be held by official nominees of the political parties, and that he considers it the duty of university electors to select the candidate with the best qualifications to advocate the services which the arts and sciences can give the nation. Sir Peter is particularly well qualified to present and uphold in the House of Commons the scientific outlook upon modern problems touched by science, and on this account his election to Parliament would be widely welcomed.

Centenary of James Craig Watson

On January 28 the centenary occurs of the birth of the American astronomer James Craig Watson, whose name is recalled by the Watson Medal of the National Academy of Sciences. He was born in Elgin County, Canada, of American parents, and at the age of fifteen years he entered the University of Michigan at Ann Arbor, and there came under the influence of the German astronomer Franz Brünnow (1821–91) who in 1854 had been appointed the first director of the Ann Arbor Observatory. Watson soon became an enthusiastic astronomer and on Brunnow's resignation in 1863 he succeeded him as director of the Observatory and as professor of astronomy. He held these positions until 1879, when he was appointed director of the Washburn Observatory at the University of Wisconsin, Madison, where he died suddenly on November 22, 1880, at the early age of forty-two years. Watson became known by his discovery of the minor planet Eurynome, which he first observed in 1863. Afterwards he discovered twenty-one other similar bodies. In 1867 he published a valuable work on theoretical astronomy which became a standard text-book. He was one of those who journeyed to Sicily to observe the solar eclipse of December 22, 1870, and four years later he visited Peking to observe the transit of Venus, for which event the astronomical world had established some forescore posts of observation at a cost of about a quarter of a million. In 1870, by which year he had discovered seven minor planets, Watson was awarded the Lalande Medal of the Paris Academy of Sciences.

Royal Astronomical Society's Awards

The gold medal of the Royal Astronomical Society has been awarded to Dr. William Hammond Wright, director of the Lick Observatory, Mount Hamilton, California, for his studies of the spectra of gaseous nebulæ and of novæ and for his work on the photography of planets in light of different colours. A bronze ('Jackson-Gwilt') medal and gift have been awarded to Mr. P. M. Ryves for his observations of variable stars and other astronomical work, and also to Mr. F. J. Hargreaves for his contributions to astronomy. The investigations of Dr. W. H. Wright on the spectra of the gaseous nebulæ comprise: (1) measurements of wave-lengths and of intensities of nebular lines; (2) the study of the nebular nuclei; (3) the investigation of the distribution of nebular radiations throughout the nebulæ. Dr. Wright was the first to realize the importance in these observations of accurate guiding, without allowing the object to drift along the slit to lengthen the lines, in order to study the spectra of the nuclei and to derive information with regard to the localization of lines in some of nebulæ. He has recently returned to the study of the spectra of planetary nebulæ in the ultra-violet, taking advantage of the extension to shorter wave-lengths made possible by the coating of the 36-inch mirror of the Crossley reflector with aluminium. Mr. Ryves has for many years been a most assiduous and accurate observer of variable stars, and has communicated fifteen papers on that subject to the Society. Mr. Hargreaves has rendered important services to astronomy by the design of valuable instrumental accessories. He has devised an electric drive for telescopes which has been very successfully applied to the 28-inch equatorial at Greenwich. He also constructed a "comparison image micrometer" with which he made double-star observations with an accuracy which compared very favourably with that of observations made with the filar micrometer. In addition, he has produced mirrors and other work of high excellence. His contributions to astronomical observation have been chiefly in the delineation of planetary detail, but he has given much attention to astronomical photography.

Geological Society of London Awards

THE council of the Geological Society has made the following awards: Wollaston Medal to Prof. Maurice Lugeon, of the University of Lausanne, in recognition of the value of his researches on the mineral structure of the earth, particularly in respect of the geological structure of the Alps and of mountain building; Murchison Medal to Dr. Henry Howe Bemrose, in recognition of his researches upon the igneous rocks of the Lower Carboniferous of Derbyshire, and also upon the Pleistocene fauna of the same area; Lyell Medal to Dr. John Pringle for his services to palæontological science, and particularly in recognition of his work in connexion with the Geological Survey and Museum; Wollaston Fund to Dr. Henry Francis Harwood, of the Imperial College of Science and Technology, in recognition of his research work on the chemistry of minerals and rocks; Murchison Fund to Dr. Frank Coles Phillips, for his contributions to metamorphism and structural petrology; a moiety of the Lyell Fund to Dr. Sydney Ewart Hollingworth, for his work on the Lower Carboniferous rocks, and the structural geology of the Lake District and northern Pennines, and on the Vale of Eden glaciation; another moiety of the Lyell Fund to Dr. Frederick Murray Trotter, for his geological researches, especially on the glacial and post-glacial phenomena of the Eden Valley.

ε Aurigæ—a Super-giant Star

UNTIL the requisite details are available in the *Astrophysical Journal* regarding Dr. O. Struve's discovery of the precise nature of the eclipsing binary system of ε Aurigæ, no useful comments can here be made. It may be inferred, however, from the Press reports that a study by Dr. Struve of the infrared spectrum of the star obtained with sufficiently high dispersion has shown that the chief component of the system is a super-giant star with a radius some 3,000 times that of the sun. The star of largest radius hitherto known is Antares, the radius of which is about 450 times the sun's. ε Aurigæ, the light variation of which is of Algol type but with an exceptionally long period of 27·1 years, has long been the subject of intensive observation, mainly in Germany, in the United States and in Canada. The spectroscopic history of the star up to 1928 is summarized in "Handbuch der Astrophysik", 6, Pt. 2, 466 (1928). Results obtained at the Yerkes Observatory by Frost, Struve and Elvey at the last light minimum in 1928–29 are given in the publications of that observatory in vol. 7, Pt. 2. During the same epoch, Adams and Sanford were able to distinguish clearly on their high-dispersion spectra taken at Mount Wilson a faint component on the redward side of the enhanced lines and those of hydrogen. They pointed out the necessity of obtaining high-dispersion spectrograms of ε Aurigæ at other epochs of the period of light variation in order to trace the origin of the faint spectral component.

Recent Advances in Glass Technology

TWENTY-ONE years ago was a strenuous period for British technologists, and in no field were the problems more urgent than in connexion with the production of glass for laboratory, optical and many other purposes; thus the necessity of team-work brought the Society of Glass Technology into existence, and its coming-of-age has recently been celebrated. A series of lectures on "Glass in Modern Life", arranged by the Society in this connexion, recalled some of the veritable struggles of the period of the Great War, and the more ordered progress of this 'key industry' under the subsequent measure of protection accorded to it. Prof. W. E. S. Turner mentioned that the value of the production of the chemical and scientific glassware industries has risen from £129,000 in 1924 to £250,000 in 1937, and is doubtless even higher today. Undoubtedly, the activities of the Society have contributed in no small degree to the possibility of this expansion, and the same is true of Prof. Turner himself and the Glass Technology Department at the University of Sheffield. The term 'glass' covers a very wide variety of chemical substances; when we find it being employed in these days (*inter alia*) for nuts and bolts, woven fabrics (of course for highly specialized purposes), and bricks for building, we may wonder whether the golden age of glass production is only just beginning. The list of lecturers also included Mr. Raymond McGrath and Mr. Bernard P. Dudding, who dealt with the applications of glass in their special fields of architecture and illuminating engineering respectively; and Dr. W. M. Hampton contributed a lecture on new developments in the field of optical glass. Although the production of optical glass may be a very minor activity from the business point of view, the experience gained in efforts to improve it has been invaluable in its lessons for the larger-scale operations.

Cave Paintings and Military Operations in Spain

WHILE anxiety was felt generally throughout the world as to the fate which was likely to befall the artistic treasures of Spain until reassurance was given by Sir Frederic Kenyon's visit of inspection to the scene of hostilities, archæologists were no less perturbed at the thought of the damage which might be done to the priceless palæolithic paintings of the caves of northern and eastern Spain, both within the zones of operations. In the current number of *L'Anthropologie* (47, 5–6) a note is published from the Abbé Breuil to M. R. Verneau, in which it is stated that Prof. H. Obermaier has been informed by a journalist that the famous cave of Altamira, in the neighbourhood of Santander, the best known and most important of the caves, had suffered no serious injury, although it had given shelter to some hundreds of refugees and the house of the guide had been occupied by an officer of the Red staff. Alcade del Rio also is informed that the same is true of the other caves with paintings of the Cantabrian Pyrenees. On the other hand, M. Verneau is told that the greater part of the archæological collection formed by Sen. Perez de Barradas and housed in the Municipal Museum of Madrid, had been broken up. News of the fate of the important paintings in the province of Teruel in eastern Spain will be awaited with no little anxiety.

Palestine Archæological Museum

THE Palestine Archæological Museum in the newly erected buildings at the north-eastern corner of the city of Jerusalem was opened to the public on January 13, the ceremony, which was to have taken place on January 11 in the presence of the High Commissioner, having been cancelled, owing to the murder of Mr. J. L. Starkey on the previous evening, when on his way to Jerusalem in order to be present. The cost of erecting the buildings has been met in part by a gift of two million dollars to the Government of Palestine by the late Mr. John D. Rockefeller. The site of ten acres, of which the buildings occupy one quarter, was provided by the Government. The architect was Mr. Austen St. B. Harrison. The Museum consists of a central rectangular block, flanked on north and south by buildings around open courts. In addition to the exhibition halls, open to the public, which will house the more striking and important exhibits, galleries are provided for the material which will be accessible to students, while in the basements provision has been made for housing archæological material from excavations and other sources, pending its allocation and distribution. Provision is also made for staff accommodation and library, the latter already consisting of ten thousand volumes, and space being reserved for a further thirty thousand. The Museum will cover the pre-, proto- and historic periods, including the Roman, Byzantine and Arab antiquities of Palestine down to A.D. 1700. Among the antiquities now on view are the Galilee skull, the first Neanderthal skull to be found in Palestine, the remarkable collection of prehistoric pottery dating from the Stone Age to the close of the Canaanitish period, and the ivories from the palace of Ahab in Samaria, discovered in the excavations of 1933–35, which are among the most striking objects of æsthetic interest as yet found in Palestine.

Further Exploration of Tell Duweir, Palestine

APPREHENSION has been felt among archæologists lest the further exploration of Tell Duweir, the Biblical Lachish, should have to be abandoned, owing to the murder of Mr. J. L. Starkey, the director of the Marston-Wellcome Archæological Expedition to the Near East, by whom the mound was being excavated. The death of Mr. Starkey is universally regarded as an irreparable loss to Palestinian studies; but the blow would have been even heavier had it not been possible to continue work on this important site, which has already provided so much valuable material bearing on the interpretation of more than one crucial period in the history of the country and its cultural development. This fear has now been allayed by the announcement that the excavation will continue, at any rate for the present. Arrangements have been made by the High Commissioner for it to be carried on under the supervision of Mr. Lankester Harding, who was recently appointed director of antiquities in Transjordania. Mr. Harding was Mr. Starkey's principal assistant in 1932–36. He is, therefore, not only well acquainted with the character of the site and the lie of its stratification, but also—and this is of no little importance—he is thoroughly familiar with the scheme of operations, which Mr. Starkey had plotted out in relation to the importance of the areas to be excavated, so far as this could be gauged in advance.

Indian Universities and Nationalism

THE annual Patna convocation lecture was delivered on November 27 by the vice-chancellor of the parent university of Calcutta, Mr. S. P. Mukherjee. The lecturer, although disclaiming for himself the qualifications of a historian, declared that Indian universities should saturate their alumni with the lessons of Indian history and civilization, and took as his principal theme an interpretation of Indian history coloured to stimulate the "ever-increasing vitality of Indian nationalism" with somewhat bitter references to present "bondage" and "a subject race and the power that wants to hold it in its leading strings". It seems regrettable, though not surprising, that the Indian universities should under the new constitution allow themselves to be used for the purposes of political propaganda. Lord Willingdon recently remarked that Indian politicians used to believe we were not sincere in wanting to help them in their advance towards responsible government but that they trust us now. No such change of heart seems to have been experienced by Mr. Mukherjee.

Earthquake Records at De Bilt

DR. E. VAN EVERDINGEN'S twenty-second report on the work of the seismological station at De Bilt continues, for the year 1934, the useful lists in its predecessors (*K. Nederl. Meteor. Inst.*, No. 108; 1936). The station lies about five miles north-east of Utrecht and is provided with horizontal and vertical Galitzin seismographs in addition to Wiechert and Bosch seismographs. The report contains the times as recorded at De Bilt of the different phases of 487 earthquakes, and in most cases gives also useful details on the position of the epicentre, as determined by the records at different observatories, the places at which the earthquake was felt and the intensity at them when known.

King George VI Sound

ONE of the most important discoveries of Mr. J. Rymill's recent British Graham Land Expedition was the discovery of the remarkable narrow sound which appears to separate Alexander Island from the main Antarctic continent and to extend for some two hundred and fifty miles in a north and south direction. *The Times* announces that this feature, by permission of the King, has been named King George VI Sound. It would appear to make not only a physiographical but also a structural division, since the rocks to the east are volcanic while those to the west, in Alexander Island, are fossiliferous sedimentaries which are probably related to the rocks of the Andean folds of Graham Land in general.

A Large Sunspot

A BRIEF scrutiny of the sun's disk on January 15, made possible at Greenwich in a break of persistent cloud, showed that a big sunspot had appeared. The approximate time of the central meridian passage was January 18·4, the latitude of the spot being 19° N.; its area was estimated to be about 2,500 millionths of the sun's hemisphere. The spot, which resembles the giant spot of last October, will reach the sun's western limb on January 24. A magnetic storm was recorded at Abinger commencing on January 16 at $22{\cdot}6^{h}$.

Dr. H. L. A. Tarr

DR. H. L. A. TARR, of the Rothamsted Experimental Station, has been appointed to the Sir William Dunn Institute of Pathology, University of Oxford, where he will carry out research on the chemistry of the bacteria responsible for certain human diseases. During the past four years he has been in charge of the investigations on the brood diseases of bees at Rothamsted and accounts of his work have appeared regularly in the various English bee journals and in scientific periodicals. Dr. Tarr went to Rothamsted early in 1934 with a considerable and varied previous experience in bacteriological work. He had been connected with the Department of Dairy Bacteriology at the University of British Columbia and the Departments of Pathology and Industrial and Cellulose Chemistry of McGill University in Canada, and, immediately before taking up his position at Rothamsted, worked for three years under Sir Gowland Hopkins in the Sir William Dunn Institute of Biochemistry, Cambridge.

New Sundials at the Science Museum

Two portable sundials of considerable interest have recently been acquired and placed on exhibition in the Time Measurement Section of the Science Museum. The first is an ivory column or 'pillar' dial dated 1587, designed for use in a latitude of 44° and indicating hours on the old Italian system in which the day-and-night period was divided into 24 equal parts, starting from sunset. The second dial is a 'universal' one, adjustable for use over a wide range of latitudes; it is by Dollond, the well-known eighteenth century London maker, and has been presented to the Museum by Mr. J. Bentley Bennett.

Announcements

THE Right Hon. Neville Chamberlain, M.P., Prime Minister; the Rev. M. E. Aubrey, general secretary of the Baptist Union; and Viscount Nuffield, chairman of Morris Motors, Ltd., have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for their public services.

DR. P. LEWIS-DALE, chief chemist of the L.M.S. Railway, has retired; he is succeeded by Mr. W. P. Henderson, assistant chief chemist (Horwich). Mr. H. Hayhurst succeeds Mr. Henderson as chief chemist of the research department at Horwich.

DR. C. G. SELIGMAN, emeritus professor of ethnology in the University of London, is leaving in a few days for Yale University, where he will occupy the post of Bishop Museum visiting professor for the second semester of the present academic year. He will lecture on New Guinea, particularly that part (now called Papua) which used to be known as British New Guinea. Dr. Seligman will be at Yale until early in June, and his address will be: Hall of Graduate Studies, Yale University, Newhaven, Conn., U.S.A.

DR. F. M. R. WALSHE has succeeded Dr. Gordon Holmes as editor of *Brain*.

A SHORT course on industrial physiology and medical industrial psychology will be held at the London School of Hygiene, Keppel Street, W.C.1, on February 7–18. It is designed for members of the supervisory staff in industry, but may also be of interest to industrial medical officers. Further information can be obtained from the Secretary of the School.

THE seventh International Congress of Genetics will be held in Edinburgh in 1939, probably on August 23–30. Prof. F. A. E. Crew, Institute of Animal Genetics, University of Edinburgh, Edinburgh, 9, has been appointed general secretary to the Congress and to him all correspondence concerning it should be addressed.

THE Ducheune de Boulogne Academy, which aims at rewarding independent workers in honour of the memory of the celebrated neurologist, has recently awarded its annual prize of 10,000 francs to Dr. Louis Bory for his work on general, experimental and comparative pathology, the chemotherapy of sulphur, and dermato-syphiligraphy. Further information about the prize can be obtained from the Secretary of the Academy, 28 bis rue Saint-Dominique, Centre Marcellin-Berthelot, Paris.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 165.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New Monochromator

IT is well known that chromatic polarization can be used for the purpose of obtaining colour-filters. In general, such a filter can be used only for selecting a very broad region of the spectrum.

R. W. Wood[1] showed in 1914 that a thick quartz plate between two polarizing prisms is a suitable means of selecting one of the D-lines in the spectrum of sodium. A bright interference band was placed on one of the components and a dark band on the other component. This arrangement proved very useful in the study of resonance radiation.

In connexion with work of this kind, the new 'Polaroid' film invented by E. H. Land offers interesting possibilities. I have constructed a new type of monochromator which is built up of a number of 'Polaroid' films with intermediate quartz plates. In this way a small spectral region can be isolated in a continuous spectrum.

Suppose, for example, that we want monochromatic light of the wave-length λ_0. We then take a number of quartz plates all giving a bright band at λ_0. If the thickness varies from plate to plate as 1 : 2 : 4 : 8, etc., and if the quartz plates are placed with their principal directions making an angle of 45° with the vibration axes of the parallel 'Polaroid' films, the whole spectrum will almost disappear except for some widely separated narrow bright bands. It is not difficult to find an ordinary colour filter which absorbs all these bands except the one at λ_0.

It is easy to calculate the intensity distribution in a spectrum transmitted by such a filter. If the polarization is complete, the intensity $I(\lambda)$ at the wave-length λ is given by :

$$I(\lambda) = \cos^2\frac{\varphi_1}{2}\cos^2\frac{\varphi_2}{2}\cos^2\frac{\varphi_3}{2}\;\ldots\;\cos^2\frac{\varphi_m}{2},$$

where

$$\varphi_m = \frac{2\pi d_m}{\lambda}\,\Delta n\,;\ \text{etc.}$$

Here d_m is the thickness of the plate m and Δn the difference in refractive index for the extraordinary and ordinary rays.

Fig. 1 shows the effect produced by four quartz plates. The calculation has here been made for crossed 'Polaroid' films ($\sin^2\frac{\varphi}{2}$ instead of $\cos^2\frac{\varphi}{2}$). In this case there is a small displacement between the maxima produced by the different plates which does not appear for parallel Polaroid films. The parallel films are therefore to be preferred.

I ordered an instrument of this kind from Steeg and Reuter in Bad Homburg in the beginning of May this year. The instrument was delivered only the other day and has now been tested in the laboratory. The instrument consists of five Polaroid films (delivered by Polaroid Products, Ltd., London) and four quartz plates of the following thicknesses : 5·1808 mm., 2·5904 mm., 1·2952 mm. and 0·6476 mm. On each side is an ordinary colour filter (Jena $R.G.$ 2). The filter was intended to give the wave-length of $H\alpha$ (λ 6563).

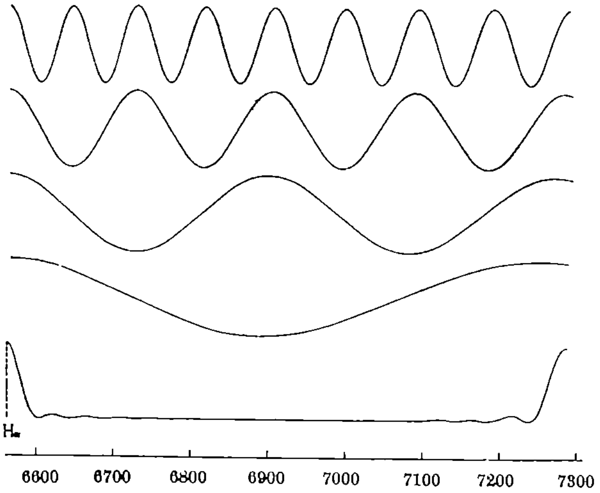

Fig. 1.

The filter has proved to be very good indeed. In Fig. 2 is the spectrum of an ordinary electric lamp and that of neon as comparison, obtained with a one-prism spectrograph. The dispersion around $H\alpha$ is only about 300 A./mm. The left image is a long exposure showing a broad line and one 'satellite' at the side. The right image shows only the central line.

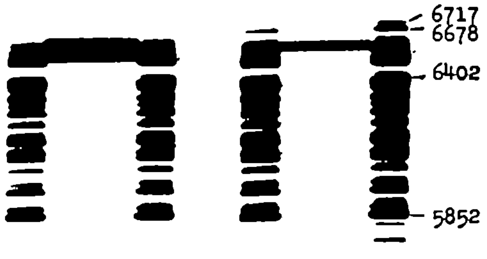

Fig. 2.

Fig. 3 was obtained with a grating spectrograph at the Physical Institute of the University of Stockholm. (I am indebted to Dr. Grundstrom for valuable help with the exposures.) The dispersion is here 5 A./mm. The central image was obtained by photographing a continuous spectrum with the filter at normal incidence. It shows the intensity maximum at about λ 6580. In the upper image the filter has been tilted 19°. This image shows stronger 'satellites' and the maximum has been shifted about 100 A. towards the violet.

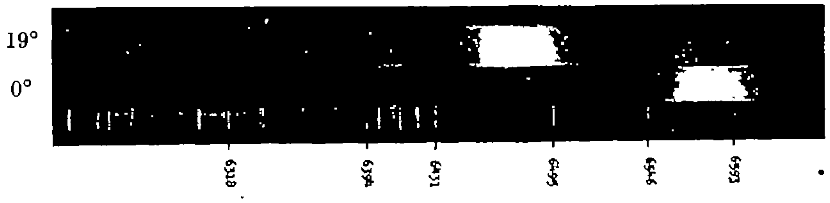

Fig. 3.

Fig. 4 shows the spectrum obtained when the filter is inclined about 9°. Now the maximum coincides with $H\alpha$, photographed above. But the monochromator has not been tilted in the most favourable way, which is around one of the principal directions of the quartz plates.

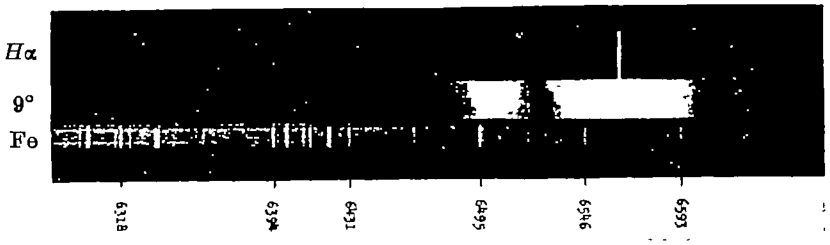

Fig. 4.

The new filter may be used for different purposes. It transmits almost only one single band in the spectrum, of a width of about 50 A. The loss of light is moderate and the definition of the images viewed by it is astonishingly good considering the many layers through which the light has to pass. For many purposes it is an advantage that the transmitted light is polarized. It is an advantage, too, that the wave-length can be adjusted by tilting the filter.

I intended to use this instrument for observing solar prominences. *Observations made to-day have shown prominences without difficulty although the altitude of the sun was only* 10°. The instrument was put after the eyepiece of a 20 cm. refractor and the sun itself was screened by means of thin sheet-metal in the focal plane of the 20 cm. lens. The instrument looks very promising for this purpose. The advantage is that the field of view is not limited by a slit as in ordinary spectroscopes.

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Nov. 26.

[1] *Phys. Z.*, **15**, 318 (1914).

Evidence of Abnormal Behaviour of NO_3 in the Cubic Crystal, $Ni(NO_3)_2 \cdot 6NH_3$.

WHEN an excess of concentrated ammonia is gently added to a concentrated solution of nickel nitrate in water, crystals of blue (somewhat violet) octahedra are obtained, the correct composition of which was first determined by Wyckoff[1]. The crystal is cubic; the size of its unit cell and the number of molecules contained in the cell were established by Wyckoff by the Laue method of X-ray analysis. But his proposed structure does not appear to be satisfactory, according to Kracek and his co-workers[2], who concluded that the nitrate group NO_3 might be rotating in the crystal and possess spherical symmetry.

I have taken some powder photographs and a series of oscillation photographs of the crystal, all of which show the crystal to have a face-centred lattice in agreement with Wyckoff's observation. But the oscillation photographs further show that reflections *hkl*, *hlk*, etc. have identical intensities, which implies that the crystal has holohedral Laue symmetry $m3m$ and not paramorphic hemihedry $m3$. The correctness of this observation can scarcely be doubted because two other modifications of the crystal at low temperatures, one at about −100° C. and the other at liquid air boiling point, were also found to have the same Laue symmetry, though their structures are quite different as revealed by the spectra on oscillation photographs of these modifications taken by a low-temperature oscillation camera constructed by me. Consequently the crystal at room temperature must have space group $F\bar{4}3m$, $F43$, or $Fm3m$. But none of the three has a symmetry consistent with that of the nitrate group in the cell if each NO_3 group is assumed to be an entity. Since chemical evidence demands independent NO_3 groups, we are forced to conclude that the behaviour of NO_3 in this crystal must be abnormal.

Different abnormal models were then tested by comparing the calculated intensities of reflections with the observed ones recorded on powder photographs of copper $K\alpha$ radiation, taken by a precision Debye-Sherrer camera of large diameter and measured by a precision micro-photometer. The following structure is found to be most reasonable and able to explain the observed intensities most satisfactorily. The structure is based on space group $F\bar{4}3m$ and has, roughly speaking, the CaF_2 grouping with Ca atoms replaced by $Ni(NH_3)_6$ groups and F atoms by NO_3 groups. Fig. 1 is a diagrammatic representation of one octant of an individual cell of such a structure. The plane triangular NO_3 group is oscillating about a line passing through the average positions of the centres of the two oxygen atoms indicated in the diagram by O_1, with the third oxygen atom O_2 alternating between two extremities which belong to the same equivalent group of the space group as the positions occupied by the two O_1's. The configuration of equivalent NO_3 groups in different unit cells is supposed to be not always the same; its two O_1's may occupy any two of the four equivalent points in the octant, that is, the two points occupied by O_1's and the two ends of the arc described by O_2 in Fig. 1.

As all the possible configurations are equally probable, random distribution of NO_3 among them gives the loci of the centres of its oxygen atoms a macroscopic average appearance like that shown in Fig. 2. The locus of the N centre appears as if the atom has a big heat motion. It is interesting to note that the theory of space groups and the definition of the unit cell do not strictly apply to this structure.

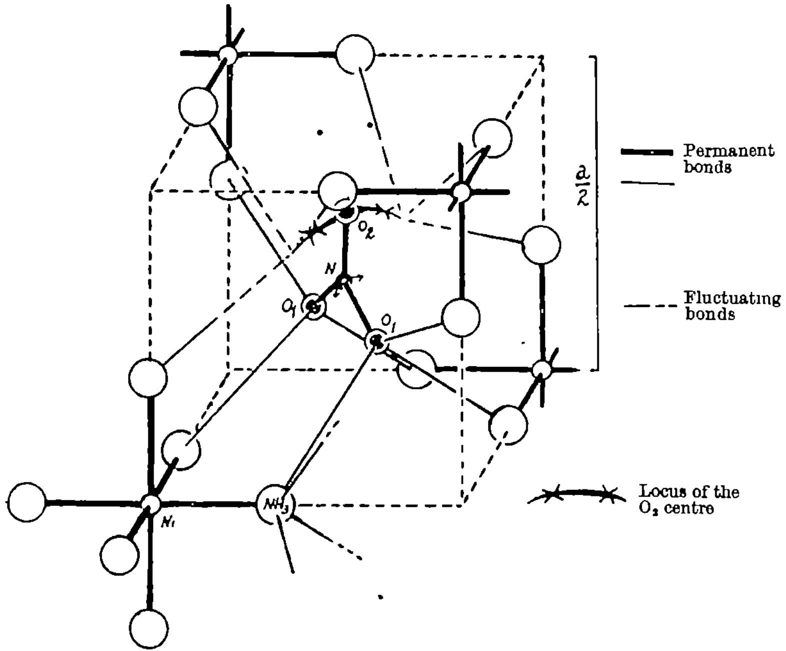

Fig. 1.

To give further evidence of the proposed structure, the signs of the structure amplitudes of the reflections, $F(hkl)$, have been determined in the following way. According to Bradley and Rodgers[3], f-values of the Ni atom for cobalt $K\alpha$ radiation are almost normal, while those for copper $K\alpha$ radiation should be depressed by 3 units. In this crystal proper choice of the origin of reference will make contributions of Ni atoms to all reflections positive. If $F(hkl)$ is positive, it should be bigger for cobalt $K\alpha$ than that for copper $K\alpha$ radiation. If $F(hkl)$ is negative, the result should be the reverse. Hence a comparison of the observed intensities of reflections for the two radiations enables us to fix the signs of the $F(hkl)$'s. The result obtained in this way is in complete agreement with the result calculated on the proposed structure.

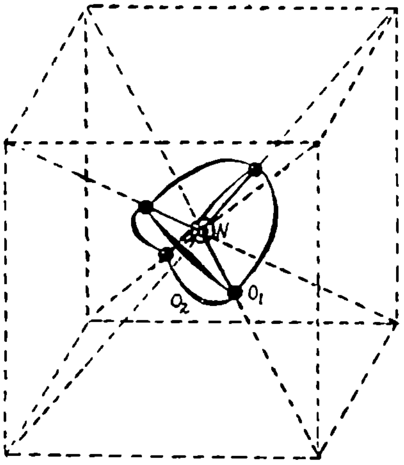

Fig. 2.

Another striking feature of this crystal is that the atoms in it have heat agitation of extraordinary magnitude. The rapid decrease of intensities of reflections with the increase of their glancing angles must be due to enormous heat motion of the atoms in the crystal. This is supported by the increase of intensities of reflections of large angle in the low-temperature oscillation photographs. This enormous heat motion of the atoms in the crystal may be correlated with the abnormal oscillation of the nitrate groups mentioned above.

Two other observations may be worth mentioning. When the crystal is cooled down to liquid air temperature, it is found from the oscillation photographs that it contracts into the −100° C. modification, and then expands into the liquid air temperature modification, of which the density is even smaller than that of the room temperature modification. The colour of the crystal exhibits a marked change from blue (somewhat violet) to dark purple and then to brilliant pink during the cooling. Owing to the preceding abnormalities of the crystal, it might be interesting to study its absorption spectra, as well as its heat capacity at different low temperatures.

Details of the work will appear elsewhere.

I wish to express my sincere thanks to Prof. W. L. Bragg for his interest and valuable advice in this work.

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University, Manchester.
Dec. 4.

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[2] Kracek, F. C., Hendricks, S. B., Posnjak, E., NATURE, 128, 410 (1931).

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The Lorentz Polarization Term and the Earth's Magnetic Field in the Ionosphere

FOR some years, there has been doubt concerning the value of the accelerating force acting on an electron in the ionosphere under the influence of an electric wave. In 1929, Hartree[1] gave reasons for believing that to the field of the wave must be added a resultant field due to the other electrons present, and showed that this could be accounted for by including a term l of value 1/3 in the derivation of the dispersion equations. The equations then became closely analogous to those first deduced by Lorentz for the propagation of light in a body composed of molecules. The term was afterwards included in a great number of published works on wave propagation in the ionosphere.

In 1934, Darwin[2] gave strong theoretical reasons for believing that the value of l in the ionosphere was zero. The settlement of the point is of considerable practical importance, since measured values of electron density in the ionosphere may be in error by 50 per cent if the wrong value of l has been used. Several unsuccessful attempts to find a crucial experimental test[3] have already been made. We have recently obtained what we believe is decisive experimental evidence in favour of the view that l is zero in the F region of the ionosphere. This conclusion has been reached from the study of a number of records similar to those reproduced herewith, which show the radio echoes obtained from the ionosphere at 0045 hours E.A.S.T., on August 28, 1937, over a frequency range of 0·9–1·30 mc./s. In the figure the lowest uniform trace is made by the ground pulse and so indicates ground-level. At the lower frequencies two upper traces are visible, both representing echoes coming from approximately the height at which the F region is normally found. As the frequency is increased, the lower of these traces rises very gradually, and in fact it is found (though this is not shown in the illustration for reasons of space) that it rises steeply only when the penetration frequency of 6·0 mc./s. is approached. On the other hand, the upper trace is seen in the figure to rise rapidly and is no longer recorded at frequencies greater than 1·27 mc./s. This upper trace exhibits a similar behaviour on all nights when it is observed, invariably disappearing suddenly at frequencies just below 1·30 mc./s. We have arranged for the emitting and receiving systems to have their maximum sensitivities at frequencies just above 1·22 mc./s., but while this has resulted in the recording of a weak echo from the E region at 130 km., and of numerous multiple echoes corresponding to the lower F trace, the 12th of which is seen just below the ground trace after being retarded right round the semi-elliptical time scale, yet we have not been able to record further evidence of the upper echo at frequencies above 1·27 mc./s.

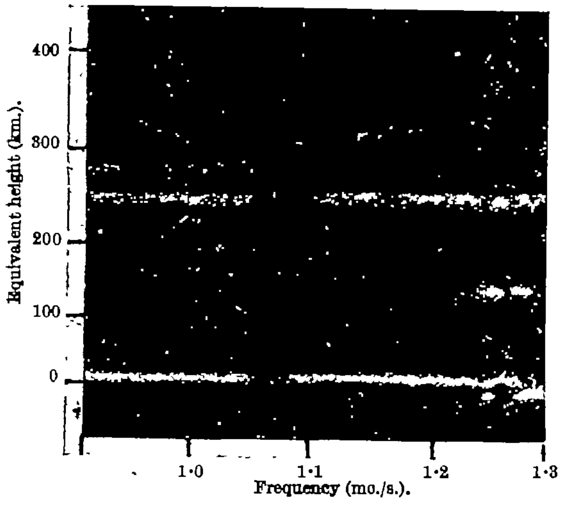

Fig. 1.

Equivalent height - frequency curves obtained by means of radio echoes from the ionosphere over a range of frequencies below the Larmor gyro-frequency. The obliteration of the record at 1·07 mc./s. is caused by interference from a broadcasting station.

The regular nightly disappearance of this echo just below 1·30 mc./s., although the critical penetration frequency of the F region is much higher and variable, leads us to believe that we are here faced with a phenomenon distinct from that normally associated with the penetration of a region of maximum ionization. We have found an interpretation of the existence and abnormal behaviour of this upper echo from consideration of the dispersion curves of an electron medium in a magnetic field H at frequencies slightly below the Larmor gyro-frequency He/m. Ratcliffe[4] has shown that at such frequencies, for $l = 0$, an infinity in μ occurs in the dispersion curve of the ordinary wave, for values of electron density N_2 greater than those (N_1) which give the first reflection point ($\mu = 0$) of the wave. We find that when an appreciable amount of energy of the ordinary wave gets past this first reflection point, it will be largely reflected deeper in the ionized region at the level where the electron density is N_2. A similar conclusion has also recently been reached by a group of workers at Allahabad[5], who show theoretically that the group velocity of a vertically incident ray becomes zero at densities equal to N_2.

From Ratcliffe's work it may easily be deduced that

$$N_2 = m\,(f_1^2 - f^2)/4\,\pi\,e^2\,(f_1^2 \cos\theta - f^2)$$

where $f_1 = H\ e/m$, f is the frequency of the wave, and θ is the complement of the inclination of the earth's magnetic field H. It follows that as f approaches the value $f_1 \cos\theta$, an increasing amount of ionization is required to produce the second echo. When $f = f_1 \cos\theta$, the necessary ionization is infinite. At Sydney the value of f_1 is 1·63 mc./s. at ground-level, and $\cos\theta$, which is independent of level, has the value 0·895. If we suppose that the magnetic field varies inversely as the cube of the distance from the earth's centre, then at a height of 230 km., $f_1 \cos\theta$ is 1·30 mc./s., which is the frequency just below which the upper echo invariably disappears.

It seems clear, therefore, that the upper trace in the accompanying illustration is to be identified as due to this second component of the ordinary wave.

Now, if l be given the value 1/3 in the dispersion equations, no second reflection point of this type is found to occur. The experimental discovery and the identification of the second ordinary echo seems, therefore, definite proof that the Lorentz polarization term l is zero in the F region of the ionosphere.

Theoretical investigation shows that the trace of the second echo should tend asymptotically to infinity on the height scale extremely rapidly, at a frequency f' slightly below $f_1 \cos\theta$. This suggests that if f' can be measured accurately, then a powerful means of measuring the earth's magnetic field in the ionosphere would become available. The small correction $f_1 \cos\theta - f'$ is accurately known in terms of the penetration frequency of the region. The only available method[6] of measuring H in these regions at present is inherently incapable of much accuracy, since it depends on the measurement of a small difference between two large numbers, expressing the penetration frequencies of the ordinary and extraordinary waves respectively.

With the object of making such measurements accurately, we are at present constructing improved equipment in the hope of recording the asymptotic upward trend of the second echo. This work, which will be more fully described elsewhere, is published by permission of the Radio Research Board of the Commonwealth Council for Scientific and Industrial Research.

D. F. Martyn.
G. H. Munro.

University of Sydney.
Dec. 3.

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New Pallial Sense Organs in Early Fixed Stages of *Ostrea edulis*

A careful study of sections of newly attached spat of *Ostrea edulis* has revealed the existence of a pair of organs, apparently of a sensory nature, one in each mantle, of a type hitherto undescribed so far as I am aware. These sense organs are not present in the free-swimming larva before attachment, but begin to develop immediately after fixation and are apparently fully developed in the spat three or four days after attachment.

The sense organs are situated on the inside border of the thickened free edge of the mantle, about one third of the length of the free edge from the mouth. In section, each sense organ appears as a thin-walled spherical pigmented sac of epithelium projecting from the inside mantle surface and containing in the cavity a comparatively large concretion which stains vividly with eosin (Fig. 1, *b*). The concretion is not calcareous as it is unaffected by decalcification. Nor does it appear to be siliceous. Each concretion is made up of a large number of small granules, loosely aggregated in the early stages of development, but in older spat closely compacted to form a roughly spherical mass. No cilia can be detected on the inside of the epithelial sac.

The development of these sense organs may be easily followed in sections of recently attached spat. In spat which have been attached for less than 24 hours, a flask-shaped mass of eosinophilous granules may be seen in the epithelium of the outer surface of the mantle, underlying the shell and apparently opening to the exterior. This situation suggests their derivation from one of the unicellular glands which secrete the shell. This view is strengthened by the occurrence of an epithelial nucleus among the granules of secretion. In slightly older spat, up to 48 hours after attachment, this mass of secretion occupies a position between the inner and outer epithelia of the mantle (Fig. 1, *a*). At the same time the inner mantle epithelium becomes raised up into a dome-shaped protuberance and a split appears in the tissues underlying it. The epithelium covering the cavity becomes charged with black pigment granules. The split later enlarges and becomes the cavity of the sense organ. The mass of secretion becomes rounded off, leaving behind a few granules, and sinks into the cavity underlying the dome of epithelium. In later spat the cavity is enlarged and the epithelium covering it is extremely attenuated and densely pigmented. In the cavity there may frequently be seen one or two nuclei which have become isolated during the formation of the sac. In spat which have been attached four to five days, the most advanced among the material available, these nuclei have disappeared and the cavity is occupied only by the rounded mass of secretion. This would appear to be the fully developed condition of these organs. Exceptionally, two masses of concretion have been observed in a single sac.

In endeavouring to assign a function to these organs, it has to be remembered that the larval statocysts persist in the spat of *Ostrea edulis*, an observation first made by Carazzi[1], and now confirmed by me. These statocysts are, however, comparatively deeply seated within the body of the spat oyster and do not appear to be in a position to appreciate small disturbances in the surrounding medium. On the other hand, the pallial sense organs here described, situated as they are on the border of the mantle, and separated from the external medium by an attenuated epithelium only, would appear to be suitably constructed and in a favourable position for receiving and reacting to vibrations caused by disturbances in the surrounding water. The value of such organs to a fixed form like the adult oyster is obvious. It would be interesting to know whether such organs exist in other lamellibranchs in which the adult stage is fixed.

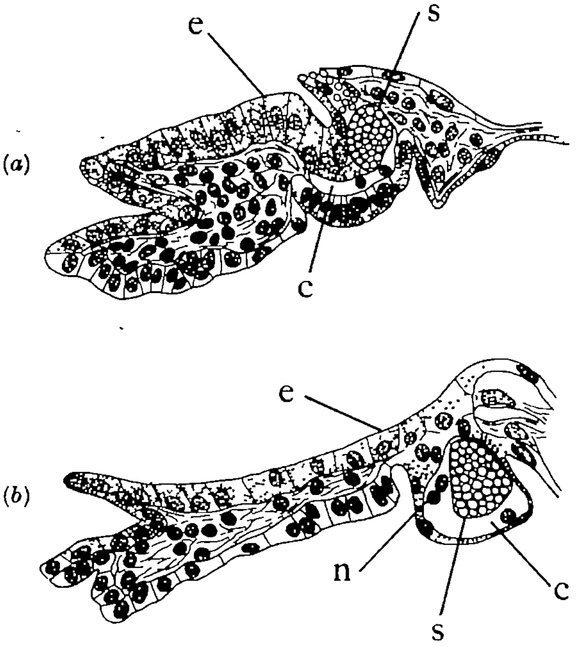

Fig. 1.

TRANSVERSE SECTION OF MANTLE EDGE OF SPAT OF *Ostrea edulis*, TO SHOW THE DEVELOPMENT OF SPECIAL PALLIAL SENSE ORGANS.

(*a*) 24–48 HOURS AFTER ATTACHMENT, SHOWING THE MASS OF SECRETION (*s*) PASSING FROM ITS ORIGINAL LOCATION IN THE OUTER SECRETORY EPITHELIUM (*e*), INTO THE RUDIMENT OF THE CAVITY (*c*) OF THE SENSE ORGAN.

(*b*) 3–4 DAYS AFTER ATTACHMENT, SHOWING THE SENSE ORGAN FULLY FORMED, WITH THE EXCEPTION OF THE ELIMINATION OF THE FEW ISOLATED NUCLEI (*n*). THE SAC COVERED BY THE ATTENUATED INNER EPITHELIUM OF THE MANTLE.

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Fisheries Experiment Station,
Conway. Dec. 1.

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Selective Thallium Moult in Sheep

It is known that sheep may be divided into two large groups according to the structure of their wool. The first group includes cultural races of sheep, the wool of which is homogeneous on the greater part of the body, that is, consists of identical fine curling wool fibres (merino and others). The second group includes a number of country unimproved races of sheep with coarse wool, which consists of fibres of different types, kemp and intermediary (mixed-woolled sheep).

I have already shown the possibility of stimulating in sheep a synchronous shedding of wool by treatment with a single dose of thallium compounds. This phenomenon was given the name of 'experimental thallium moult'[1]. In fine-woolled sheep this phenomenon has already been described[2]. I am now able to report the possibility of obtaining an analogous experimental thallium moult in mixed-woolled sheep.

Since mixed-woolled sheep are characterized by the heterogeneity of their fleece, their experimental moulting may *a priori* be thought of in at least two forms: (*a*) first case—a general shedding of the fleece ('general moult'); (*b*) the shedding of certain types only of wool fibres. We have obtained both these possible forms of experimental moulting in mixed-woolled sheep.

The experimental sheep belonged to the following races of mixed-wool sheep bred in the U.S.S.R.: the fat-rumped sheep of Casakhstan, the Russian-Wallach sheep of the North Caucasus, the chushka-Karakul of the Ukraine, the northern small-tailed sheep of the middle Russia, the fur Romanov sheep (Moscow region), the Armenian sheep, Balbas and Masekh. The experiments were carried out both at the Laboratory in Moscow and under farm conditions (Sovkhozes). The total number of mix-woolled sheep treated with different thallium compounds was 839 and that of untreated control ones 869.

The shedding of certain types of wool fibres while other types of wool fibres remained unchanged was called 'selective or differential experimental moult'.

The course of the general experimental moult in mix-woolled sheep is identical with that in fine-woolled sheep described elsewhere.

The selective experimental moult is a peculiar reaction of the fleece that may be considered morphogenetic. Since fine wool and kemp differ in their structure, they may be expected to differ in their physiological properties as well. We supposed that the differences in the form and the structure of the various types of fibres should be accompanied by functional differences.

Engels'[3] and Spencer's[4] work on the connexion between form and function was the basic hypothesis for our study. These *a priori* theses of dialectical logic led us to study the influence of different doses of thallium acetate upon the heterogeneous fleece.

A number of experiments showed the different heights of the thallium threshold of the fine wool and the kemp fibres. With doses exceeding 12–13 mgm. the fat-rumped mix-woolled sheep shed both their kemp and their fine wool. With doses of 8·5–9·5 mgm. the root strength of kemp remains unchanged, while the fine fibres undergo a diminution of their root strength and consequently fall out. Hence the thallium threshold is approximately 11·5 mgm. for the kemp and about 9·0 mgm. for the fine fibres (stall keeping). This difference in the height of the thresholds for the kemp and the fine wool shedding is the theoretical basis for the realization of the selective moult of fine wool alone.

In a selective moult, the fine wool is always more or less mixed with a certain quantity of intermediate fibres or even of single broken kemp fibres. In the same way the kemp fibres which remain upon the body of the animal contain a certain admixture of fine wool fibres. The wool taken off as a result of a selective moult and containing chiefly fine wool fibres was given the name of 'fine fraction'. The wool which remains on the body of the animal was named 'coarse fraction'.

The effect of the selective moult in fat-rumped mixed-woolled sheep of Casakhstan is as follows: A normal 'original' wool cover proper to this race contains on an average 52·05 per cent of coarse and 47·95 per cent or even 31 per cent of fine wool fibres. The fine fraction contains 12·6–14·9 per cent of coarse and 85·1–87·4 per cent, in some cases 92–95·8 per cent, of fine fibres. The coarse fraction contains 80–93·1 per cent of kemp and 6·9–19·8 per cent of fine fibres.

Similar results are obtained with other races of sheep.

The experiments on selective moulting in sheep which we have carried out may be considered from both the theoretical and the practical points of view.

Selective moulting, as a peculiar morphogenetic reaction, is a proof of the possibility of a *physiological distinction between morphologically different structures* ("Morphologische und physiologische Erscheinungen, Form und Funktion bedingen einander wechselseitig" (Engels[3])).

Hence selective moulting is an excellent subject for the study of the part played by chemical agents in morphogenesis. It may, moreover, be considered as a *method of analysis of living matter* by means of the action of chemicals and pharmacons. These two methods demonstrate the theoretical importance of selective moulting in biology.

Selective moulting has obvious prospects of economically important industrial applications. The country mixed-woolled races are often very valuable because adapted to the climatic conditions and are utilized in many ways (for milk, flesh, fat, etc.). Their wool is of but small value because of its coarseness and heterogeneity. Nevertheless, the fine wool fibres contained in the fleece of sheep with heterogeneous wool does not greatly differ from the wool of fine-woolled sheep. Selective moulting makes it possible to obtain from coarse-woolled sheep with mixed wool, a fine wool approaching or even equalling merino as to wool quality. The only obstacle to a wide application of this method is the presence of certain harmful by-effects, which we shall describe elsewhere.

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Wool Laboratory,
Moscow.
Oct. 15.

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Functions of the Tube in Sabellid Worms

Spirographis spallanzanii Viviani and *Sabella pavonina* Savigny live in tubes made of a mucoid secretion mixed with mud. The animals are negatively thigmotropic, negatively geotropic and positively phototropic. The tubes, after the animals have been removed from them, cannot be stretched, but they can easily be bent. The tubes, however, are completely elastic in that they return at once to their initial shape after bending. In spite of this, the animals can bend their tubes permanently into new curves in the course of their various tropisms. To bend such a tube permanently it would be necessary to soften it; this is probably the function of the external digestion of the tube which I previously described[1]. The innermost lining of the tube is more elastic than the rest, and the new curvatures would be produced by a combination of softening with the deposition of new elastic tube substance within the concave side of the bend.

Removed from their tubes, *Spirographis* and *Sabella* are incapable of making new ones. Tubeless worms can be kept alive indefinitely in aerated sea-water, but in water deficient in oxygen they die, whereas worms with their tubes live in this water. We thus have the apparent paradox that a worm exposed on all sides to the water dies of asphyxia, while a worm whose body is enclosed in a tube can breathe and live.

Sabella and *Spirographis* can be removed from their own tubes and put into glass tubes. They line the glass tube with a secretion, and lengthen it with normal tube material. Such worms in glass tubes will live in conditions of oxygen deficit which kill naked worms. Observation of *Spirographis* in glass tubes has given a probable reason why naked worms are less viable than those in tubes. Inside its tube the worm executes rhythmic movements, which must continually renew the water in contact with the body. At regular intervals a swelling of the body wall, completely filling the tube, forms at the hind end of the worm; this swelling moves forwards. In the case of tubeless worms there are scarcely any such movements, and the animals are probably asphyxiated because of a stagnant layer of water in immediate contact with the body.

Tubeless worms can live in aerated water; presumably they are able to do so in spite of the absence of vigorous body movements because there is more than enough oxygen for them in the water. Worms in their tubes execute the rhythmic movements even in fully aerated water; the result of this must be that the small amount of water in the tube is continually renewed, and presumably it is necessary for the worm to renew this water even when the surrounding sea-water is fully aerated. These observations show that the tube has a second function besides that of protection: it provides the mechanical stimulus for the reflex body movements necessary for respiration.

The metabolism of *Spirographis* removed from its tube falls very considerably. On the same day that worms are taken out of their tubes their oxygen consumption decreases to three quarters, and on the following day to one half, of its previous value, while the ammonia excretion falls on the day of removal from the tube to four fifths of its previous value. This fall in metabolism is probably due in large part to the absence of vigorous rhythmic body movements.

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Dec. 17.

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[1] Fox, H. Munro, *Proc. Roy. Soc.*, B, 112, 479 (1933).

A Curious Case of Supposed Silicon Poisoning in the Swan

DURING March 1936, a swan was received from the Belle Vue Gardens, Manchester, at the Harper Adams Agricultural College, where I was working, with a note that it was one of two or three waterfowl which had all died recently on a particular pond. Post-mortem examination revealed nothing abnormal except an acute enteritis most marked in the duodenum but spreading into the middle third of the intestine. All the other organs were healthy and a bacteriological examination proved negative.

Examination of the bowel contents showed no parasites, protozoan or otherwise, to be present, but large quantities of the water weed *Potamogeton* were found, and amongst them what appeared to be diatomaceous frustules. I became suspicious, and my senior officer, Mr. K. D. Downham, had a chemical analysis made of the intestinal contents. A certain percentage of silicon derived from the gizzard contents is always present in the intestine of birds, but in this case was found to be unusually high. A reference to the files showed that in the previous year, 1935, in the same month, and within four days of the then date, another swan had been received from the Gardens with precisely the same lesions. The Gardens were requested to forward a sample of the water and weed from the particular pond, which when received was found to be full of diatoms. The 'weed' consisted largely of filamentous algæ and blades of *Potamogeton*, encrusted with various species of diatom, notably *Fragillaria* and *Gomphonema*. These were also found free-swimming in the water. A chemical analysis of the water alone revealed an abnormally high percentage of colloidal silicon present. (I may here perhaps mention that the analyses were carried out by the analyst of the Harper Adams College, Mr. Lee).

It was therefore assumed that the enteritis in the swan was the result of mechanical irritation caused by the diatom frustules and the free silicon present in the pond.

Freshwater biologists, particularly Kathleen Carpenter in her "Life in Inland Waters", have pointed out that the spring and late winter are the times of maximum diatom increase. Their frustules cause a rise in the silicon content of fresh waters also in autumn, when *Cladocera* feed upon them but release their valves into the water. Birds would be killed in the spring and not in the autumn, because in spring they are greedy for the greenstuff represented by the weeds and because in addition to the diatoms there is present a large amount of free silicon released during the winter by bacterial action, namely, that which the diatoms themselves utilize in the formation of their valves. In autumn, dead shells float freely through the water, and are simply washed through the gut of water-fowl as they swallow water. I suggest that it was because the diatoms were entangled in the weed that they exerted their supposed irritative action; combined with the action of the water saturated with silicon which permeated and enveloped the algal cells.

Instructions were given that the pond was to be drained, all vegetable matter removed and its floor and sides thoroughly scrubbed and disinfected with Chloros; and no further cases have been reported.

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Use of Sulphur Dioxide against the Bedbug

SULPHUR dioxide, usually obtained by burning sulphur, when used as a fumigant for bug-infested houses, has not always been successful. Schlupp[1], Gunn[2] and others have suggested that the eggs of the bedbug (*Cimex lectularius* L.) were more resistant than adults to sulphur dioxide. Fetscher[3], however, recorded adults surviving at concentrations which killed the eggs.

I have carried out laboratory experiments to determine the relative resistance of different stages of the bedbug to sulphur dioxide. Using a fumigation apparatus similar to that described by Bovingdon[4], I have exposed different stages of the bedbug for 2½ hours to known concentrations of this gas under controlled conditions of temperature and humidity. A summary of these results, expressed as the amount of sulphur dioxide required to give a complete kill of each stage at 23° C. and 60 per cent relative humidity, is given below.

Stage	Concentration of SO_2 (mgm./litre)	Concentration of SO_2 (% by volume approx.)
0–2 day old eggs	16·7	0·63
2–4 " " "	15·8	0·61
4–6 " " "	12·0	0·46
6–8 " " "	8·9	0·34
1st nymphal instar 1 day after hatching, unfed	6·2	0·23
1st nymphal instar 2 days after feeding	6·1	0·23
2nd " " " " " "	6·0	0·23
3rd " " " " " "	5·7	0·22
4th " " " " " "	5·8	0·22
5th " " " " " "	6·1	0·23
Adults, 2 days after first meal	4·2	0·16

It appears, therefore, that the egg, especially just after being laid, is considerably more resistant to sulphur dioxide than either the adult or any nymphal instar, and that this resistance gradually decreases as the time of hatching approaches.

These results are part of an investigation carried out under the direction of Prof. J. W. Munro on behalf of the Committee on Bedbug Infestation of the Medical Research Council.

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[1] Schlupp, W. F., *J. Dept. Agric. S. Africa*, 4, 132 (1922).

[2] Gunn, W. C., "The Bedbug". Prevention of House Infestation. Dept. Hlth. Scotland, 2 (1933).

[3] Fetscher, R., *Reichsgesundheitsblatt*, Nos. 11 and 12 (1927).

[4] Bovingdon, H. H. S., *Ann. Applied Biol.*, 21, 4 (1934).

Stomatal Movement and Epidermal Water-Content

IN a recent paper, F. J. Nutman[1] has described the behaviour of the stomata of the coffee plant and directed attention to their remarkable sensitiveness to insolation. Within three minutes of exposure to direct sunlight the stomata begin to close, even though the water supply is abundant. Moreover, the closure is reversible: shading a single leaf on an insolated plant results in opening of the stomata of the shaded leaf. This is quite outside the normal range of stomatal behaviour hitherto described.

It seems possible, however, that results obtained in my laboratory by Dr. H. A. Razvi[2] may provide a clue. Following up the observation that the stomata of certain succulents are sensitive to atmospheric humidity, Dr. Razvi discovered that their behaviour, in the leaves of *Kleinia articulata* and *Sedum album*, is not correlated with the water-content of the leaf as a whole, for a turgid leaf in a dry atmosphere will open its stomata less widely than a leaf with a considerable water deficit in a saturated atmosphere.

These observations direct attention to the water content of the *epidermis* as the effective factor. In a dry atmosphere cuticular transpiration, if considerable, would reduce the water-content of the epidermis in relation to the mesophyll. Stomatal transpiration would affect primarily the subepidermal mesophyll and so the epidermis itself. In succulent leaves the vascular organization is not very efficient, and the gradients of water deficit would be correspondingly steep. In a saturated atmosphere, these gradients would be equalized, or possibly the epidermal water-content raised above that of the rest of the leaf by direct absorption, without affecting the total leaf water-content recognizably.

In normal leaves, it is possible that lateral movement of water through the epidermis itself is the main channel of supply to the epidermal cells, direct from the veins. La Rue[3] observed in *Mitchella repens* that the epidermis remains alive and normal even when it becomes entirely separated from the underlying tissues except at the midrib and the margins of the leaf. The wavy outline characteristic of the stomatal epidermis in so many plants must reduce the resistance to lateral passage of water from cell to cell. Freer movement of water through the epidermis would tend towards uniformity of stomatal behaviour.

Since epidermal water-content is the factor directly affecting stomatal movement, and since it may be relatively independent of the water-content of the mesophyll, it is conceivable that insolation of coffee leaves may act by lowering the epidermal water-content although the leaf as a whole remains turgid. The possibility could readily be tested, for the effect should not be observed, or should be reversed, in a saturated atmosphere. Coating the leaf with 'Vaseline' should have a similar effect.

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Dec. 28.

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[1] Nutman, F. J., *Ann. Bot.*, (N.S.) 1, 681 (1937).

[2] Razvi, H. A., Ph.D. thesis (Wales, 1937).

[3] La Rue, C. D., *Mich. Acad. Sci., Arts and Letters*, 13, 131 (1931).

Structure of Permian Homoptera and Psocoptera

THE recent note in NATURE[1] on the ancestors of some groups of existing insects prompts me to mention certain facts apparently overlooked by Prof. G. Zalessky, and to direct attention to others bearing on the subject. Zalessky announces his discovery that the Permian Psocoptera had a "proboscis-shaped" head, provided with a sucking apparatus similar to that of the Homoptera. In 1933[2] I gave a detailed account, which is not mentioned by Zalessky, of the body structure of the Kansan Permian Psocoptera, and demonstrated then (Fig. 13, and plate 1, Fig. 4) that the head possessed a prominent rostrum. The significant feature of the rostrum of these Psocoptera is the presence of large and generalized maxillary and labial palpi, which are scarcely suggestive of the structure of the piercing beak of the Homoptera. Zalessky also states that he doubts the correctness of Dr. R. J. Tillyard's description of the chewing mouth-parts in *Psocidium*. This description I corrected in 1932[3] and at the same time showed *Psocidium* Till. to be a synonym of *Dichentomum* Till., as it was later regarded by Dr. Tillyard[4].

Zalessky also notes his discovery that the members of the order Hemipsocoptera, which was established by him in 1936[5], similarly possessed a "proboscis-shaped" head and mouth-parts like those of the Homoptera. The species for which he erected this new order, *Mauria sylvensis* Zal., was based upon a single and poorly preserved specimen, showing the more general features of both fore and hind wings. At that time (1936) the nature of the hind wings of the Permian Homoptera was not known, and Zalessky, noting that the hind pair of *Mauria* suggested the wings of the Permian Psocoptera, and the fore pair those of the Permian Homoptera (Archescytinidæ), made the new order Hemipsocoptera for the genus. In 1935 I collected in the Permian strata of Kansas a number of Homoptera belonging to several genera of the family Archescytinidæ, descriptions of which are now in press. The hind wings have a venation like that of *Maurii* and the fossils show beyond doubt that the latter is nothing more than a typical member of the Homopterous family Archescytinidæ. It is not surprising, therefore, that the members of the "order" Hemipsocoptera possessed sucking mouth-parts like those of the Homoptera, for as I have already shown (1931)[6], the Archescytinidæ had a perfectly developed haustellate beak, with a swollen clypeal region, and piercing stylets.

The close relationship between the Psocoptera and the Homoptera has been recognized for many years by students of insect phylogeny and morphology, and the similarity between the Permian representatives of these two groups is, of course, very striking. It is unfortunate that Zalessky did not wait for more satisfactorily preserved specimens of *Mauria* before he established a new order.

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[1] NATURE, **140**, 847 (Nov. 13, 1937).

[2] *Proc. Amer. Acad. Arts Sci.*, 68, 446 (1933).

[3] *Amer. J. Sci.*, (5) **24**, 4 (1932).

[4] *Proc. Linn. Soc. N.S.W.*, **60**, 267 (1935).

[5] *Ann. Soc. Geol. Nord*, **60**, 51 (1936).

[6] *Amer. J. Sci.*, (5) **22**, 116 (1931).

Points from Foregoing Letters

A NEW type of monochromator, built up of a number of 'Polaroid' films with intermediate quartz plates, is described by Prof. Yngve Öhman, who calculates the intensity of distribution in a spectrum transmitted by such a filter. Single bands of about 50 A. can be separated. Photographs are submitted comparing results obtained with a grating spectrograph and with the new instrument, which appears to be especially useful in observing solar prominences, since the field of view is not limited by a slit as in the ordinary spectrograph.

From X-ray photographs of crystals of ammonia-nickel-nitrate, $Ni(NO_3)_2 . 6NH_3$, S. H. Yü concludes that the behaviour of the NO_3 group in those crystals must be abnormal, and submits diagrams of possible structure which allows for an abnormally large oscillation of the nitrate group. This may be correlated with the large amount of heat motion of the atoms, indicated by the rapid decrease of intensities of the X-ray reflections with increase of glancing angle. Cooling the crystals to the temperature of liquid air produces contraction (at − 100° C.) followed by expansion, while the colour changes from blue-violet to dark purple and then to brilliant pink.

Dr. D. F. Martyn and G. H. Munro have identified a second ordinary echo from the *F* region of the ionosphere at frequencies below the Larmor gyro-frequency $f_1 = He/m$. The retardation of this echo increases, and it eventually disappears just below the frequency $f_1 \cos \theta$, where θ is the complement of the inclination of the earth's magnetic field. The discovery of this echo shows that the Lorentz polarization term is not to be applied in the treatment of dispersion in the ionosphere, and provides a means of measuring the earth's magnetic field in the ionosphere with greater accuracy than was hitherto possible.

Diagrams of transverse sections of the mantle edge of the spat of the oyster before and after attachment are submitted by H. A. Cole. They show in the later stage the existence of a pair of organs not found in the free-swimming larvæ and possibly serving to receive, and react to, vibrations caused by disturbances in the surrounding medium. The newly described sense-organs appear as thin-walled spherical pigmented sacs forming part of the surface layer of cells, projecting from the inside mantle surface and containing, in the cavity, a comparatively large concretion which stains vividly with eosin.

Prof. N. A. Iljin gives an account of experiments in which the shedding of certain types of wool fibres in sheep while other types of wool fibres remain unchanged, is produced by means of treatment with thallium acetate. This phenomenon, termed 'selective or differential experimental moult', is considered as a peculiar morphogenetic reaction; it is evidence of the possibility of a physiological distinction between morphologically different structures proper to the race with a certain genetical constitution.

Prof. H. Munro Fox shows that certain sabellid worms removed from their tubes live indefinitely in aerated water, but they die in water deficient in oxygen, whereas intact worms live in the latter water. In their tubes, these sabellids execute rhythmic respiratory movements, the absence of which in tubeless worms may account for their lower viability. The absence of rhythmic movements in tubeless worms is reflected in their lowered metabolism.

The death of two swans from lesions of the intestine is tentatively ascribed by E. Gray to the presence of diatoms entangled in weeds ingested in early spring, combined with a high percentage of silica in the water.

Prof. D. Thoday directs attention to Dr. Razvi's observation that the opening of the stomata in the leaves of certain succulent plants depends not on the water-content of the leaf as a whole but on the water-content of the surface layer of cells. This, Prof. Thoday suggests, may explain why in the leaves of the coffee plant the stomata begin to close within three minutes of exposure to the sun, though the water supply may be abundant.

Research Items

Identification of Vitamin C

PROF. G. J. COX, in a letter to *Science* (Dec. 10, 1937; p. 540) points out that the award of the Nobel prize for medicine to Prof. A. v. Szent-Gyorgyi (see NATURE, 140, 798; 1937) may tend to obscure the part played by C. G. King and W. A. Waugh, of the University of Pittsburgh, in establishing the identity of vitamin C with a pure crystalline substance. The two groups of investigators, in fact, reached their goal by converging paths, at almost the same time. King and Waugh isolated active crystals from lemon juice and considered the substance to be apparently identical with Szent-Györgyi's "hexuronic acid", and published a note of their results early in 1932 (*Science*, 75, 357; 1932). Svirbely and Szent-Gyorgyi announced, about a fortnight later, that they had protected guinea pigs from scurvy, in an experiment lasting two months, by giving them daily doses of "hexuronic acid" (NATURE, 129, 576; 1932). It must be remembered that the question of the potency of the "hexuronic acid" was not easy to settle, since until it was certain that it had been obtained in the perfectly pure state there was always the possibility to be considered that it was contaminated by another much more highly active substance.

Osmotic Pressure

PROBABLY no conception in physical chemistry is used so often by biologists, with such lack of understanding of its precise nature, as that of osmotic pressure. The so-called pressure is clearly quite fictitious, and corresponds only in very special circumstances to any real pressure. In many quarters, the necessity for a new term to describe the effect is already being felt, and a recent addition to the series "Actualités scientifiques et industrielles" (Duclaux, J., "Pression Osmotique". Traité de Chimie physique appliqué à la Biologie, Tome 2, chap. iv. Paris: Hermann et Cie.) serves to emphasize this view. Although the treatment there is chiefly mathematical, the book is well worth the attention of biologists for its conclusions alone. The original comparison by Van't Hoff with gas pressure, interpreted in terms of the kinetic theory by Nernst, Meyer, Boltzmann, Rayleigh, Kelvin, Gibbs and others, is inadequate in many respects; for attention is concentrated on the solute rather than the solvent, and no account is taken of the two characteristics of osmosis—that the pressure is 'fictitious' and that the volume to be used in the van der Waals equation $PV = RT$ is not the whole volume of the solution. Considerations of the thermodynamical principles involved, made by Van't Hoff, Rayleigh, Gibbs, Planck and others, are equally inadequate, and the various theories they involve would seem to be incompatible. The only satisfactory theoretical expositions of the subject would seem to be those involving the Gouy-Chaperon effect, according to which, in a solution under the influence of gravity, the concentration varies with the height. The chief feature of importance to biologists is the clear recognition that in practice few membranes approach sufficiently closely to the theoretical 'normal' membranes to allow any rigid application of theoretical considerations—in other words, 'abnormal' osmosis in Nature is the rule rather than the exception. One may quote, for example, the fact that the blood of a fish has a concentration lower than that of sea-water, and that urine is more concentrated than blood. In all such cases the equilibrium must be far removed from that of Van't Hoff.

Choice of Background in Fishes

THE colour-change in fishes which takes place when they move from one background to another of different colour has been investigated on several occasions, but not much is known about the possibility of fishes selecting backgrounds to correspond with their skin colour. Observations have been interpreted as yielding positive and negative evidence of choice. Frank A. Brown and David H. Thompson record the results of several thousand choices of individual background-adapted fishes, belonging to eight fresh-water species (*Copeia*, 172; 1937). They reach the definite conclusion that fishes are influenced in their choice by the background to which their skin is adapted. Fishes adapted to black backgrounds choose black more frequently than do fishes adapted to white backgrounds. But in all the eight species tested black-adapted individuals chose black more often than white-adapted chose white. The fishes which showed the greatest modification of background choice as a result of residence upon a black or a white background (silver-mouthed minnow, steel-coloured minnow, straw-coloured minnow, and black-fin) were fishes which frequent shallow and relatively clear water in their natural habitat. The less sensitive were species (orange-spotted sunfish and horned dace) which characteristically hide during a large part of the time.

Larval Characters of the Brachyura

DR. HIROAKI AIKAWA has already advanced considerably our knowledge of the brachyuran larvæ (1933, 1935, 1936) and has devised schemes whereby they may be recognized and classified. In his latest paper "Further Notes on Brachyuran Larvæ" (Records of Oceanographic Works in Japan compiled by the Committee on Pacific Oceanography of the National Research Council of Japan. Tokyo, 1937) he extends these schemes in the light of a large number of new larvæ (30 species) obtained by himself by rearing them from the berried crabs. Taking certain larval characters, especially the second antenna and telson, presence or absence of spines on the carapace, and, in some cases, in addition, the hair formula of the endopodites of the two maxillæ and second maxillipede and the primary chromatophores, he attempts to define the larval characters of the important families including the zoeas of Japanese crabs as well as those of other countries. So great has been the advance in our knowledge of crab zoeas during the last few years that we now know, to a certain extent, the larvæ of 150 species and about 70 genera. Dr. Aikawa has classified all these and gives a key to the families based on larval characters. Applying this also to undetermined zoeas described by various authors, he suggests their probable position. It is interesting that in several cases two megalopæ are found in the life-cycle, whereas certainly in all the British species in which the life-cycle is known there is only one. In *Plagusia dentipes* it is stated that megalopa I stage forms swarms in the open seas from late winter until spring, whilst those of II stage live in great abundance on floating weeds and timbers from spring until early summer.

A Parasite of the Hessian Fly

In the *Journal of Agricultural Research* (55, 199–213; 1937), Messrs. C. C. Hill and W. T. Emery give an account of the biology of the parasitic hymenopteron, *Platygaster herricki*, the host of which is the Hessian fly. In certain parts of the United States, this parasite destroys an appreciable percentage of the fly. Its egg is laid in that of the host, wherein it develops simultaneously with the latter. Development is monoembryonic and not polyembryonic, as in related species of *Platygaster*, and, at the time of hatching, numerous pseudogerms, or groups of trophamnion cells, are liberated into the body cavity of the host. The primary larva at this stage is about 0·29 mm. long: it becomes nearly spherical during growth and gradually consumes the inner contents of the host, but not before the puparium has been formed. When fully fed, the parasite forms a cocoon within the host's puparium. The adult hibernates within the cocoon and emerges in the spring at the time when the Hessian flies are ovipositing. There is only a single generation in the year.

Heart-Rot of Sugar Beet

Sugar beet is subject to a severe disease the symptoms of which are a rotting of portions of the root, and frequently the death of the terminal bud. It is now recognized that this malady is occasioned by a deficiency of boron in the soil. Drs. Winifred E. Brenchley and D. J. Watson have made a study of the effect of this element upon the second year's growth of infected sugar beet (*Ann. App. Biol.*, 24, 3, 494–503, Aug. 1937). Diseased plants from the field were transferred to sand cultures, some of which contained the deficient element in the form of boric acid. Growth made in the absence of boric acid was uniformly diseased, but the addition of this substance in moderate amount (0·25 gm. per 25 lb. of sand) invariably corrected the trouble. Application of a double amount of boric acid, however, had a somewhat toxic effect.

Root Nodules of the Soy Bean

A short account, by Chan Hsien Wu, of the strains of *Bacillus radicicola* from root nodules of the soy bean, is published in the report of the Institute of Scientific Research, Manchoukuo (1, No. 5, 139–162, April 1937). Morphological and cultural characters are described, and the effect of the reaction of the medium upon growth has been investigated. The optimum reaction is about *p*H 6·5, though the organism will grow between the limits *p*H 3·7 and 7·8. Fermentation tests with various polyhydric alcohols, sugars and organic acid salts have been made; mannitol supported the best growth.

Entomogenous Fungi

Mr. T. Petch has continued his "Notes on Entomogenous Fungi" (*Trans. Brit. Mycol. Soc.*, 21, Pts. 1 and 2, 34, Oct. 1937), and provides critical dissertations upon thirty-four species. No fewer than fifteen of these are described for the first time, and thereby attain the dignity of Latin diagnoses. The species belong to a wide variety of genera—*Entomophthora*, *Hypocrella*, *Cordyceps*, *Hirsutella*, *Calonectria*, *Torrubiella*, *Stilbella*, *Isaria*, *Hymenostilbe* and others. The study includes specimens from North America, Ceylon, China, Silesia, Trinidad, Great Britain and many other places the full recital of which would be eloquent of the international scale of Mr. Petch's work.

Fault Lines off Spitsbergen

The recent Norwegian chart of the west coast of Spitsbergen based on extensive echo soundings reveals some submarine features of interest. These are discussed by Dr. O. Holtedahl in *Norsk Geografisk Tidsskrift*, Band 6, Hefte 4, 1936 (republished as *Norges Svalbard og Ishavs-undersökelsr Meddelelse* No. 35). He finds a number of features which resemble closely others found off the coast of northern Norway, especially a longitudinal depression off the coast of Prince Charles Foreland and, more to the east, off the land to north and south. This feature is attributed to longitudinal faults, and these have also been traced in the shelf areas off the coast of Western Greenland. Dr. Holtedahl points to the probability of similar fault lines off Labrador just east of Hamilton Inlet and off Nova Scotia along the inner slope of George's Bank. Similar features may be expected to occur off the west coast of Scotland, although Cainozoic volcanic activity may there have disguised them. Dr. Holtedahl illustrates his paper with a chart of the probable fault line off the west coast of Spitsbergen.

Earthquakes and Atmospheric Pressure

The effects of changes of atmospheric pressure on the occurrence of about two hundred New Zealand earthquakes from 1931 until 1936 are examined by Mr. R. C. Hayes in a brief but interesting paper (*Wellington Dom. Obs. Bull.*, No. 124; 1937). When the pressure rose or fell by one tenth of an inch or more within one or two days before an earthquake, a positive or negative sign was entered at the position of the epicentre. In general, it was found that earthquakes with centres on land were associated with a rise of pressure, and those with centres at sea with a fall, the different signs predominating in series of zones running north-east and south-west, parallel to the main folds and fault-systems of the islands. The most extensive zone is one marked by negative signs lying off the east coast of the North Island, and this is bounded to the north-west by an almost equally well-defined zone on land with positive signs.

Ice Accretion on Aircraft

In Prof. Note No. 82 of the Meteorological Office under the title "Ice Accretion on Aircraft" (London: H.M.S.O.), Sir G. C. Simpson discusses in turn the physics, the meteorology and the practical side of this subject. The physics is a simple matter. We have first the common phenomenon of clouds made up of water drops below the normal freezing point of water and the fact that the latent heat released when such a 'supercooled' drop begins to freeze prevents freezing from being at once completed unless the drop is at least 144° F. below 32° F. The manner of accretion of ice on aircraft is a matter of the size of the drops and of temperature; there are four main types of accretion corresponding with hoar frost, rime, something between rime and glazed frost, and glazed frost. The first may form in clear air when an aeroplane passes from regions of very low temperature into warmer and damper regions and is not thick enough to be very dangerous. The second—rime—comes when the machine flies in clouds made up of very small drops, generally at temperatures many degrees below 32° F. It is a light white deposit on the leading edges of wings, struts, etc., and is dangerous through its alteration of the aerodynamical characteristics of such parts and choking of instruments and carburettor. The third comes in dense clouds made up of large drops more nearly at 32° F. Freezing is very incomplete at impact, and the drops flow for some distance, gradually covering the machine with a dangerously heavy covering of clear ice. Lastly we have glazed frost, which is a similar covering of clear ice, the result of rain from a warmer layer above falling on a machine in a layer with temperature below 32° F. The meteorology of the subject is concerned with the development of rain clouds at suitable temperatures, and is not dealt with in great detail; the practical side is largely concerned with the problem of escaping the dangers of ice accretion either by ascending or descending out of the dangerous layer according to the meteorological circumstances and aided by the wireless warnings issued by the Meteorological Office.

Uranium, Thorium and Lead in Thucholite

THE radioactive carbon mineral thucholite, found in the Parry Sound district, Ontario, has been analysed by O. B. Muench (*J. Amer. Chem. Soc.*, **59**, 2269; 1937). Well-defined crystals, regarded as pseudomorphs after uraninite, were available. The ratio Pb/U was 0·038, whilst that in cyrtolite from the same mine was 0·019. The percentage of uranium in nodular thucholite was almost four times that in the crystalline material, whilst the percentage of thorium was four to five times as great in the crystals as in the nodular mineral. These results indicate a possibility of a concentration of thorium in the crystals and either a leaching of the uranium or else a replacement of the uranium by the carbon mineral. They indicate that Pb/U ratios for this mineral are of little value for an age-determination by this method.

Effect of Temperature on Permanent Magnets

IT has been known for many years that the strength of a permanent magnet changes with alteration of its temperature. In general, the strength diminishes when the temperature is raised and increases when it is lowered. In the case of highly accurate instruments such as electricity meters, the constancy of the strength of the magnets used is of very great importance. It is especially important in the case of the electrical instruments which use permanent magnets employed on aircraft. In view of the recent developments that have been made in the electromagnetic instruments used in high altitude flying where very low temperatures are encountered, it is necessary to know the behaviour of magnets at these temperatures. In a paper by Albert C. Whiffen, published in the December issue of the *Journal of the Institution of Electrical Engineers*, a survey is given of recent researches on this subject. It has been proved that a magnet can be put into the steady condition, as regards magnetic strength, either by mechanical shocks or by cyclic heating. It then has a definite strength at each temperature. A survey of previous experiments shows that the change with temperature depends on the linear dimensions of the magnet. Tests were made of cobalt steel, aluminium-nickel and aluminium-nickel-cobalt alloy magnets over the temperature range from −60° C. to 100° C. An electrically heated oil bath was used for the range 20° C. to 100° C., whilst solid carbon dioxide dissolved in acetone was employed for the range 20° C. to −60° C. It was found that the magnetic strength at any temperature between these limits could be connected with the standard temperature by a quadratic coefficient, both coefficients being negative. It is stated that a magnet which has attained the reversible condition by a series of heating cycles between two limits of temperature is only in the reversible state for these limits of temperature.

Green Flash from Venus

THREE observations of the 'green flash' phenomenon from the planet Venus as it was setting behind a sea horizon are recorded in the meteorological record of S.S. *Tairoa* by Captain W. G. West and W. G. Burt (*Marine Observer*, **15**, 8; 1938). On January 4, 1937, in lat. 1° 00′ S., long. 70° 04′ E., the setting planet, watched through binoculars, turned to a deep green for about half a second before disappearing. On January 5, when the planet was watched through a telescope for five minutes before setting, there were periods of 1–3 or 4 seconds during which the body would appear elongated vertically, with red at the lower limb and green at the upper; the final colour was a dull green. On January 19, when the planet, again watched through a telescope, was only a few minutes of arc above the horizon, a reflection on to the horizon was observed, bright and yellowish in colour. Then "it turned bright red, and as a pillar of red spreading down from the planet to the horizon. After turning back to yellowish-white, it turned green, and then seemed to sink out of sight rather quickly. The whole of this latter phenomenon lasted for not more than 4 seconds."

Most Accurate Method for Determining Meteor Radiants

IN "Extrait, Congrès International des Mathematiciens, Oslo, 1936", Jindrich Svoboda has a paper with the title, "Les Essais expérimentaux du calcul d'un radiant du courant météorique des trajets observés", in which he describes his experiments with a group of artificial meteors. Knowing the true radiant, he used different methods for finding the nearest approach to this, and though the results did not differ very much, one was undoubtedly superior to the others. It was found that when the sum of the squares of the angles by which the lines should be turned around the centre of each trajectory, in order that these lines should pass through the computed radiant, was a minimum, the best results were obtained. Meteor workers may find this conclusion of considerable value.

The Advancement of Science and Society

PROPOSED WORLD ASSOCIATION

AT the recent Indianapolis meeting of the American Association for the Advancement of Science, two important resolutions were adopted unanimously by the Council and may have profound effects, not only upon the future of science, but also upon social history. The resolutions propose, in effect, the setting up of a scientific 'brains trust' for the world, and proclaim the democratic principles of science, and the intellectual freedom of scientific workers; and they denounce totalitarian suppression as a major crime against civilization.

This action may be said to have had its origin in a movement, started several years ago, and strongly supported by NATURE, to make the British Association the platform for the discussion of social problems which science had helped to create and might help to solve. By the time of the Blackpool meeting in 1936, the success of the British Association in this field was manifest. The American delegates, led by Prof. E. G. Conklin, were greatly impressed by the spirit of the meeting. They wanted to hear the men of science of the United States speak as freely, and constructively, on social issues.

Among the American visitors was Mr. Waldemar Kaempffert. Mr. Ritchie Calder, who had already discussed the ideas with leading British men of science, proposed with Mr. Kaempffert 'A Magna Charta of Science'—a declaration of independence, declaring the free, democratic, altruistic principles of science, and also the formation of an Anglo-American concord, as the nucleus of a world organization for all who would subscribe to, and advance, these principles. Together, they saw Prof. Conklin, who wholeheartedly approved, and Sir Josiah Stamp. Coincidentally, Prof. Etienne Gilson, professor of the history of philosophy in the Middle Ages in the Collège de France, was proposing, at the Harvard tercentenary, the setting up of a 'Supreme Court of Science' for the world.

The British Association, during 1937, entered into negotiation with the American Association for collateral membership and exchange of publications, but the major proposals were deferred. In October 1937, however, the *New York Times* published a leading article on an open letter which Mr. Ritchie Calder had addressed, in the *Daily Herald*, to Lord Rayleigh, reviving the proposals. The response in the United States was immediate. Dr. F. R. Moulton, executive secretary of the American Association, made the proposals the basis of his address last December to the Council, in which he also proposed that the American Association should invite lay members, mostly from the universities, to the number of one hundred thousand. The symposium on science and society, Prof. Conklin's inspiring address on science and ethics (see NATURE, Jan. 15), and Dr. Moulton's appeal assured the enthusiastic reception of the proposals. On December 30, the Council of the Association responded by unanimously endorsing the following resolutions:

"Whereas, science and its applications are not only transforming the physical and mental environment of men, but are adding greatly to the complexities of the social, economic and political relations among them; and

"Whereas, science is wholly independent of national boundaries and races and creeds and can flourish permanently only where there is peace and intellectual freedom: now

"Therefore, Be it resolved by the council on this thirtieth day of December 1937, that the American Association for the Advancement of Science makes as one of its objectives an examination of the profound effects of science upon society; and that the Association extends to its prototype, the British Association for the Advancement of Science, and to all other scientific organizations with similar aims throughout the world, an invitation to co-operate, not only in advancing the interests of science, but also in promoting peace among nations and intellectual freedom in order that science may continue to advance and spread more abundantly its benefits to all mankind."

The Association at the same time reaffirmed a resolution on intellectual freedom, originally presented by Dr. Robert A. Millikan and Prof. Henry Norris Russell. The Millikan-Russell resolution, incorporated in the new declaration, reads:

"The American Association for the Advancement of Science feels grave concern over persistent and threatening inroads upon intellectual freedom which have been made in recent times in many parts of the world.

"Our existing liberties have been won through ages of struggle and at enormous cost. If these are lost or seriously impaired there can be no hope of continued progress in science, or justice in Government, of international or domestic peace, or even of lasting material well-being.

"We regard the suppression of independent thought and of its free expression as a major crime against civilization itself. Yet oppression of this sort has been inflicted upon investigators, scholars, teachers and professional men in many ways, whether by government action, administrative coercion or extra-legal violence.

"We feel it our duty to denounce all such actions as intolerable forms of tyranny.

"There can be no compromise on this issue, for even the commonwealth of learning cannot endure 'half slave and half free'. By our life and training as scientists and by our heritage as Americans we must stand for freedom."

As one of the first steps to create the machinery, Dr. Moulton was requested by the council "to take up with the British Association the question of the desirability of inviting its members to join the American Association", so that the combined scientific forces of America and Great Britain should act as a "united world intellect".

Another gesture, which was warmly received by the American men of science, was the announcement made by Sir William Bragg in his presidential address to the Royal Society on November 30 last that the National Academy of Sciences of the United States of America and the Royal Society of London had arranged for the exchange of lectureships between the two democracies in alternate years. An account of this endowment by the Pilgrim Trust was given in NATURE of December 4, 1937 (140, 961).

Geography and Planning

THE Geographical Association's annual conference usually has a theme corresponding to the interests of its president for the time being, and since in its choice of presidents the Association does not confine itself to academic geographers, considerable service to the subject is often done by this importation of a new viewpoint. This year the keynote of the Conference held at the London School of Economics on January 4–6 was the part that geography can play in planning. The presidential address, delivered by Prof. Patrick Abercrombie, professor of town planning at University College, London, was entitled "Geography, the Basis of Planning"; and a symposium on town and rural planning was the principal individual item in the programme. To a certain extent these items in the Conference may be considered as corollary to the important discussion on "Planning the Land of Britain", which was held at the Nottingham meeting of the British Association, as reported in NATURE of November 6, 1937, p. 791.

Prof. Abercrombie took as his starting point the famous Geddes triad "place, work, folk"; geography (place) represents the basis of planning, business (or work) the kernel of planning, and men and women (or folk) the purpose of planning. Planning may be defined as "any conscious effort to mould our environment for our own purposes". The geographer's aid to planning can be given by three types of study: the recording of natural conditions (geology, soil, vegetation, etc.), the tracing of the historic growth of adaptation to environment in the region, and, by combining these two, the presentation of a survey of existing conditions. A plea was put forward for the popularization of geology; the Geological Survey provides ample material in the shape of maps and memoirs, but few people can interpret them without the aid of the professional geologist, and numerous fundamental errors have been made in planning which might have been prevented by a little elementary geological knowledge.

Dr. S. W. Wooldridge, however, in the symposium, contended that the matter is one for geographers; the geologist studies rocks mainly as a record of the earth's history, and is not primarily concerned with the form of the land, and its surface constitution. Both Prof. Abercrombie and Dr. Wooldridge pleaded for soil maps, but had little hope of their appearance for many years. But a more serious handicap is the absence of a complete drift map covering the whole country; the past and present geography of the drift-covered areas cannot be fully appreciated without a map showing the character of the surface deposits.

Dr. Wooldridge said, in addition, that for studying the form of the land something more than contour maps is necessary, and he deplored the abandonment of the fifth (Relief) edition of the Ordnance Survey One-Inch Map—a sentiment which was obviously shared by an audience consisting very largely of school-teachers. Another matter in which the planner must be interested is structure, especially in its effect on water supply. Dr. Wooldridge showed how sub-surface contour maps of water-bearing formations may be far more useful than simple cross-sections; for example, it may be demonstrated that the chalk is much nearer the surface underneath the central part of London than in the regions to the west and east, a fact which has an obvious bearing on the relative difficulty of securing water by boring. He cited cases, too, of buildings which had subsided through being built on a shallow clay formation overlying running sands, and mentioned that central London, built on Thames terrace gravels, is the only part that has subsided appreciably, the parts built on London Clay showing no movement. He added a warning that the expansion of 'bungaloid growths' on the top of the chalk dip-slope around London may have disastrous effects on the pollution of the water, which runs down the dip to the areas from which well-water is obtained.

Both Prof. Abercrombie and Dr. Willatts were concerned with agriculture, which the former called the "Cinderella of planning". There is a well-known phrase "an army moves on its stomach"; it is equally true that the non-combatants must be fed in time of war, and in an island country such as Great Britain, it seems curious that so much attention should be given to the production of weapons of defence and aggression, and so little to the possibility of making the nation more self-supporting in essential foodstuffs. Agriculture, in the law, is not regarded as a development at all; 'development' consists of the utilization of the land for building purposes, and planning schemes plan the extension of urban areas, not the extension, nor even the retention, of agricultural land-use. The land, as Dr. Stamp said at Nottingham, is our one ultimate asset; the soil is a form of capital; yet not only have three-quarters of a million acres of farm-land been lost to the nation since 1900, but also, by a curious misfortune, it is usually the best agricultural land which is taken for building.

Dr. Willatts, who is organizing secretary of the Land Utilization Survey, stressed the need for a historical study of land utilization. The present use represents the result of centuries of adaptation; modern planning visualizes a sudden change. Only by studying the past land uses can apprisal be made of the optimum use of any given area. Thus near London there are three large areas of rich market-garden land—actually amongst the finest soils in the country, in western Middlesex, south-west Essex and north-west Kent—all of which are being rapidly eaten into by the builder. No account whatever seems to have been taken of the agricultural value of this land, either in planned or haphazard development. It is noteworthy that London's open heaths (for example, Hampstead, Wimbledon) have remained as such for centuries because of poverty of soil; they would make admirable residential areas, yet what an outcry there would be if they were to be built on! But thousands of acres of rich arable land, which for centuries has yielded abundant harvests to the farmer or small-holder, are now being destroyed by houses and factories without a protest being raised. The 'gravel subsoil' of the Thames terraces is far more valuable to the builder as an inducement to the prospective purchaser than the poorer clay land, and could far better be spared from the rapidly decreasing area of farm land. The question which the geographer, and the planner, may ask is, "Which is the best and most economic use of this land, considered from the national point of view—for houses or crops ?"

Lastly, Dr. R. A. Pelham urged a better appreciation of traditional building styles and materials in the development particularly of rural areas, in order that such "incongruous atrocities" as rows of red brick houses on the edge of Cotswold towns and villages might be avoided. It is feared, however, that this is an age in which utility and cheapness are more often considered than the æsthetic, and it is after all much cheaper and easier to build with mass-produced bricks than with elaborately prepared stone.

Apart from a highly entertaining and unbiased lantern lecture on South Russia and the Caucasus by Sir John Russell, and a fascinating biological introduction to the study of landscape from Prof. H. H. Swinnerton, the remaining items in the Conference dealt mainly with educational subjects, ranging from the conception of geographical ideas by school-children to the conception of examination questions by examiners, and from the study of local geography by observation to the study of far-off lands by corresponding with the officers of 'tramp' ships. A lengthy report of a committee of the Association which has been studying world natural regions was also submitted and discussed; the report has been published in full in the December 1937 issue of *Geography*. S. H. BEAVER.

Prize Awards for 1937 of the Paris Academy of Sciences

AT the annual public meeting held on December 20 last the president announced the prizes and grants awarded in 1937 as follows :

Mathematics. The Francœur Prize to Jean Leray, for his work on mathematical analysis.

Mechanics. The Montyon Prize to Lucien Malavard, for his electrical apparatus for the rapid calculation of the distribution of hydrodynamic circulations. The Poncelet Prize to Joseph Bethenod, for his work on mechanics and electricity. The Pierson-Perrin Prize to Léon Brillouin, for the whole of his work, especially for his contributions to the development of quantum mechanics.

Astronomy. The Lalande Prize to Michel Giacobini, for his work on stellar astronomy and comets. The Benjamin Valz Prize to Maurice Burgaud, for his work on terrestrial magnetism in China. The G. de Pontecoulant Prize to Henri Roure, for his work on planetary perturbations.

Geography. The Gay Prize to Jean Vignal, for his work on the accuracy of a method of levelling. The Tchihatchef Prize to Etienne Bruzon, for his travels, work and publications relating to the climate of Indo-China. The Binoux Prize to Raoul Goudey and Jean Lagrula, for their gravimetric observations made in France and Northern Africa. The Alexandre Givry Prize to Henri Legrand, for the whole of his hydrographical work in France and its colonies.

Navigation. The Plumey Prize to Roger Brard, for his studies on screw propellers.

Physics. The Kastner-Boursault Prize to Bernard Decaux, for his work on the applications of piezoelectric quartz to chronometry. The Gaston Planté Prize to Jean Bernamont, for his studies on the fluctuations of electrical resistances. The François Hébert Prize to Paul Couderc, for his work on astronomy. The Henri de Parville Prize to Paul Lainé, for his researches on the magnetic and magneto-optic properties of liquefied gases. The Hughes Prize to Paul Soleillet, for his work on the structure of light. The Clément-Félix Foundation to Etienne Vassy, for his work on atmospheric ozone.

Chemistry. The Montyon Prize (Unhealthy Trades) to Roger Renaud, for his work on gas masks. The Jecker Prize to Gustave Vavon, for his work on catalytic hydrogenation and the stereochemistry of the cyclic compounds. The Cahours Foundation to Georges Laude, for his work on the synthesis of cyanic acid. The Paul Marguerite de la Charlonie Prize to Georges Darzens, for his work in organic chemistry. The Berthelot Prize to Jacques Parrod, for his researches on the synthesis of hydrocyanic acid. The Houzeau Prize to Marius Picon, for his work on sulphides and camphocarbonates. The Charles Adam Girard Foundation to Georges Brooks, for his researches in biological chemistry.

Mineralogy and Geology. The Delesse Prize to Mlle. Simonne Caillère, for her work on the minerals of the serpentine group. The Victor Raulin Prize to Mlle. Henriette Alimen, for her studies on the Stampian of the Paris basin.

Botany. The Desmazières Prize to Robert Potier de La Varde, for his work entitled "Mousses du Gabon". The Montagne Prize to Marius Chadefaud, for his work on Algæ. The Jean Thore Prize to Emile Chemin, for his biological researches on certain Algæ. The de la Fons Mélicocq Prize to Maurice Bouly de Lesdain, for his work entitled "Graminées indigènes et adventices des environs de Dunkerque". The de Coincy Prize to Raymond Benoist, for work in systematic botany in tropical regions.

Anatomy and Zoology. The Cuvier Prize to Paul Chabanaud, for the whole of his work. The Savigny Foundation to Henri Heim de Balsac, for his book on the mammals and birds of northern Africa.

Medicine and Surgery. Montyon Prizes to Emile Césari and Paul Boquet (2,500 francs), for their researches on the antigens of snake poisons and the antibodies of the sera ; Michel Salmon (2,500 francs), for his book on the arteries of the skin ; Jean Vague (2,500 francs), for his book "Les Hépatonephrites aiguës". Honorable Mentions (1,500 francs) to Ram Kumar Goyal, for his contribution to the study of the Streptothriceæ ; to Eugène Saint-Jacques, for his work on injections of animal charcoal in various diseases ; and to Jean Terracol, for his book on the diseases of the nasal fossa. The Barbier Prize to P. Emile Weil, Paul Isch Wall and Mme. Suzanne Perlès, for their book on the puncture of the spleen. The Bréant Prize to Georges Girard and Jean Robic, for their work on the application to man of a new vaccine against plague. The Godard Prize to Gaston Gros, for his memoir on sexual endocrinology. The Mège Prize to Georges Curasson, for his treatise on veterinary pathology. The Bellion Prize to Jacques Vialle, Chevalier Jackson and Chevalier L. Jackson, for their memoir on bronchoscopy in bronchopulmonary affections. The Argut Prize to Jean Braine and Raymond Rivoire, for their book on the surgery of the parathyroid glands. The Charles Bouchard Foundation to Maurice Doladilhe, for his studies on the properties of the blood serum. The Jean Dagnan-Bouveret Prize to Michel Weinberg, for his memoir on the anærobic micro-organisms.

Cancer and Tuberculosis. The Roy-Vaucouloux Foundation to Eugene Wollman, for his work on the nature of malignant tumours. The Louise Darracq Prize to Mme. Nadine Dobrovolskaia-Zavadskaia, for work on cancer. The Henriette Régnier Foundation to Robert Broca, for work on tuberculosis.

Physiology. The Montyon Prize to Mlle. Eliane Le Breton, for her memoir on the physiological signification of the oxidation of ethyl alcohol in the organism. The Pourat Prize to Georges Morin, for his work on the intestinal automatism of the vertebrates and its regulation. The Philipeaux Prize to Jean Roche, for his physiological and biological researches on the respiratory pigments. The Fanny Emden Prize between André Tournade (2,000 francs), for researches in experimental physiology, and Raoul Lecoq (1,000 francs), for researches on the B vitamins.

Statistics. Montyon Prizes to Mlle. Dagmare Weinberg (1,000 francs), for her work on the correction of examination papers ; Adolphe Lesage and Marcel Moine (1,000 francs), for their study on infant mortality during the first year. A Mention (500 francs) to Marcel Luc-Vernon, for his studies on the science of values applied to bookkeeping and the statistics of undertakings.

History and Philosophy of Science. The Binoux Prize to Cornelis de Waard, for his contribution to the edition of the correspondence of Père Marin Mersenne.

Works of Science. The Henri de Parville Prize to the Association de la Presse de l'Institut et des Sociétés Savantes.

Medals. The Berthelot Medal to Roger Renaud and to Jacques Parrod.

General Prizes. The Prize founded by the State to Gaston Delépine, for the whole of his palæontological and geological work. The Alhumbert Prize to (the late) Fernand Jacquet, for his researches on the stratigraphy of Senegal and Mauritania. The Bordin Prize to Georges Darmois, for his work on the calculus of probabilities. The Lallemand Prize to Jean Delay, for his work entitled "Les Astéréognosies. Pathologie du toucher". The Petit d'Ormoy Prize (Mathematical Sciences) to Paul Lévy, for the whole of his mathematical work, (Natural Sciences) to Emile Roubaud, for the whole of his entomological and biological work. The Saintour Prize to André Marchaud, for his work on geometry. The Lonchampt Prize to Lazare Silberstein, for the whole of his work on the importance of sulphur in plants and animals. The Wilde Prize to René Lucas, for his work on transversal waves in liquids. The Gustave Roux Prize to Stanislas Goldsztaub, for his work on the crystalline structure of the natural hydrated iron oxides. The Thorlet Prize to Paul Dorveaux. The Marquet Prize to Charles Joyeux, for the whole of his helminthological studies. The Général Muteau Prize to Gaston Ramon, for work on the anatoxins.

Prizes of the Grand Ecoles. The Laplace Prize to Charles Crussard. The L. E. Rivot Prize to Charles Crussard, Jean Hüe de la Colombe, André Brocard and Bruno Cirilli.

General Foundations for Scientific Research. The Gegner Foundation to Claudius Roux, for his work on natural science and the history of science. The Hirn Foundation to Marcel Fouché, for his work in acoustics. The Henri Becquerel Foundation to André Savornin, for his work in terrestrial magnetism.

THE LOUTREUIL FOUNDATION

Researches on Fixed Questions. Henri Erhart (5,000 francs), for the extension of his pedological researches. Albert Henry (3,000 francs), for his researches on parasitism of the mammary gland. Louis Nattan-Larrier (6,000 francs), for the study of the serological conditions of the development of normal tissues and of cancers. Paul Vayssière (3,000 francs), for work on the disinfection and preservation of agricultural products.

Researches to be Carried out in French Colonies. Lucien Berland (8,000 francs), for researches on the entomological fauna of the upper regions of the atmosphere, especially in Senegal. Henri Humbert (6,000 francs), as a contribution to a new botanical expedition in southern tropical Africa and in the north-west of Madagascar.

For Laboratory Equipment. Zéphirin Carrière (10,000 francs), for the purchase of an electrical apparatus for the analysis of sound. Institut national agronomique (10,000 francs), for the purchase of a microscope for the examination of fluorescence by production of ultra-violet rays. Casimir Monteil (5,000 francs), for the purchase of a petrol motor for brake measurements. Henri Thiel (2,000 francs), for the purchase of a Nistri stereographometer.

Publications. Comité de Physique du Globe des Colonies (10,000 francs), for the publication of the "Annales de Physique du Globe de la France d'outremer". Fédération française des sociétés de sciences naturelles (4,000 francs), for the publication of the "Fauna de France". Henri Gaussen (5,000 francs), for the publication of a memoir by Charles Flahault on the flora of the French Mediterranean region. Marc Simonet (4,000 francs), for the publication of sixteen coloured plates of certain hybrids of *Iris*. Société Linnéenne de Lyon (3,000 francs), for the publication of library catalogues.

Libraries. Ecole nationale vétérinaire d'Alfort (8,000 francs), for preparing a card catalogue and completing its foreign periodicals. Ecole nationale vétérinaire de Lyon (7,000 francs), for the purchase of foreign veterinary works. Ecole nationale vétérinaire de Toulouse (7,000 francs), for the purchase of French and foreign veterinary works. Ecole polytechnique (5,000 francs), for the purchase of scientific publications. Institut national agronomique (5,000 francs), for the purchase of foreign periodicals. Société astronomique de France (2,000 francs), for increasing its collection of lantern slides. Société d'encouragement pour l'industrie nationale (8,000 francs), for the purchase of foreign works.

MME. VICTOR NOURY FOUNDATION

Edgar Aubert de La Rue, for his explorations in the French Colonies ; Albert Berthelot, for the whole of his studies ; Maurice Bouvet, for his work on the history of pharmacy in France ; Gilbert Ranson, for his memoir on the medusæ collected during the voyages of Prince Albert I of Monaco ; Constantin Toumanoff, for his studies relating to antipaludism in Asia (2,500 francs each).

GENERAL FOUNDATIONS

The Henry Le Chatelier Foundation to Léon Guillet, for his studies on zirconium and beryllium. The Millet-Ronssin Foundation to Justin Savornin (4,000 francs), for his geological work in Algeria; Paul Remy (3,000 francs), for the whole of his zoological work and especially that on insects; Robert Kühner (3,000 francs), for his researches on Basidiomycetes.

VILLEMOT FOUNDATION

Mme. Rose Bonnet-Sainturier (15,000 francs), for the publication of a memoir on the double stars. Lucien Cayeux (15,000 francs), for the purchase of a polarizing microscope and various other instruments. Aimé Cotton (40,000 francs), for the electromagnet laboratory. Alexandre Dauvillier (12,000 francs), for a recording electrometer. Jean Goarnisson (5,000 francs), for the establishment of a laboratory for the preparation of certain remedies against leprosy and sleeping sickness. Edouard Legé (53,000 francs), for experimenting, on a semi-industrial scale, on the synthetic preparation of motor petrol from certain colonial seeds. Charles Maurain (15,000 francs), for researches on terrestrial magnetism and atmospheric electricity. Marin Molliard (5,000 francs), for researches on the morphogenic and physiological action on plants of atmospheric gases under varying pressures. Albert Peyron (8,000 francs), for the development and publication of his studies in comparative pathology relating to tumours. Maurice Piettre (10,000 francs), for the installation of a low-temperature room at the Halles. Gustave Ribaud (10,000 francs), for the experimental study by various methods of the heat losses through the walls of furnaces. Hyacinthe Vincent (12,000 francs), for the purchase of laboratory animals and material for continuing his researches on immunity and pathology of infectious diseases.

SPECIAL FOUNDATIONS

The Lannelongue Foundation to Mme. Gabriel Cusco. The Girbal-Baral Foundation (each 10,000 francs) to Daniel Bouttier and Julien Jouin. The d'Aumale Prize Grants of 5,000 francs each to the widows of Joannès Chatin and Jean Charcot.

Science News a Century Ago

Russian North Polar Expeditions

UNDER the above title, the *Athenæum* of January 27 gave a long account of the exploration of the coasts of Novaya Zemlya based on the memoirs of von Baer contributed to the Imperial Academy of Sciences, St. Petersburg. After referring to the earliest voyages to the north, the writer of the review said: "During the years 1819–24 five well equipped expeditions were despatched by the Russian government for the Survey of Novaïa Semlïa, four of which were under the command of the experienced navigator Lütke; yet they all failed in the especial object of their mission, namely, to trace the eastern coasts of that country." In 1832 a merchant of Archangel named Brandt, equally alive to the interests of science and of commerce, formed a company, and despatched one ship commanded by Lieut. Krotoff to sail along the west coast of the islands and a second in command of the pilot Pachtussoff to survey the eastern coasts. A third vessel sent to the western coast in search of walrus returned richly laden. Lieut. Krotoff and his ship were lost, but Pachtussoff and his party wintered in the north and made valuable surveys.

In 1834 the Russian Government fitted out two vessels, one commanded by Pachtussoff and another by Ziwolka. Leaving Archangel in July, Pachtussoff was away about a year and died shortly after his return. "The two expeditions conducted by Pachtussoff," said the *Athenæum*, "produced a mass of meteorological observations of a very valuable kind, and which bear unequivocal testimony to the carefulness and assiduity of that officer." The greatest cold experienced in Novaya Zemlya was in February, when the thermometer fell to − 40°. It often remained for days together at −34°.

Karl Ernst von Baer was born in Esthonia on February 17, 1792, and studied medicine at Dorpat. Finding that his native country presented indifferent prospects for a naturalist, he went to Germany and became professor of zoology at Könisberg, where he founded a Zoological Museum. In 1834 he was appointed librarian to the Imperial Academy of Sciences, in which situation he made use of his opportunities to collect information regarding the polar regions of the Russian Empire. He had previous to this become famous for his discovery of the mammalian ovum, which led to his being regarded as the founder of comparative embryology. His death took place at Dorpat on November 28, 1876.

The Zoological Society

AT a meeting of the Zoological Society held on January 23, 1838, Richard Owen being in the chair, Mr. Ogilby characterized several new species of mammals contained in the collection made by Captain Alexander in South Africa, and Mr. Gould described several new and interesting birds included in the collection. Among them was an eagle with a white breast and red tail; two small falcons, scarcely exceeding in size the English house-sparrow; and a very small owl of scarcely larger size. There was also a jay of very gaudy plumage which perches upon the horns of rhinoceros, supposedly for the purpose of obtaining insects; the hunters of the rhinoceros anxiously watch this bird, as when they see it fly up from the horn they know that the animal is alarmed. At the same meeting, Owen read some observations on the anatomy of the giraffe, from dissections made of the animals which died at the Regent's Park and Surrey Zoological Gardens.

The Morse Telegraph

"A NEW and improved transmitting and recording apparatus was completed for Prof. Morse by his partner, Mr. Alfred Vail, of the Speedwell Iron-works, near Morristown, N.J., at the close of the year 1837; and early in January, 1838, Prof. Morse first discarded the numeral signs for words, and employed a true *alphabet* of 'dots and dashes'. The first exhibition of an alphabetic record of words and sentences took place in the New York City University, on January 24, 1838, through ten miles of wire wound on reels. The New York *Journal of Commerce*, in a notice of this performance, remarked, 'Professor Morse has recently improved on his mode of marking, by which he can dispense altogether with the telegraphic dictionary, using letters instead of numbers'." ("A Memorial of Joseph Henry", p. 384.)

Societies and Academies

Paris

Academy of Sciences, December 6 (*C.R.*, 205, 1113–1188).

Dimitri Riabouchinsky : Hypersonic waves in gases.

Lucien Daniel : New researches on the variations of the reserve function in the autonomous and grafted Jerusalem artichoke.

Lucien Hibbert : Univalence cells of polynomials.

Amédée Guillet : The determination of a network of values of the acceleration of gravity (g) centred on a given station.

Alexandre Favre : The experimental study of movements in two dimensions by means of the Toussaint-Carafoli hydrodynamic tunnel : the influence of the viscosity.

Emile Merlin : A theorem on the motion of fluids deprived of acceleration.

G. A. Mokrzycki and J. Wysocki : *Décollage* in flight.

Jean Hély : A synthetic theory of gravitation and of electromagnetism.

Gérard Petiau : A system of hypercomplex numbers derived from the system of quaternions.

Jean Roubaud-Valette : The passage of vectorial magnitudes to the corresponding spinors by the notion of sub-spaces. The interpretation of Dirac's equations.

Gustave Robaud : The calculation of the temperatures and pressures in a closed vessel. The use of a QT diagram, where Q is the total heat necessary for the partial dissociation of the CO_2 and O_2 molecules and to carry the products of dissociation from the temperature T_0 to T, simplifies the laborious calculations hitherto necessary.

Georges Simon and Jean Bouchard : The influence of a longitudinal magnetic field on the thermo-electric power of nickel and of various ferronickels submitted to traction.

V. Dolejšek and M. Tayerle : The separating power in X-ray spectra.

Maurice Cotte : Aberrations of the second order of orthogonal systems.

Claude Magnan : Study of the energies of electrons and positrons emitted during certain nuclear reactions.

Augustin Boutaric : Some simple formulæ relating to adsorption phenomena occurring in mixtures.

Wilfried Heller and Mlle. Germaine Quimfe : The isothermal and reversible immobilization of the particles in thixotropic sols.

Paul Mondain Monval : The application of the laws of displacement of equilibrium to heterogeneous liquid mixtures.

Emile Carrière and Maurice Delpla : The comparative action of potassium iodate and of potassium periodate on sodium thiosulphate in weakly acid medium. The oxidation of sodium thiosulphate by iodic acid is markedly influenced by the hydrogen ion concentration, but with periodic acid this concentration has small influence.

Maurice Anglade : The synthesis of the mono-ether oxides of 2,4-dimethylolanisol.

Antoine Hautot : A method of measuring the periodic internal potential of crystals.

Fernand Jacquet and Maurice Nicklès : The relations of the eastern Senegal chain with the Mauritanian and Sudanese plateaux.

Jean Marçais : The tectonic constitution of the eastern French Rif.

Albert Robaux and Marc Bernatzky : The tectonic of the secondary strata of Lorraine.

Octave Mengel : The Robinet of Donzère : its relations with the physiography and seismicity of the Tricastin (Drôme).

B. Trouvelot and G. Busnel : Modifications of the rhythm of the cardiac beats in the larvæ of Doryphora (*Leptinotarsa decemlineata*) produced by the *Solanum* on which they are feeding.

Pierre Drach : The morphogenesis of the external crystalline mosaic in the tegumentary skeleton of the brachyurous Decapods.

Albert Guieysse-Pellissier : The pulmonary vessels with striated fibres of the small mammals.

René Guy Busnel : The biochemical study of the lipins and reducing substances in *Leptinotarsa decemlineata*.

René Couteaux : Origin of the secondary myotubes in the embryos of mammals.

Serge Tchakhotine : An arrangement (drops of water in a non-miscible liquid) for researches in embryology and experimental cytology.

Henri Nouvel : Observation of coition in a species of Mysis, *Praunus flexuosus*.

Auguste Trillat and Arthur Beauvillain : An attempt at the aerial transmission of influenza to the ferret through the lungs or eyes.

Moscow

Academy of Sciences (*C.R.*, 16, No. 9 ; 1937).

N. Vedenisov : Varieties of E. Čech.

G. N. Neujmin : Return to perihelion of the periodical comet Neujmin II in 1937.

J. Larionov and A. Seidel : Photo-luminescence of solutions of rare earth salts.

H. Neujmin : Use of solid indicators for direct detection of photo-dissociation products.

A. E. Porai-Koschitz and A. I. Kulikov : A new substantive colouring matter.

A. E. Porai-Koschitz, B. A. Porai-Koschitz and S. A. Luick : Constitution of chinophtalon.

L. S. Selivanov : Composition of the mud of the brine of the Karabugaz Gulf.

D. F. Petrov and D. A. Tukan : Heterozygoty of the male sex in *Fragaria orientalis* Los.

K. E. Ovčarov : Production of thiourea by fungi.

I. A. Stefanovskij and I. V. Guščin : Specific action of drought on wheat crops at various stages of development.

T. A. Krassnoselskaja-Maximova, T. V. Kulagina, K. I. Orlova, L. N. Filimonova and N. V. Cugrejeva : Physiology of apple trees in relation to soil conditions.

A. Jacenko-Chmelevskij : Some peculiarities in the conductive system of the petiole of ramie (*Boehmeria nivea*, var. *tenacissima* Gaudich).

M. F. Nikitenko : Problem of the mechanism of regeneration of the eye lens in Amphibia.

C.R., 17, Nos. 1–2 ; 1937.

M. M. Greenblum : The adjoint transformation.

D. A. Frank-Kameneckij : The limiting form of the free convection law for high values of Grasshof's criterion.

K. Alexeeva : Artificial radioactivity of antimony provoked by slow neutrons.

G. V. Gorškov and V. N. Ionov : A new method of determining radium, mesothorium I and radiothorium in sealed preparations.

S. J. Turlygin: Effect of electromagnetic centimetre waves on the central nervous system.

A. A. Grünberg and P. M. Filinov: The hydroxy compounds of quadrivalent platinum (1).

I. Preobraženskij: Tin-bearing granitoids of Borshchovochny Range, Eastern Transbaikalia.

V. V. Aršinov: The pocket mineralogical or polarizing magnifier.

K. L. Povolockaja: Vitamin C in germinating seeds.

A. G. Šestakov and A. P. Kačeev: Method of rapid determinations of chlorine in plants.

M. F. Ternovskij, M. I. Khmura and N. I. Zhukov: Inheritance of nicotine and anabasin in inter-specific hybrids with *Nicotiana glauca* Jr.

V. V. Butkevič: Soil temperature and the effect of fertilizers on the yield and quality of spring wheat.

M. M. Gogolašvili and N. A. Maximov: Effect of heteroauxin in the rooting of cuttings from subtropical wood.

A. Sereiskij and M. Sludskaja: Acceleration of the growth of seedlings and the accumulation of blastanin in the endosperm through the vernalization of spring and winter wheats.

T. T. Demidenko and V. P. Popov: Periods of absorption of nutrient substances by the sunflower plant in connexion with supplementary feeding.

V. P. Popov: (1) Influence of daily introductions of nitrogen and phosphorus on the storing-up of hydrophilic colloids in sugar beet. (2) Colloidal chemical composition of sugar beet as determined by the time of introduction of nutrient substances.

M. S. Jakovlev: The number of fibro-vascular bundles in the coleoptile of barley and oat.

K. T. Sukhorukov and O. B. Nataljina: The harmfulness of anthracnose of black currant.

I. Švajkovskij: Aerodynamic properties of insects.

A. A. Voitkevič: Morphogenetic activity of different parts of the hypophysis. (7) The growth-stimulating influence of the "eosinophilous zone" of anterior lobes of the hypophysis, and of other endocrine organs.

G. V. Boldovskij: Warm-water Euphausiidæ (Crustacea) of the Murman coast.

Tokyo

Imperial Academy (*Proc.*, **13**, No. 8, 1937).

Motokiti Kondô: Standardization of complementary analytics.

Sôichi Kakeya: Boundary values of analytic functions.

Sôichi Kakeya and Kinjiro Kunugi: A relation between the length of a plane curve and angles stretched by it.

Kôsaku Yosida: The exponential formula in the metrical complete ring.

Tetsuro Ikeda: Wearing of the micrometer screw of the Wanschaff zenith telescope. The wearing of the screw is due to the repelling force of the spring.

Mankiti Hasegawa and Yûiti Tamura: The regular progressive changes of the magnetic field in diurnal variations of terrestrial magnetism (1).

Shinkichi Yoshimura: Abnormal thermal stratifications of inland lakes. Three kinds of chemical stratifications are designated: (*a*) biochemical; (*b*) non-biochemical; (*c*) combined stratifications of biochemical and non-biochemical origin.

Rempei Goto: Positive ion emission from heated nickel wire in oxygen and hydrogen. Oxidized nickel wire heated in oxygen or hydrogen emits some positive ions.

Teikichi Fukushi: An insect vector of the dwarf disease of the rice plant. Another species of leafhopper, *Deltocephalus dorsalis* Motsch., is shown to be a vector of the disease.

Tsuneo Eguchi: Effects of the length of day upon time of differentiation of the flower bud and the subsequent development to flowering.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Monday, January 24

Engineers' Study Group on Economics (at 64 Great Cumberland Place, W.1), at 8.—Alexander Farquharson: "Frederick Le Play, Engineer and Sociologist".*

Royal Geographical Society, at 8.30.—Dr. C. von Furer-Haimendorf: "Journeys in the Naga Hills, Assam".

Thursday, January 27

Royal Society, at 4.30 p.m.—E. Gluckauf and Prof. F. A. Paneth: "Identification and Measurement of Helium formed in Beryllium by Gamma Rays".

J. W. J. Fay, E. Gluckauf and Prof. F. A. Paneth: "On the Occurrence of Helium in Beryls".

The Chemical Society (at the London School of Hygiene and Tropical Medicine), at 5.30.—Prof. Richard Kuhn: "Synthesis of Polyenes" (Pedler Lecture).

Friday, January 28

Geophysical Discussion (at the Royal Astronomical Society), at 4.30.—"The Montserrat Expedition" (Opener: Dr. C. F. Powell).

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Junior Scientific Officer at the Building Research Station, Garston—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (January 25. Quote J. 38/1).

Lecturer in Electrical Engineering in the Wolverhampton and Staffordshire Technical College—The Director of Education, North Street, Wolverhampton (January 27).

Heads of the Science and Engineering Departments of the South-West Essex Technical College—The Director of Education, County Offices, Chelmsford (January 31).

Assistant Lecturer in Entomology in the School of Tropical Medicine, Pembroke Place, Liverpool, 3—The Secretary (January 31)

Chief Physicist, an Applied Physicist, and a Colour Chemist to the Wool Industries Research Association, Torridon, Leeds, 6 (January 31).

Deputy Director of the Imperial Bureau of Dairy Science—Prof. H. D. Kay, National Institute for Research in Dairying, Shinfield, Reading (February 5).

Mycologist in the Plant Pathological Laboratory, Harpenden—The Secretary, Agricultural Research Council, 6A Dean's Yard Westminster, S W.1 (February 7).

Assistant Keeper in the Science Museum—The Director of the Science Museum, South Kensington, S.W 7 (February 14).

Chemist in the Geological Survey Department, Federated Malay States—The Director of Recruitment (Colonial Service), 8 Buckingham Gate, Westminster, S W.1 (February 15).

Scientific Assistant (veterinary) at the Field Station, Compton, Berkshire—The Secretary, Agricultural Research Council, 6A Dean's Yard, Westminster, S.W.1 (March 1).

James Watt Professor of Theory and Practice of Heat Engines in the University of Glasgow—The Secretary (March 1).

Civil Engineers in H.M. Naval Establishments—The Civil Engineer-in-Chief, Admiralty, S.W.1.

Abstractor from the Slavonic Languages at the Imperial Mycological Institute, Ferry Lane, Kew, Surrey—The Director.

Veterinary Research Officer in Palestine—The Director of Recruitment (Colonial Services), Colonial Office, 8 Buckingham Gate, S.W.1.

Resident Engineer (Civil and Building Construction) in H.M. Office of Works—The Chief Architect, Room 65A, Third Floor, H.M. Office of Works, Storey's Gate, S.W.1.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Association of Special Libraries and Information Bureaux Report of Proceedings of the Fourteenth Conference held at Gonville and Caius College, Cambridge, September 24th to 27th, 1937. Pp. 140 (London: Association of Special Libraries and Information Bureaux) 5*s.* [812

City of Leeds: College of Technology Report of the Principal, 1937. Pp. 27. (Leeds. College of Technology) [812

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia in 1936. Survey prepared by Dr. B P. Uvarov and Miss W. Milnthorpe. Pp. 55+9 maps. (London: H M. Stationery Office.) 3*s.* net. [812

Department of Scientific and Industrial Research Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research, for the Year 1936 Pp. vi+76+4 plates. (London. H.M. Stationery Office.) 1*s.* 6*d.* net. [1312

A List of Official Chemical Appointments. Compiled by direction of the Council of the Institute of Chemistry and under the supervision of the Publications Committee. Ninth edition, revised and enlarged. Pp 415. (London: Institute of Chemistry.) 5*s.* [1312

Royal Technical College, Glasgow. Annual Report on the One Hundred and Forty-first Session adopted at the Annual Meeting of Governors held on the 26th October, 1937. Pp. 93. (Glasgow: Royal Technical College.) [1312

P E P (Political and Economic Planning). Report on the British Health Services: a Survey of the Existing Health Services in Great Britain with Proposals for Future Development. Pp. iv+430. (London: P E P.) 7*s* 6*d.* net; cloth, 10*s* 6*d.* net. [1412

British Film Institute. Fourth Annual Report, Year ended 30th June, 1937, presented to the Annual General Meeting, 4th November 1937. Pp. 27. (London · British Film Institute.) [2212

National Smoke Abatement Society. Eighth Annual Report, 1937–8. Pp. 32. (London: National Smoke Abatement Society.) [51

Metropolitan Water Board Thirty-first Annual Report on the Results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months ended 31st December, 1936. By Lieut.-Colonel C H. H. Harold. Pp. 117. (London: P.S. King and Son, Ltd) 10*s.* 6*d.* [51

North-East Development Board. The Barytes, Fluorspar and Lead Resources in Upper Teesdale and Weardale. By Prof. Granville Poole. Pp. ii+10. (Newcastle-on-Tyne: North-East Development Board.) [51

Amgueddfa Genedlaethol Cymru · National Museum of Wales. Thirtieth Annual Report, 1936–37, presented by the Council to the Court of Governors on the 22nd October, 1937. Pp. 48. (Cardiff · National Museum of Wales.) [51

The Examination of Colliery Ropes in Service. Pp. 37. (London: H.M. Stationery Office.) 3*d.* net. [51

Huddersfield Technical College. Report of the Principal, 1936–37 Pp. 8+8+2+3 (Huddersfield: Technical College.) [51

University of Cambridge: School of Agriculture. Memoir No. 9 A Brief Summary of the Papers published by the Staffs of the School of Agriculture and its Associated Research Institutes during the Period October 1st, 1936—September 30th, 1937. Pp 48. (Cambridge: School of Agriculture.) 1*s.* net. [51

University of Bristol Annual Report of Council to Court, 1936–37 Pp. 64. (Bristol: The University.) [51

Other Countries

Det Kongelige Departement for Handel, Sjøfart, Industri, Håndverk og Fiskeri: Norges Svalbard- og Ishavs-Undersøkelser. Meddelelse Nr. 35 · On Fault Lines indicated by the Submarine Relief in the Shelf Area West of Spitsbergen. By Olaf Holtedahl. Pp. 8. Meddelelse Nr 36: Periodiske vekslinger i småviltbestanden. Av J. Baashuus-Jessen (With Summary in English) Pp 15. Meddelelse Nr 37: Norges Svalbard- og Ishavs-Undersøkelsers ekspedisjoner til Øst-Grønland og Svalbard, året 1936. Av Anders K Orvin. Pp. 13. Meddelelse Nr. 38: Kaptein Ragnvald Knudsons ishavsferder; Sammenarbeidet efter hans dagbøker, rapporter m v. Pp. 137. Meddelelse Nr. 39: Grønlandske distriktsbeskrivelser forfattet av nordmenn før 1814. Utgitt av H Ostermann. Pp. iii+156. Skrifter om Svalbard og Ishavet, Nr. 18 Das Festungsprofil auf Spitzbergen; Karbon-Kreide. Von Adolf Hoel und Anders K Orvin. 1: Vermessungsresultate. Pp. 59+5 plates 4 00 kr. Skrifter om Svalbard og Ishavet, Nr. 68: Das Festungsprofil auf Spitzbergen. 3: Stratigraphie und Fauna des Jura und der Unterkreide. Von Hans Frebold und E. Stoll. Pp. 85. 5.50 kr. Skrifter om Svalbard og Ishavet, Nr. 69 · Das Festungsprofil auf Spitzbergen. 4: Die Brachiopoden- und Lamellibranciatenfauna und die Stratigraphie des Oberkarbons und Unterperms, nebst Beschreibung anderer Verkommen in Svalbard. Von Hans Frebold. Pp. 94+11 plates. 10.00 kr. Skrifter om Svalbard og Ishavet, Nr. 70: Lichens from Southeast Greenland. Collected chiefly by Dr. P. F. Scholander in 1932 during the Norwegian Expedition in the S.S *Polaris.* By Eilif Dahl, B. Lynge and P. F. Scholander. Pp. 76+2 plates. 4.50 kr. (Oslo. Jacob Dybwad.) [812

Cornell University. Agricultural Experiment Station. Bulletin 674: An Economic Study of Land Utilization in Steuben County, New York. By W E. Keepper. Pp. 46. Bulletin 675: An Economic Study of Land Utilization in Rensselaer County, New York. By R. S. Beck. Pp. 41. Bulletin 678: Asparagus Fertilizer Experiment on Long Island. By P. H. Wessels and H. C. Thompson. Pp. 16 Memoir No. 205 · Aquatic Diptera. Part 3: Chironomidae; subfamilies Tanypodinae, Diamesinae and Orthocladiinae. By O. A. Johannsen. Pp. 84+18 plates. Memoir 206: Loss of Plant Nutrients from Peat Soil By B. D. Wilson and E. V. Staker. Pp 16. (Ithaca, N.Y.: Cornell University) [812

Bergens Museums Årbok 1937. Naturvidenskapelig rekke. Heft 1. Pp. 138. Heft 2. Pp. 152+6 plates. Bergens Museum. Årsberetning 1936–37. Pp 99. (Bergen: A/S John Griegs Boktrykkeri.) [812

New Zealand Eleventh Annual Report of the Department of Scientific and Industrial Research. Pp. 147+5 plates. (Wellington: Government Printer.) 3*s.* 6*d.* [812

Colony of Mauritius. Annual Report of the Royal Alfred Observatory for the Year 1936. Pp. 8 (Port Louis: Government Printer) [812

Annuario della Pontificia Accademia delle Scienze. 1: 1936–1937. Pp. lxxxix+809+38+87 plates. (Città del Vaticano: Pontificia Accademia delle Scienze.) [812

U.S. Department of the Interior. Geological Survey. Bulletin 847–E: Geology and Mineral Resources of the Western Part of the Arkansas Coal Field. By T. A. Hendricks and Bryan Parks. (Contributions to Economic Geology, 1934–36.) Pp. iv+189–224+plate 35. 25 cents. Bulletin 847–F · Geology and Mineral Resources of North-Central Chouteau, Western Hill and Eastern Liberty Counties, Montana. By W. G. Pierce and C. B Hunt. (Contributions to Economic Geology, 1934–36.) Pp. iv+225–264+plates 36–43. 35 cents. Bulletin 883–A: Spirit Leveling in Texas. Part 1: Western Texas, 1896–1935. By J. G. Staack. Pp ii+50. 10 cents Bulletin 886–B · Geologic Factors in the Interpretation of Fluorspar Reserves in the Illinois-Kentucky Field. By L. W. Currier. (Contributions to Economic Geology, 1937.) Pp. ii+5–14. 5 cents. (Washington, D.C.: Government Printing Office) [912

Geological Survey of Nigeria. Bulletin No. 16 · The Technique of Well Sinking in Nigeria. By H. A. Cochran. Pp 63+9 plates. (Lagos: Government Printer.) 7*s.* 6*d.* net. [1312

U.S. Department of the Interior: Geological Survey. Bulletin 875: Nonmetallic Mineral Resources of Eastern Oregon. By Bernard N. Moore Pp. viii+180+16 plates 30 cents Bulletin 887 · Geophysical Abstracts 87, July–December, 1936 Compiled by W. Ayvazoglou. Pp. ii+98. 15 cents. Professional Paper 186–B: Fossil Flora of the Wedington Sandstone Member of the Fayetteville Shale. By David White. (Shorter Contributions to General Geology, 1936.) Pp ii+13–41+plates 4–9. 10 cents. Professional Paper 186–J: Additions to some Fossil Floras of the Western United States. By Roland W. Brown. (Shorter Contributions to General Geology, 1936.) Pp ii+163–206+plates 45–63. 20 cents. Professional Paper 186–M. A Redescription of Ferdinand Roemer's Paleozoic Types from Texas. By Josiah Bridge and George H. Girty. (Shorter Contributions to General Geology, 1936.) Pp ii+239–271+plates 66–70 10 cents. Water-Supply Paper 781: Surface Water Supply of the United States, 1935. Part 1 · North Atlantic Slope Basins. Pp. 421. 50 cents. Water-Supply Paper 782: Surface Water Supply of the United States, 1935. Part 2 · South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. 233 30 cents. Water-Supply Paper 783: Surface Water Supply of the United States, 1935. Part 3: Ohio River Basin. Pp. 400. 45 cents. Water-Supply Paper 792: Surface Water Supply of the United States, 1935. Part 12: Pacific Slope Basins in Washington and Upper Columbia River Basins Pp. 166. 25 cents. Water-Supply Paper 796–A: Methods of Locating Salt-Water Leaks in Water Wells. By Penn Livingston and Walter Lynch (Contributions to the Hydrology of the United States, 1937.) Pp. ii+20+9 plates. 10 cents. Water-Supply Paper 796–B: Flood on Republican and Kansas Rivers, May and June, 1935 By Robert Follansbee and J. B Spiegel (Contributions to the Hydrology of the United States, 1937.) Pp. ii+21–52+plates 10–15. 15 cents. (Washington, D.C. Government Printing Office.) [1312

Osiris · Studies on the History and Philosophy of Science, and on the History of Learning and Culture. Edited by George Sarton. Vol. 3. Dedicated to Edmund O. v. Lippmann, Historian of Chemistry. Part 1. Pp. 404. (Bruges: St. Catherine Press, Ltd.) [31

Educational Yearbook of the International Institute of Teachers College, Columbia University, 1937. Edited by Prof. I. L. Kandel. Pp. xv+583. (New York: Columbia University.) 3.70 dollars. [41

Bulletin of the National Research Council. No. 101 · Handbook of Scientific and Technical Societies and Institutions of the United States and Canada. Third edition. United States Section compiled by Callie Hull; Canadian Section compiled by S. J Cook and E. R. Berry. Pp. 283. (Washington, D.C.: National Academy of Sciences) 3.50 dollars. [41

Report on the Administration of the Meteorological Department of the Government of India in 1936–37. Pp. iii+46. (Delhi: Manager of Publications.) 14 annas; 1*s.* 6*d.* [51

Indian Forest Records (New Series). Vol. 2, No. 6: The Formation of Heartwood and its Amount in Deodar Timber. By M. A. Kakazai. Pp. v+223–257+6 plates. 2.4 rupees; 4*s.* Vol. 3, No 3. New *Crossotarsus* (Platypodidae, Col.). By C. F. C. Beeson. Pp. ii+49–103. 1 14 rupees; 3*s.* 3*d.* (Delhi: Manager of Publications.) [51

Department of Agriculture, Cyprus. A First List of Cyprus Fungi. By R. M. Nattrass. Pp. xvi+87. (Nicosia: Department of Agriculture.) 2*s.* [51

Nigeria. Annual Report on the Geological Survey Department, 1936. Pp. ii+27+6 plates. (Lagos: Government Printer; London: Crown Agents for the Colonies) 2*s.* 6*d.* (51

Catalogues, etc.

Catalogue of Important Works on Botany, Zoology, etc. (No. 24). (London: John H. Knowles.)

Quickfit Interchangeable Laboratory Glassware. Pp. 70. (London: Quickfit and Quartz, Ltd.)

Calendar for 1938. (Belgrade: Anglo-Yugoslav Review.)

Latest British Analytical Balances. (Pamphlet No. 285A.) Pp. 4. Graduated Glassware to British Standard Specifications. (Circular No. 322) Pp. 2. (London: A. Gallenkamp and Co., Ltd.)

Price List of Fine Chemicals for Analytical, Pharmaceutical, Photographic, Research and Technical Purposes; Standard Stains and Indicators. Pp. 108 (London: Hopkin and Williams, Ltd.)

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Ethnographical Museums and Empire

IN a lecture delivered recently before a joint meeting of the Royal Society of Arts and the India Society by Mr. J. de La Valette (*see* NATURE, Dec. 25, p. 1108) attention was directed to the work of the museums of Holland in promoting the study of the indigenous cultures of the Dutch possessions in Indonesia, and their aim of making familiar to the Dutch people the conditions of native life in these remote parts of the world, for the administration of which they themselves are ultimately responsible. In its broader aspect the problem with which those who have organized these museums have been confronted is one obviously of special interest to Great Britain, where there is a like need for general understanding of alien peoples and cultures under one and the same ***imperium***, but on a vastly extended scale.

Mr. de La Valette pointed out that in their method of approach to the problem of the arrangement and organization of an ethnographical museum demonstrating the mode of life of their dependencies, the Dutch are in harmony with the modern tendency towards a 'humanism' in anthropological studies, in which the various disciplines of the study of man—ethnology, physical anthropology, archæology, history and the like—set apart for academic purposes in the past, are once more brought together and focused on the study of a single integrated group or culture. Man, his works and his environment, are thus studied as a single and unified whole and not in water-tight compartments. Mr. de La Valette then went on to contrast with these methods the antiquated procedure, as he sees it, of the museums of Great Britain; he admitted that they are unrivalled in the extent and variety of their collections, but, he maintained, dominated by a Victorian tradition of specimen-collecting and a passion for classificatory arrangement, which sterilizes them of all life and meaning in relation to the cultural history of man in its specific manifestations.

In directing attention to the merits of this regional or unitary method of museum organization in ethnographical studies, in which the whole life of a group is displayed as a rounded whole, Mr. de La Valette raised a question to which in its wide ramifications it is difficult to set limits of discussion. He was also in the strong tactical position of addressing an audience the interests of which in the main were directed to a single area, India—which is none the less concentrated though it is a sub-continent comprising not one but many ethnic, cultural and regional units. On the general question, however, this much may be said. In so far as the aim of the Dutch museums has been to bring home to their people an understanding of the life of their subject populations by intensive illustration, it is in accord with anthropological opinion in Great Britain, where the advantage to the British people of an ethnographical museum demonstrating the life and modes of thought of the peoples of alien culture of the dominions and dependencies has long been urged. Close on forty years ago Mr. (later Sir) Hercules Read, keeper of the Ethnographical Department of the British Museum, advocated in the strongest terms the establishment of an Imperial Bureau of Anthropology in connexion with his department, and time and again since then the need of an imperial ethnographical museum has been urged as the best, if perhaps not the only, means of promoting an educated interest among the general public in our dependent and fellow-subjects of culture other than our own.

While it is probable that there would be no two opinions as to the desirability, not to say the urgency, of establishing an imperial ethnographical museum, the choice of method of arrangement and organization is not without its difficulties. There can be no question that in so far as these should be determined by the instructional aim, the regional and unitary method of display is ideal. Practical considerations, however, have to be taken into account; and whereas in Holland the problem has proved open to solution, in dealing with the native peoples of the British Empire provision would have to be made for a very different set of conditions. The Dutch possessions in Indonesia cover an environment limited in range; the cultures and ethnic groups relatively are neither numerous nor on the whole widely diverse in character. In the British dominions, on the other hand, the range in environment, in ethnic and cultural contrast, is world-wide. As a concrete proposal a scheme of intensive display, such as has been introduced in Holland, on a scale commensurate to the British Empire, would be wrecked at its inception by financial considerations alone. On the other hand, there is no adequate reason why certain larger units such as Africa and India, which lend themselves to a modified unitary treatment, should not receive special consideration and be the subject of intensive display.

Curators of existing collections in Great Britain will no doubt have received Mr. de La Valette's criticisms with very mixed feelings. They themselves are their sternest critics, and not all are wedded to tradition. But the museum curator, perhaps more than any other research worker, is firmly circumscribed by conditions; and the history and character of the collections, as well as the space available, limit the freedom with which problems in display may be solved.

Notwithstanding the aspersion of specimen-collecting cast upon our museums, it must be remembered that many of the exhibits are of historic interest in themselves as commemorative of early exploration, and could not be withdrawn from exhibition without loss of interest. Such, for example, are many exhibits from the Pacific in the British Museum, especially those acquired by Capt. Cook, or some of the early material from America. This brings us to the most serious point in Mr. de La Valette's indictment of museum policy in Great Britain. He alludes to a proposal to break up and distribute among other institutions in South Kensington the collections which, as the Indian Museum, form part of the Victoria and Albert Museum. These collections have as their nucleus the historic collection which belonged to the Honourable East India Company, a collection which embodies a stirring page in British history. Becoming the property of the Government after the Mutiny, it was transferred in 1870 to the Science and Art Department, later absorbed in the Board of Education when that body was formed. It thus became part of the Victoria and Albert Museum. Recently, under a new curator, Mr. K. de B. Codrington, the collections have undergone, or rather are undergoing, a process of rearrangement and selection, which departs from the æsthetic prepossession of the major collection in favour of a grouping of interests to give as full and as educative a picture as possible of India's national culture as a whole in its historical and geographical setting. Consternation aroused by this proposal to destroy what all who have examined it with any care must agree is a brilliant essay in museum arrangement on scientific and educational lines, has to some extent been allayed by an assurance received by Sir Francis Younghusband, as president of the India Society, that the collections will not be distributed, but will remain as a part of the Victoria and Albert Museum.

Satisfactory as this may seem, it is questionable whether it goes far enough. Is it to be assumed that provision will be made for the expansion which will be necessary to carry out fully the scheme now in progress of development? Unless the present divorce of antiquity from historic times is to continue, it is difficult to see how adequate provision for a satisfactory display of Indian culture can be made short of a much enlarged museum. For not only are the antiquities of the original collections, including many valuable examples of early Buddhist art, still housed at the British Museum, although the property not of the trustees of that institution, but of the Secretary of State for India, but also the span of time to be covered now goes back to the beginning of the third millennium B.C. in the civilization of the Indus valley. Further, geographically, Indian cultural study now leaps the barrier of boundaries to extend half over Asia, from Irak to Central Asia, China, Japan, Further India and Indonesia, so far as Bali and distant Celebes. The material available in the national collections—the Aurel Stein collections from Central Asia alone are unique as documentary evidence for the spread of Buddhist art and Indian influence—if brought together under one roof, would demonstrate

Indian culture in a manner possible nowhere else among the collections of the world, even in India itself.

On the grounds of public policy, the formation of a museum of Indian life and culture cannot be too strongly urged. Now that the bonds of Empire have become tenuous indeed, we hold India by a thread. But impalpable bonds, as has been shown by the visit of the British Association delegation to the jubilee meeting of the Indian Science Congress Association this month, can be made stronger than any material force. To the degree in which our future policy towards India is rooted in an understanding of Indian aspirations on the part of the British people, the greater the strength of the bond that will hold this great country within the Empire. A great Indian cultural museum would certainly contribute the major part to such an understanding. It would show that whatever the differences between the two peoples may be, to India belongs a civilization older than our own, which in art and intellectual accomplishment has been in no way our inferior, while in Buddhism it has produced a creed which more nearly than any other in the world's history approaches the way of life inculcated by Christianity.

Principles of Biological Control

The Biological Control of an Insect in Fiji
An Account of the Coconut Leaf-mining Beetle and its Parasite Complex. By T. H. C. Taylor. Pp. 239 + 23 plates. (London: Imperial Institute of Entomology, 1937.) n.p.

WORKERS in the field of applied science are often reproached by their academic colleagues engaged in pure science with their failure to publish their methods and results and with the sketchy and inadequate character of what they do publish. This complaint is based, to some extent at least, on a misunderstanding of the object of applied science, which is not, primarily, the discovery of truth, but simply the production of facts. We call in the medical man to cure our rheumatism, and the builder to put up our house. We do not expect them to write monographs on these subjects, and we should feel rather dissatisfied if we found that they were doing this instead of getting on with the job for which we paid them. A certain continuous pressure brought to bear on the economic worker often prevents him effectively from exploiting the scientific by-products of his work; and in some cases this pressure is probably both necessary and justifiable.

On the other hand, it is clear that there are vast fields of applied science in which such effective practical rules as have been worked out in medicine and bricklaying do not yet exist, where almost every conceivable practical operation is at the same time a scientific experiment, on the result of which further progress depends. In such cases, it may be impossible to draw any lesson from the work done unless the methods used and the consequence of resultant events are recorded in detail. Furthermore, though there is not necessarily any connexion between the power of doing something well and the ability to explain how it is done, it does seem that, for the full comprehension of data, explanation carried to the point of actual exposition is highly desirable. Writing up our facts for publication helps us to realize not only what we know, but also, and even more important, what we do not know.

Work on the biological control of insect pests, which is applied entomology of the most difficult and complex description, has suffered a good deal in the past, and still suffers, from the fact that scientific analysis has not kept pace with practical experiment. Great operations have been carried out in certain parts of the world of which we can scarcely say whether they have succeeded or failed, to say nothing of specifying the reasons for failure and success. Attempts have been made in recent years to deal with some of the problems of biological control by mathematical methods; but, interesting and suggestive as they are, it is only too obvious that they can never replace the observation of actual events and indeed, the investigations carried out by workers like Salt, Lloyd, Ullyett, Walker and others on the problem of host selection have made amply clear the defects of the concepts embodied in the basic equations of our mathematical theories. Fundamental work on a large scale is urgently required and although, as was pointed out in NATURE of February 20, 1937 (p. 304), the authorities concerned with operations in biological control in the British Empire have not yet provided for it, satisfactory progress cannot be made until the need is met.

In these circumstances, we feel sure that every student of biological control will heartily welcome Dr. T. H. C. Taylor's fascinating monograph on the successful control, by parasite introduction, of the coco-nut leaf-mining beetle in Fiji. Dr. Taylor was one of the entomologists associated with Dr. J. D. Tothill in the brilliantly successful work he carried out in Fiji on the coco-nut moth. These entomologists have consistently adhered to the practice, which we are here advocating, of exploiting the scientific aspect of their problems to the full, so that they and all the other workers in the field have not merely the satisfaction of a spectacular success, but also a reasonable explanation of how it has been obtained.

The subject of Dr. Taylor's work is the leaf-mining hispid beetle, *Promecotheca reichei* Baly., which is injurious to coco-nuts in Fiji, Samoa, Tonga and some of the intermediate islands. It is attacked in its native home by a number of natural enemies which, in normal circumstances, are able to keep the pest under control. In comparatively recent years, however, this natural equilibrium has been disturbed owing to the accidental introduction of the well-known parasitic mite *Pediculoides ventricosus*. This mite is able, under favourable conditions, to destroy a very large proportion of the hispids ; but it is unable to maintain permanent control. The actual outcome of its work is to produce gaps in the sequence of host material of such a character that the original native parasites suffer severely and outbreaks of a very serious character occur. The practical problem, then, was to find in some other areas parasites capable of reproducing on *Promecotheca* and able to bring it under control in the abnormal condition created by the mite *Pediculoides*. Dr. Taylor's account of the attack on this extraordinary problem, which was eventually solved by the introduction of a chalcid parasite found on other leaf-mining hispids in Java, is of great theoretical and practical interest and contains a mass of valuable and illuminating observations on the biology and interrelations of the various species involved.

A few minor criticisms may be made. The work is adorned with a large number of beautiful and costly plates, the like of which few entomologists are able to secure for their papers in these days ; but the anatomical details there represented, though perhaps sufficient for the purposes of their particular problem, are, according to our modern standards, inadequate. In some cases, Dr. Taylor's account of events, though highly interesting and plausible, rather fails to produce complete conviction, because the basic numerical data have not been exhibited in sufficient detail. At one point (p. 16), he gives a surprisingly full account of the variation in the *Promecotheca* population before the advent of the white man in the islands, which the present writer found a little staggering. The suggestion (p. 204) that the limited quantity or unusual quality of the food of parasite larvæ "causes them to become male by a process in the nature of castration" also requires amplification.

In regard to this and other matters the author shows signs of isolation from other workers due partly no doubt to the circumstances of his work and the habit engendered by it of doing everything single-handed. We think, also, that his paper could have been compressed with advantage. Nevertheless, it is, as it stands, a highly original and stimulating monograph, and a striking example of what individual effort can accomplish as against mere mass organization.

A Statistical Survey of the Stellar Universe

Lehrbuch der Stellarstatistik
Von Prof. Dr. E. v. d. Pahlen. Unter Mitwirkung von Dr. F. Gondolatsch. Pp. xvi + 934. (Leipzig: Johann Ambrosius Barth, 1937.) 96 gold marks.

THE title of this book gives a rather bald impression of its contents, and we may be permitted to amplify it into "the spatial and dynamical structure of the stellar universe, based on the observed statistics of stellar magnitudes, spectra, masses and motions". Our first word must be one of welcome for this encyclopædic volume. If we leave out of consideration the relevant portions of the "Handbuch der Astrophysik" (a work in which there is considerable, but excusably unavoidable, overlapping, due, of course, to the different predilections and points of view of the several experts concerned) the present volume is the first systematic treatment of the subject since Eddington's classic "Stellar Movements and the Structure of the Universe" was published nearly a quarter of a century ago. When we consider the immense amount of observational and theoretical investigations during the last two decades, it is indeed surprising that an attempt has not been made before this to gather into a coherent whole the researches of a multitude of workers in this important field.

Dr. v. d. Pahlen's general mode of treatment is the historical, and the principal contributions to the several sections are described in roughly chronological order. There is a lot to be said for this procedure, but, on the other hand, the magnitude of the book tends to become of almost astronomical dimensions, and this may well prove a real defect so far as its circulation in astronomical circles is concerned. Again, the author's thoroughness in dealing with his subject is commendable, but, to a large extent, it is unnecessary, especially in the earlier stages; it is scarcely likely that the reader of the book will be wholly unacquainted with the elementary principles of astronomy, such as the measurement of right ascension and the classification of spectra—to take only two examples. Our view is that the book is, in the first instance, a specialist's book and, in the second, a work of reference; accordingly, we feel that its value would have been greatly enhanced by a judicious—and, in some places, a severe—pruning of elementary and other topics that are dealt with in more general publications.

It is scarcely possible to give, within the compass of this review, more than a rough sketch of the contents. The first part—amounting to a little less than one sixth of the whole volume—is concerned with the mathematical development of statistical theory and, in particular, with the discussion of normal and skew frequency functions and the theory of correlation. This section had been written by Dr. Hufnagel, whose death, five years ago, deprived Dr. v. d. Pahlen of an experienced collaborator almost at the outset of the project the fruition of which is seen in the present volume. It may be interpolated here that three chapters in later parts of the book—amounting to about 130 pages in all—are from the pen of Dr. F. Gondolatsch of the Recheninstitut, Berlin-Dahlem. The mathematical methods developed in the section under consideration bear the impress of the influence of the Lund school and, in particular, of the late Prof. Charlier; the section is a clear and comprehensive exposition of the subject as formulated. It is to be remarked, however, that the plan of systematic comprehensiveness has partially broken down here, as the theory of combining observations according to well-known methods—such as we find in the solar motion problem, to take a simple instance—is omitted.

The second part of the volume, amounting to two hundred pages, deals with the observational side of the subject, namely, the determination of such stellar characteristics as position, proper motion, radial velocity, brightness, colour, spectrum and parallax. This is one of the sections where the reviewer's earlier criticism applies in considerable measure. However, apart from this, the author has done his work exceedingly well, and the reader will find all the information about past and modern observational practices that he is likely to require. In the latter pages of this section the usual methods of deriving statistical parallaxes are developed in full; the work of Kapteyn and van Rhijn in this interesting field is described at length and correlated with the theoretical formulæ derived about a quarter of a century ago by Schwarzschild. An omission of theoretical and of some practical importance concerns the effect of the well-known systematic motions of the stars on the mean parallaxes derived according to the methods described.

The third, and the longest, section of the work is concerned with the space distribution of the stars. Numerous investigations on this subject depend on an initial assumption as to the mathematical form of the stellar density function, with or without a further assumption as to the law governing the distribution of the absolute magnitudes of the stars investigated. This mode of procedure is dictated by the fact that our knowledge of stellar distances, as determined by direct or ancillary methods, stops short at a comparatively trifling distance from the sun. On the other hand, the apparent magnitudes of the stars can be determined easily and accurately. In general, apparent magnitude is not a completely satisfactory criterion of distance, but, with the stars segregated according to colour-index, statistical investigations based on counts of stars of different apparent magnitudes are of undoubted value in giving us reasonably trustworthy information as to the structure of the stellar system. A second line of attack is based on the observed proper motions of the stars; it may be remarked that proper motion is a much better criterion of distance than apparent magnitude. The author gives also a full account of the methods based on Schwarzschild's integral equations. Within the last ten years, a serious complication to the statistical methods has been introduced by the discovery of well-marked galactic absorption—in this connexion Trumpler's investigation of open clusters may be mentioned as placing beyond doubt the existence of a comparatively thin absorbing layer in the equatorial plane of the galaxy. The author describes fully and successfully most of the fundamental investigations carried out within recent years, with commendable emphasis on the present situation as created by the discovery of galactic absorption.

The fourth and final part of the volume deals with the kinematics and dynamics of the stellar system. It may be noted in passing that there is a certain amount of unnecessary reiteration in connexion with the solar motion. Kapteyn's two-streams theory and Schwarzschild's ellipsoidal hypothesis concerning the systematic motions of the stars are treated fully. Schwarzschild's original papers are not readily accessible and the detailed account of his methods as presented by Dr. v. d. Pahlen will be welcomed. Of the two mathematical formulations of the systematic motions of the stars, Schwarzschild's is the more convenient, from the analytical point of view, in theoretical investigations in stellar dynamics, a subject which has received an increasing amount of attention during the last decade, on both the observational and the mathematical sides. The author gives a good, though not quite complete, account of the researches in this field. The theories of galactic rotation associated with the names of Oort and Lindblad are described at length, and the observational material patiently gathered in recent years has been summarized in tabular form.

Dr. v. d. Pahlen is to be heartily congratulated on completing this authoritative volume, which will prove indispensable to present and future workers in the field surveyed.

W. M. S.

Asiatic Yams

An Account of the Genus Dioscorea in the East Part 1: The Species which Twine to the Left. By D. Prain and I. H. Burkill. (*Annals of the Royal Botanic Garden, Calcutta*, 14, Part 1.) Pp. 210 + vi 91 Plates. (Alipore: Bengal Government Press, 1936.) 75 Rs.; £5 13*s*.

THE yam, the tuber of various species of *Dioscorea*, is a staple food in the tropics and commonly cultivated, especially in India, Malaya and tropical Africa. The two volumes under notice, which maintain the excellence of production of the *Annals of the Royal Botanical Garden, Calcutta*, form the first part of an account of the Oriental species by two eminent botanists who, by thirty years of careful investigation, have specially qualified for the task.

The genus is a large one and has been the subject of monographs by previous botanists, who, however, have had at their disposal mainly herbarium material. The origin of the present monograph dates from the difficulties experienced by the late Sir Joseph Hooker when revising the genus for the "Flora of British India", and by the late Sir George Watt in his efforts to elucidate the cultivated species for his "Dictionary of the Economic Products of India". Hooker, in 1892, found the species in a state of indescribable confusion, and the food-yielding species for the most part indeterminable. He begged Watt and Sir George King, then in charge of the Calcutta Garden, to grow, not only all the food-yielding forms, but also as many of the uncultivated species as could be procured. In 1898, on King's retirement, the collaboration devolved on Sir David Prain, his successor, and in 1901 Mr. Burkill took over from Watt. When the senior author left India in 1904, Mr. Burkill continued the systematic study of the living material in cultivation in the Garden, and when transferred to Singapore in 1912 extended his study to species outside the limits of India. Since his return to England in 1925, he has continued his work at Kew. Material has also been examined in or from all the important herbaria at home and abroad.

Part 1 includes the species that climb to the left, comprising nine of the ten sections into which the authors divide the genus. Part 2 includes the species that climb to the right, that is the large section *Enantiophyllum*, and also a tabulated account of the distribution of the species, a phytogeographical review and the history of the various collections that have been studied. Text and plates are already in print and these should appear shortly.

The authors, for sake of completeness, have included the very rare Pyrenean species *D. pyrenaica*, the sole representative of the anomalous section *Borderea*, a dwarf, non-climbing plant which in some characters recalls the temperate Old World genus *Tamus*—the black bryony of our hedges; also two species respectively from the Balkans and the Caucasus that are allied to oriental species.

The ten sections under which the species are grouped represent an arrangement differing from those of previous monographers, which are critically examined by the authors. Thirty years' experience of cultivating the oriental species indicates that the subgenera recognized by E. B. Uline in the "Pflanzenfamilien" (1897) and by R. Knuth in the "Pflanzenreich" (1924) should be discarded.

The general description includes a study of the formation of the food-storage organ—tuber, rhizome or corm—by which the plant persists from season to season and which supplies prime characters for the construction of groups of sections. Opinions have differed as to the morphology of the tuber, which has been regarded as a root structure, or by Goebel as an organ *sui generis* combining the characters of root and shoot. The authors, however, are convinced that it is a stem structure.

The form of the leaf shows great variety on a simple cordate type, but in two sections palmately compound leaves occur. The male flowers, capsule and seed also afford distinctive characters.

Seventy-six species are recognized, and the thoroughness of the work is indicated by the very large proportion that have been described by the authors in the course of their studies. Synonymy is given in full and expresses the confusion to which Hooker referred, dating back sometimes to Linnæus himself. The species are very unequally distributed among the sections; elaborate keys are supplied for their identification. Each species is described at length and each description is admirably supplemented by a plate which, whenever possible, includes details of form of the storage organ, together with figures of leaf, flower and fruit. Dialect names are discussed, and economic uses, mainly as food, for which often careful preparation is required that poisons may be removed which have also economic uses. Geographical distribution is given in very great detail, and every specimen examined is cited.

The production of the plates, which suggests a crayon drawing, is pleasing. Some are by native artists, others by the late Matilda Smith of Kew and others by Mr. Burkill himself. There are also five plates of maps indicating the geographical regions recognized and the distribution of the individual species. The financial aid of the Bentham-Moxon fund towards the production of the plates is acknowledged.

Theory of Fourier Integrals

Introduction to the Theory of Fourier Integrals
By Prof. E. C. Titchmarsh Pp. x + 390. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 17*s*. 6*d*. net.

SINCE the publication of Prof. Zygmund's "Trigonometric Series" in 1935, there has been considerable demand for another book dealing with trigonometric integrals. Prof. Titchmarsh's book meets this demand. He is already well known to students of mathematics by his text-book on the theory of functions, and his new book comes up to the high standard of the former.

After two more or less introductory chapters, Prof. Titchmarsh devotes a chapter to the theory of Fourier transforms in the class L^2, that is, the class of all functions whose squares are integrable in the Lebesgue sense. This is undoubtedly the most important part of the subject. The theory centres round a very beautiful theorem due to Plancherel, which asserts that every function (x) of Lf^2 has a Fourier transform $g(x)$ also in the class L^2 and

$$\int_{-\infty}^{\infty} \{g(x)\}^2\,dx = \int_{-\infty}^{\infty} \{f(x)\}^2\,dx.$$

Plancherel's original proof was published in 1910, and since then other proofs have been given by various writers. Prof. Titchmarsh gives four of these proofs, including Nobert Wiener's very interesting proof, of which the chief feature is the use made of the Hermite polynomials.

The Lebesgue theory of integration is fundamental in all this work, and in reading this chapter no one can fail to be impressed by the tremendous amount which the theory of Fourier integrals and mathematics generally owes to Lebesgue's definition of the integral.

The chapter on Fourier transforms in L^1 is followed by another on transforms in L^p. The symmetry which exists in L^2 is of course lost in other Lebesgue classes. There are, however, analogues for most theorems. Among the other topics treated may be mentioned the general theory of transforms and the theory of conjugate functions. The last two chapters are devoted to applications to the solution of differential equations and integral equations respectively. In the latter chapter, examples are given of the use of Fourier transform methods in the theory of probability and statistical dynamics. The book concludes with a long bibliography.

Prof. Titchmarsh is to be very warmly congratulated on his book. As the title implies, it is primarily an introduction to the subject and does not cover the whole field. The author has not attempted to give an account of all the recent developments, especially the more specialized ones. Those who wish to pursue the subject further can refer to Wiener's "Fourier Integral", Boehner's "Vorlesungen über Fouriersche integrale" and, above all, Paley and Wiener's, "The Fourier Integral in the Complex Domain". Fourier integrals have much in common with Fourier series, and this subject has been very adequately treated in Zygmund's book, to which reference has already been made.

The book under notice is probably of more interest to analysts than to applied mathematicians, but the latter might find much that interests them. No one should be put off by the Lebesgue theory of integration, as it is only necessary to know a few of the properties of the integral, especially those concerning strong convergence. The book contains a sufficient number of examples, including applications to mathematical physics, to illustrate the scope of the methods. A. C. OFFORD.

Raum oder Zahl?

Von Cl. H. Tietjen. (Schule im Aufbau aus volkischer Wirklichkeit, herausgegeben von Cl. H. Tietjen, Band 6.) Pp. 51 + 4 plates. (Leipzig: Friedrich Brandstetter, 1936.) 1.59 gold marks.

SPACE or number? Is the infant intelligence to be inclined towards mathematics by curiosity about shapes and patterns, or do we perceive that there are as many oranges as apples before we recognize a common quality of roundness? Artificial questions, we may think, but at least we take for granted that they are questions for the psychologist. It seems that we are wrong. According to a work which claims the support of the German Ministry of Education, they are questions of immense importance, and questions for the ethnologist and the politician. Fortunately the answers in Germany at least are perfectly definite, for the alternative, space or number, is the same as the alternative, German or Jew.

The Nordic race has a native feeling for space, which it is the duty of every teacher to foster, and German children, from their earliest years, must be protected from the logic which curses the mathematics of the Latin and Semitic peoples. Even the application of numbers to geometry is a danger, for we cannot report the direction of approach of hostile aircraft in terms of Cartesian co-ordinates, and the only hope of safety for a nation to-day is that every member of it should be a competent military observer. It is true that even altazimuth observations are a kind of measurement; fortunately their use is not a development from analytical geometry or a debt to Asia, for it is implicit in the most rudimentary astronomy, and it is intuitively certain that the regular movements of the heavenly bodies were studied and understood by the German inhabitants of the north of Europe long before the rise of Chaldæan civilization. So now we know. E. H. N.

Faune de France

31: Homoptères auchénorhynques, 1 (Typhlocybidæ). Par Prof. H. Ribaut. (Fédération française des Sociétés de Sciences naturelles: Office centrale de Faunistique.) Pp. 230. (Paris: Paul Lechevalier et fils, 1936.) 60 francs.

THE advent of the present part of the "Faune de France" series will be welcomed by all students of Hemiptera. It deals with leaf-hoppers of the group Typhlocybidæ, which are often difficult to identify, and much confusion has existed with regard to certain of its members. Although more usually classified as a group of the Jassidæ, M. Ribaut separates the Typhlocybidæ from the latter on venational characters. Revision of the British species has long been needed and the appearance of this volume will prove a valuable aid to their identification since almost all of them are represented in the French fauna. Twelve new species and several new varieties are described, some also being recorded from England, and are consequently not yet recorded in any English work.

It may be mentioned that certain species (from England, Germany, etc.), which are not at present known from France, are also included in view of the probability of their subsequent discovery. Extensive use is made of the genitalia, which afford essential specific characters. The need for accurate illustrations of these parts is fully appreciated and well catered for; no amount of descriptive text alone can convey the same clear impressions of the structural complexity involved. It is hoped that M. Ribaut will see his way to provide the companion volume on the Jessidæ at a not very distant date.

The Torch-Bearers

By Alfred Noyes. Pp. vii + 422. (London: Sheed and Ward, 1937.) 7*s*. 6*d*. net.

THE man of science, though he must be full of imagination and insight as the veriest poet, has rarely become known as a writer of verse; and strangely enough, when he has shown a flair for poetry, it has not generally been inspired by the subject of his own studies. The poet, so far as he has touched upon natural science, has been content to let his muse play upon the phenomena of Nature, the sun, the stars, the clouds, the trees, the woodlands and their inhabitants. To Mr. Alfred Noyes belongs the credit of seeing in the wonders of scientific achievement a theme which can stir the soul with deep emotion, and in the workers who have dedicated themselves to the pursuit of science a band of torch-bearers, handing on the flame of knowledge through the ages. His trilogy appeared originally in three parts, which were reviewed appreciatively in these columns as they appeared (NATURE, May 20, 1922, July 18, 1925, and March 7, 1931). The issue of the three parts in a single volume, at a very modest price, will be much appreciated.

Aristotle's Physics

A revised Text, with Introduction and Commentary, by W. D. Ross. Pp. xii + 750. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 36*s*. net.

THIS scholarly work has been received by students and specialists alike as an invaluable addition to Aristotelian literature. The Introduction and Commentary are masterpieces of their kind and help considerably the understanding of a natural philosophy which does not correspond with modern views, but which inspired scientific thought until the advent of Galilean mechanics. The physics of Aristotle, however, have more than a historical value: they help to form a more accurate view of the whole Aristotelian synthesis, and of the scientific problems which were discussed in classical antiquity. Further, its philosophical foundations could still be used to-day; have we not heard scientific workers heralding a return to Aristotelianism in natural philosophy? The printers have taken considerable care in producing a Greek text as faultless as possible, and have thus secured a share in the praise which the book rightly deserves. T. G.

The Scientific Activities of Sir Charles Parsons

THE second Parsons Memorial Lecture was delivered on November 25 last by Dr. Gerald Stoney at the Institution of Electrical Engineers. As Sir Frank Smith in the first of these lectures, given at Newcastle-upon-Tyne a year earlier, had dealt at length with the invention and application of the steam turbine, Dr. Stoney devoted his lecture to the less well-known activities of the great engineer. This was a subject for which he was pre-eminently fitted, for he was closely associated with Sir Charles Parsons during his most prolific period. Parsons himself once spoke of Dr. Stoney as having grown up with the Heaton Works of Messrs. C. A. Parsons and Co., but he was also closely connected with the work of the Parsons Marine Steam Turbine Co. Much of what he had to say was therefore of great historical interest.

The question may well be asked what led Parsons to the conception of the steam turbine. At the outset, Dr. Stoney answered this by recalling that, when quite a young man, Parsons was interested in the production of power from the kinetic energy of a jet of gas. His first efforts in this direction were applied to the development of torpedoes, which were driven by the kinetic energy of gases produced by the combustion of an explosive. His ideas were also largely influenced by noticing the analogy between the flow of steam under small differences of pressure and the flow of an incompressible fluid like water. At Heaton is preserved a model boat (Fig. 1) the propeller of which was driven by the action of compressed air. The screw propeller is fitted beneath the centre of the boat and is surrounded by a double shrouding carrying blades on which the jet of air impinged. It is evident, said Dr. Stoney, that this work led to the conception of the steam turbine.

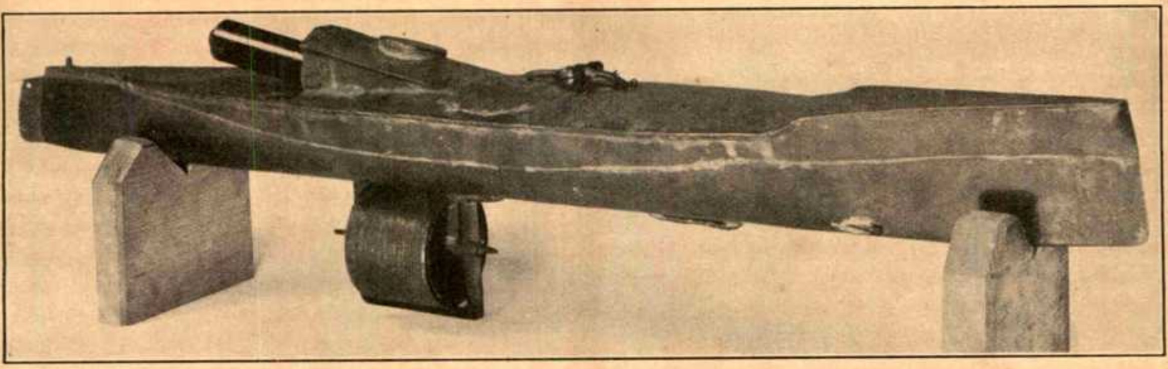


Fig. 1.

MODEL BOAT, DESIGNED BY SIR CHARLES PARSONS, DRIVEN BY COMPRESSED AIR.

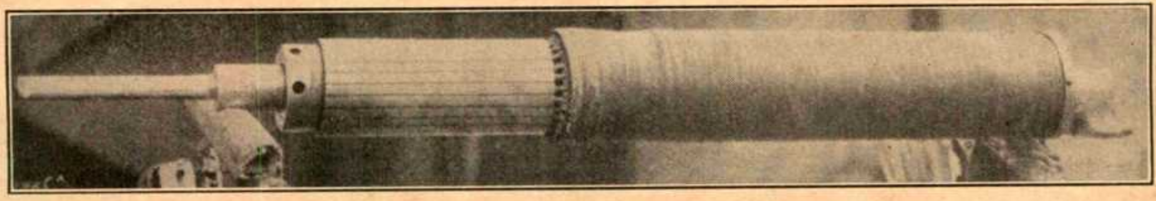


Fig. 2.

ARMATURE OF THE FIRST PARSONS TURBO-GENERATOR.

Though he was influenced by analogies between the flow of steam and the flow of water, Parsons never told anyone, not even the most trusted members of his staff, how he arrived at the design of an actual machine for any given conditions. Possessing high mathematical ability, he was rarely, if ever, known to make use of formal mathematical reasoning for the solution of any problem. He had a thoroughly scientific mind and scientific habits of thought, and his results were the outcome of these, rather than of any deliberate calculations. In the early days, he would come into the office with a scrap of paper on which were written particulars of the blading he had decided upon for a certain turbine. These were set out to scale and modified if necessary according

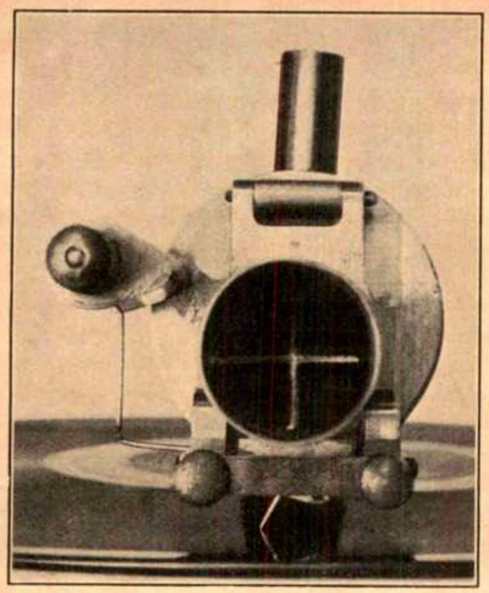


Fig. 3.
THE AUXETOPHONE MOUNTED ON A GRAMOPHONE RECORD.

to his judgment. The staff was completely puzzled as to how he determined the proportions of the blading. It was doubtful if he ever possessed a slide rule, and indeed seemed to have no need for such a thing. He could work out results in his head or on paper as quickly as most people could obtain them on a slide rule, though he never explained the process and it is doubtful if he could have done so.

It never seemed to Parsons that his powers were exceptional. He had an extraordinary intuition on all matters connected with design. No matter how difficult or novel the problem, he seemed to know instinctively how to solve it. He also had great mechanical aptitude. He was perfectly familiar with all workshop processes, and had unusual skill with his hands. He took a delight in making models, not as ends in themselves, but as a means of studying some problem.

It was in 1884 that Parsons made his first turbo-generator. This developed about 4½ kw. at 18,000 revolutions per minute. The dynamo had to be specially designed, for dynamos at that time revolved at about 1,200 revolutions per minute. The armature of this first turbo-generator (see Fig. 2) was only about 2⅝ in. in diameter. Every pound weight at the surface of it had a centrifugal force of about 5 tons at the normal speed of the machine, so great care had to be taken to make the construction sufficiently strong to resist mechanical stresses. Few better examples of Parsons's intuition, said Dr. Stoney, can be given than the fact that the proportions of his first turbo-dynamo, designed fifty-three years ago, when electrical knowledge was so rudimentary, could scarcely be improved upon to-day. After further references to the development of turbo-dynamos and turbo-alternators, Dr. Stoney remarked: "Some of the practices of these early days must now appear very primitive, but one must remember that Parsons was breaking new ground in almost every direction. Books such as we have in abundance to-day on steam, electricity and every branch of engineering were either non-existent or extremely elementary. Measuring instruments, as we know them to-day, did not exist and the range of materials for constructional and insulating purposes was very restricted."

The record of the work of Parsons on the turbo-generator formed the first half of Dr. Stoney's lecture, and he then turned to consider the work of Parsons on condensing plant, turbo pumps, fans and compressors, cavitation, the erosion of marine propellers and matters less closely associated with engineering. It will perhaps come as a surprise to many to learn that when Parsons was deeply immersed in his early study of the turbine and the dynamo, he should have turned to the manufacture of electric lamps. In 1885, when a partner in the firm Clarke, Chapman, Parsons and Co., he founded the Sunbeam Lamp Company, making arc lamps and incandescent lamps. At

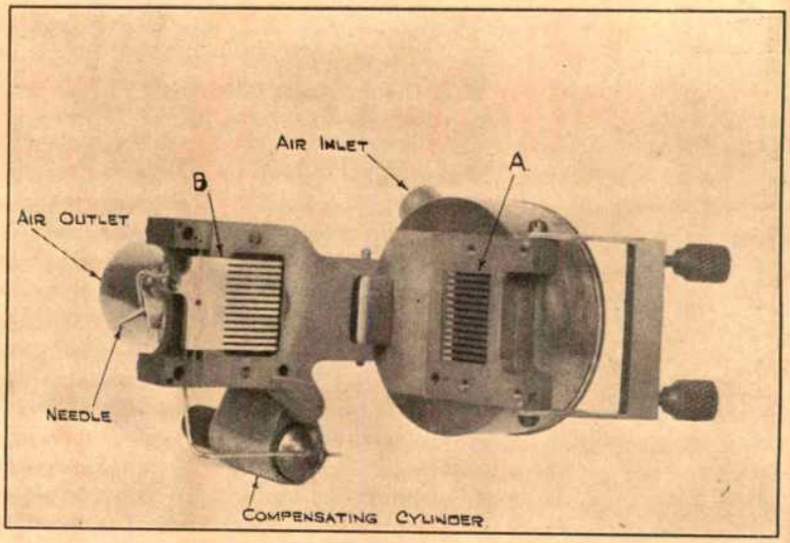


Fig. 4.
THE AUXETOPHONE OPENED TO SHOW PARTS.

first small lamps were made, but after a legal decision in a patent action that a 'filament' was less than $\frac{1}{32}$ in. in diameter, the Company restricted itself to the production of lamps having 'carbons', not 'filaments', of $\frac{1}{32}$ to $\frac{1}{8}$ in. diameter. The lamps ranged from 100 to 3000 c.p. At the Newcastle Exhibition of 1887, lamps made by the Sunbeam Co. were used for lighting, the current being supplied by ten Parsons turbo-dynamos ranging from 16 kw. to 32 kw. in capacity. Little information has been preserved as to the processes used in the manufacture of the lamps, but the material for the carbons appears to have consisted of tar, a special anthracite and zirconium.

To the same early period—the 'eighties—belongs the early optical work of Parsons, which began with the manufacture of parabolic mirrors for searchlights. He devised a process for bending the glass while hot in an accurately figured cast-iron mould, and his methods are used to-day with very little alteration. Several hundred mirrors per month are now turned out at Heaton for searchlights and other purposes. He had always a liking for optical work, no doubt inherited from his father, the Earl of Rosse, whose 6 ft. telescope at Birr was the wonder of the astronomical world. After the Great War, Parsons purchased the optical glass works set up by the Government near Derby and acquired a controlling interest in the firm of Messrs. Ross, Ltd. A year or two later he acquired the works of Sir Howard Grubb at St. Albans, and forming the firm of Sir Howard Grubb, Parsons and Co., Ltd., founded new works at Walker Gate, close to the Heaton Works, and it was there the 74-in. telescope for Toronto, the largest in the British Empire, was built.

Parsons's interest in other scientific matters was shown by his suggestion for a very deep bore hole, his experiments on the artificial production of diamonds, his experiments on the compressibility of liquids and his invention of the auxetophone. About 1902, when phonographs and gramophones were becoming popular, he realized that their reproduction of sound was far from satisfactory. He therefore decided to make a reproducer worked by compressed air by which the sound waves should be generated more in accordance with the action of an organ pipe than that of a telephone receiver. Then followed experiments on the flow of air and trials with various types of valves which could be controlled by the needle of the gramophone. Figs. 3 and 4 show the auxetophone mounted above a gramophone record, and open to show the valve and its seating. The moving part of the valve, about $\frac{1}{2}$ in. by $\frac{3}{4}$ in., was a flat comb of magnalium. Air at about 2 lb. per square inch was supplied to the wind-box through a flexible tube. Such a valve, said Dr. Stoney, made thirty-five years ago, reproduced sound with a volume and quality which have only recently been equalled by wireless loudspeakers and electric gramophones. The auxetophone was also applied to musical instruments, and was used with success in the orchestra at the Queen's Hall, London, in 1906. The invention of this instrument was entirely the work of Parsons's leisure hours, just at the time he was engaged in the application of steam turbines to naval vessels and fast mercantile ships.

Heat Production, Nutrition, and Growth in Man: Some New Views*

By Dr. E. P. Poulton

CONSTANCY OF CARBON DIOXIDE

Series of basal metabolism observations on the same individual have been published by a number of observers, and analysis shows that when the previous diet did not contain much carbohydrate the carbon dioxide tended to remain more constant than did the oxygen, which fell as the quotient rose. When the previous diet was rich in carbohydrate there was a tendency for the carbon dioxide to rise. It will be shown that a constant carbon dioxide as shown in Figs. 1 *a* and 1 *b* is in favour of the theory of the constant combustion ratio, and, such being the case, further observations would be desirable to prove definitely the relation of this constancy to the diet taken. According to this theory, the carbohydrate and fat are always burnt in a fixed ratio corresponding to a quotient of about 0·8, and if the quotient is higher there is a simultaneous conversion of carbohydrate to fat and if lower a conversion in the opposite direction. Such a theory cannot be proved by metabolic determinations on the whole organism between the respiratory quotients for the combustion of pure fat and pure carbohydrate, because it would make no difference whether with a higher quotient a higher proportion of carbohydrate was burnt or whether the same amount was burnt as before and the extra amount disappeared by being

*Continued from p. 147.

turned into fat. But biochemically in the organism there might be a big difference between the two theories, because combustion of carbohydrate and fat in a fixed ratio might be occurring in one place, while a simultaneous conversion might be occurring elsewhere in the organism. Cathcart and Markowitz have also pointed out that it would be absurd to suppose that conversion suddenly began just as the quotient rose above 1, and that it probably does begin at a much lower quotient.

TABLE 1.
THEORY 1. VARIABLE CONSTANT RATIO.

		R Q.	0·72	0 8	0·9	1·0
A. Constant CO_2	CO_2 from oxidation	Carboh.	0	4·81	5 72	7 63
	,, ,, ,,	Fat	7·63	3·32	1·91	0
	O_2 ,, ,,	Carboh.	0	5·88	6 35	7 63
	,, ,, ,,	Fat	10·6	4·16	2·125	0
	Cals. ,, ,,	Carboh	0	26·35	31 9	39
	,, ,, ,,	Fat	5·1	20·35	10 6	0
B. Constant O_2	CO_2 from oxidation	Carboh	0	4·78	7·15	10·6
	,, ,, ,,	Fat	7·63	3·70	2·39	0
	O_2 ,, ,,	Carboh.	0	6	8	10·6
	,, ,, ,,	Fat	10·6	4·6	2·6	0
	Cals. ,, ,,	Carboh.	0	29·3	39·8	54·25
	,, ,, ,,	Fat	51	22·7	13·2	0
C. Constant Cals.	CO_2 from oxidation	Carboh.	0	4 7	6·83	9·96
	,, ,, ,,	Fat	7·63	3·68	2·29	0
	O_2 ,, ,,	Carboh	0	5·86	7·63	9·96
	,, ,, ,,	Fat	10·6	4·54	2 54	0
	Cals. ,, ,,	Carboh.	0	28·8	38 2	51
	,, ,, ,,	Fat	51	22·2	12 8	0

A detailed study of all DuBois's results, which it is hoped will be published in the *Guy's Hospital Reports*, shows that all the variations in respiratory quotient and measured heat are compatible with the theory of the constant combustion ratio and that those between the respiratory quotients for the combustion of fat and carbohydrate are compatible with both theories. There are any number of ways in which the carbon dioxide, oxygen and heat can change so as to comply with the variable combustion ratio; but there is only one simple way that satisfies the theory of the constant combustion ratio, and that is when the carbon dioxide remains constant as the quotient varies.

For example, in Table 1 are given the amounts of carbon dioxide, oxygen and heat produced by the combustion of (1) carbohydrate, (2) fat at varying quotients on theory 1, according as (*A*) the carbon dioxide remains constant, (*B*) the oxygen remains constant, (*C*) the heat remains constant. The values are calculated from a Zuntz-Schumburg table deduced from the figures given (p. 70) in the *Guy's Hospital Reports* (85, 56; 1935); but the argument is unaffected by the particular Zuntz-Schumburg relation used. Any number of other tables could be calculated with variation of both oxygen and carbon dioxide with the quotient. The point is that all the tables resemble one another in the increased amount of carbohydrate and diminished amount of fat burnt with rise of quotient, and if the experimental results agreed with any of the tables the theory of the variable combustion ratio would be applicable; there is no reason on theoretical grounds for choosing *A*, *B*, *C*, or any other combination.

When, however, in Table 2 the results are expressed on the theory of the constant combustion ratio, in *A* where the carbon dioxide is constant (it is assumed that at a respiratory quotient of 0·8 combustion in a fixed ratio is alone taking place), the simplest state of affairs is obtained; this is because on this theory carbon dioxide can only result from combustion (*loc. cit.*, p. 68) and oxygen plays a part both in combustion and in conversion. In *B* and *C* and in all other calculations we have to assume that at other respiratory quotients than 0·8 not only is conversion occurring, but there is a variation in the amount of combustion too. In all cases about 4 calories are given out or absorbed in the conversion process per litre of oxygen involved, which is equivalent to 2·1 calories per gram fat as previously calculated (*loc. cit.*). Of course, it is not necessary to take 0·8

TABLE 2.
THEORY 2. CONSTANT COMBUSTION RATIO.

	R Q.	0·72	0·8	0 9	1 0
A Constant CO_2	CO_2 from combustion	7·63	7·63	7·63	7 63
	O_2 for combustion	9·54	9·54	9·54	9·54
	,, ,, conversion	1·06	0	1·065	1·91
	Cals. from combustion	46·7	46·7	46·7	46·7
	,, ,, conversion*	4·3	0	4 2	7·7
B. Constant O_2	CO_2 from combustion	7·63	8·475	9·54	10·6
	O_2 for combustion	9·55	10·6	11·95	13·25
	,, ,, conversion	1·05	0	1 35	2 65
	Cals. from combustion	46·8	52	58·5	65
	,, ,, conversion*	4·2	0	5·5	10·75
C. Constant Cals.	CO_2 from combustion	7·63	8·38	9·17	9·96
	O_2 for combustion	9·53	10·4	11·45	12·44
	,, ,, conversion*	1·07	0	1·28	2·48
	Cals. from combustion	46·75	51	56 1	61
	,, ,, conversion*	4 25	0	5·1	10

* The Cals. per l. oxygen used in conversion are obtained by dividing these figures by those two lines above.

as the respiratory quotient for pure combustion; this method of calculation would be valid for any other respiratory quotient.

It was pointed out above that Benedict's results could not be explained on the theory of the variable combustion ratio. But on applying the theory of the constant combustion to them there is this difficulty, namely, that more heat is liberated at high quotients than would be accounted for by the combustion of the constant carbohydrate-fat mixture and a simultaneous conversion of carbohydrate to a less oxygenated compound; this would mean that removing oxygen from the molecule of an organic compound caused an evolution of heat, that is, diminished its heat of combustion, a condition unknown in thermochemistry. It is only right to point out that Benedict and Carpenter themselves do not now place reliance on these early results of theirs, because the oxygen determinations were not very accurate. Dr. Carpenter has kindly sent me the figures for the eliminated heat in Figs. 1 *a* and 1 *b*, and it does not seem possible to account for the discrepancy by a wide difference between the direct calorimetry and the eliminated heat. I must accept their explanation, though I have already pointed out that the oxygen values in the alcohol control experiments were satisfactory, and it will be necessary to assume a large error in the oxygen.

Summarizing—on the theory of the variable combustion ratio, a carbon dioxide that rises, falls or is stationary with rise of quotient is equally probable; and this theory is not applicable to the higher quotients; on the theory of the constant combustion ratio a constant CO_2 would be expected and this is, in fact, usually found. Further, this theory is applicable to all quotients. Hence, if the facts are looked at *de novo*, paying no attention to the views held from the beginning of the century up to the present day, this theory would probably be chosen.

It must be admitted that this theory is not altogether unreasonable. Many quantities associated with the human body have in health a more or less constant value. The body temperature at rest varies within comparatively small limits, and the same is the case with the hydrogen ion concentration of the blood and the quantity of phosphocreatine broken down in relation to muscular work; while the amount of sleep remains the same for an individual at any particular age. Why should not carbohydrate and fat be burnt in constant proportion in the post-absorptive condition in a normal healthy man. The story of Cain and Abel suggests that the diet of primitive man was variable in its carbohydrate and fat content, depending on his success in cultivation, when it would be mainly carbohydrate, or hunting, when it would be mainly protein and fat. Which is most likely, that the complicated metabolic processes resulting in the actions of the heart, muscles and glands should be entirely at the mercy of the individual's caprice (or luck) in his choice of food, or that these processes should in the main run always along well-defined lines of chemical and physical action, while any foodstuff taken in unusual quantities is stored in some suitable form for future use, even though this means a conversion of some kind ? Is it not reasonable to look on these conversions of food as some of the earliest adaptations that the organism has acquired in the course of evolution, and, as Dr. H. E. Magee has suggested, this would be a reason for the evolution in the body of the power to manufacture the ferment glutathione, which is otherwise without a clear explanation.

A NEW DEFINITION OF BASAL METABOLISM

On the theory of indirect calorimetry, based on the constant combustion ratio of carbohydrate and fat, the non-protein carbon dioxide results entirely from the combustion of carbohydrate and fat, while the oxygen is used partly for combustion and partly in conversion processes. If the respiratory quotient is high, say, 0·9, the heat, calculated on the assumption that the oxygen is used entirely for combustion, is about 8 per cent above the heat actually found, because the heat due to combustion is diminished by the heat absorbed in the conversion of carbohydrate towards fat. Since under basal conditions there are continual small variations in the quotient, there will be continual additions to or subtractions from the heat of combustion, according as the conversion of fat to carbohydrate is taking place or vice versa. Since these conversions are ephemeral and will cancel each other over a long period, they can scarcely be regarded as part of a 'standard' metabolism, and so it is much better to neglect them, and this is done by taking the carbon dioxide alone into consideration. In these circumstances the basal or standard metabolism must be defined afresh as the heat of combustion at rest in the post-absorptive state and not as the total heat measured in a calorimeter, the value of which may be a little different, depending on the respiratory quotient. If this definition be accepted it follows that the carbon dioxide alone must be measured and no account must be taken of the intake of oxygen.

Suppose, on the other hand, we retain the older but less likely theory of the variable combustion ratio, the significance of the constant carbon dioxide still remains and we should look on the variable oxygen as indicating an ephemeral increase or diminution in the proportion of carbohydrate to fat burnt, which is also not part of a standard metabolism. In either case, carbon dioxide should alone be used for the determinations, and the subject should probably take a low carbohydrate diet for 18 if not 24 hours before the experiment is carried out.

Practically, in determinations of the basal metabolism I find that the carbon dioxide does remain very constant over half an hour; the error from "aus-pumping" of carbon dioxide has been exaggerated.

Obituary Notices

Prof. G. A. Buckmaster

ON December 22, Prof. George Alfred Buckmaster died at the age of seventy-eight years. Buckmaster was one of the last of the great teachers of physiology of the late Victorian and Edwardian times, who in their teaching regarded physiology as the handmaiden of medicine. He was educated at Magdalen College, Oxford, where he held a demyship; he took a first class in the Natural Science Schools in 1881, and in the following year was elected to the Burdett-Coutts University scholarship in geology. He received his medical education at St. George's Hospital, qualifying in 1883, took his Oxford M.B. in 1885, and his M.D. in 1887. He also held the Radcliffe travelling fellowship and continued his studies in various German universities.

Buckmaster's first teaching appointment was that of lecturer in physiology at St. George's Hospital Medical School, which he held until 1905; he then became assistant professor of physiology at University College, London, and in addition, in 1909, accepted the professorship at the Royal Veterinary College. In 1919 he succeeded Prof. Stanley Kent as H.O. Wills professor in the University of Bristol, and he held this chair until his retirement in 1930. In 1934 he was elected F.R.C.S. (Eng.), *honoris causa*, a distinction of which he was very proud.

Buckmaster's first paper, "Uber eine neue Beziehung zwischen Zuckung und Tetanus" was published in the *Arch. f. Anat. u. Physiol.*, and was followed by a note in the *Proceedings of the Physiological Society* on a new relation between "Contraction and Tetanus". Buckmaster was selected as one of the three English members of the Leprosy Commission in India, 1890 and 1891; the results of this work are embodied in papers in the *Leprosy Investigation Journal* and in the report of the Commission; a good deal of useful information was collected, but nothing very definite was found with regard to the causation and treatment of the disease; they produced a culture, but I gather that this has not been accepted.

During his time at St. George's Medical School, Buckmaster had abundant opportunities of investigating not only normal but also pathological bloods. The results of such experiences were embodied in a series of lectures, given in the Physiological Laboratory (South Kensington) of the University of London and afterwards published in 1906 in book form under the title "The Morphology of Normal and Pathological Blood". In one chapter he gives an account of observations carried out by himself and two colleagues, Dr. Chas. Slater and Mr. C. T. Dent, during two successive years in the Alps (Mont Blanc) on polycythæmia at high levels. In another he gives a masterly discussion of the question of the existence of blood platelets in unchanged blood, and to the end of his career Buckmaster held strongly to the view that blood platelets were artefacts.

In the year 1906, Buckmaster and J. A. Gardner collaborated in the study of the mechanism of chloroform anæsthesia, and their experimental results and conclusions are detailed in a series of papers in the *Proceedings of the Royal Society* between 1906 and 1911, dealing with methods of estimation of chloroform, with the function of the red cells in carrying the chloroform around the circulation, the rate of absorption of chloroform by the blood and its rate of elimination. In general, it was found that in the initial stages of anæsthesia the chloroform content of the blood rises rapidly to a value approaching a maximum; during this period, which occupies the first few minutes, the first danger period is reached, because the quantity of chloroform in the blood directly or indirectly affects the respiratory nerve centres, and in consequence the respirations become slower and shallower; the concentration of chloroform in the blood then falls, and the respiratory centre recovers. When the animal has passed this stage the amount of chloroform quickly rises towards a maximum value, and an equilibrium between the various factors which determine the amount of chloroform in the blood appears to be obtained. This state persists for a considerable period, and throughout the period the differences between the amount of chloroform present in the blood and that found at the lethal point is very small. The whole of the period is dangerous and the animal may die at any point should any disturbing factor come into play. They also showed that the view of some French workers that the action of chloroform is due to its decomposition in the blood with formation of carbon monoxide is erroneous; and clearly demonstrated that the carbon monoxide, estimated by the French observers by the iodine liberated on passing the gases of the blood over heated iodine pentoxide, was due to the decomposition of the chloroform vapour, contained in the blood gases, by the alkali over which the gases were passed in order to remove carbon dioxide. In a paper on the ventilation of the lung during chloroform anæsthesia they described a new form of plethysmograph suitable for use with cats.

In 1910, Buckmaster and Gardner were led to devise a new form of blood gas pump without taps or joints and ending in barometers, thus being entirely leak-proof. It was described in the *Journal of Physiology*, 1910, and in the same journal were published papers on the nitrogen content of blood, the gases in arterial and venous blood of cats, the composition of the blood gases in chloroform anæsthesia, and the composition of the blood gases during the respiration of oxygen.

While at Bristol, Buckmaster and Dr. Hickman made use of the same pump in an exhaustive investigation of the body fluids other than blood, particularly bile and urine.

Socially, Buckmaster was a delightful man. His superb memory, his wide knowledge of literature and his fund of stories of men and things made him an interesting and fascinating talker, while his deep sense of humour, his wit and his kindly loyalty of disposition endeared him to all who had the privilege of his friendship. J. A. G.

Prof. Alfred Lodge

ALFRED LODGE, who died at Oxford on December 1 of last year, so far outlived his contemporaries that it is scarcely possible now to see him through their eyes. Born in 1854, educated at Horncastle Grammar School and Magdalen College, Oxford, he was elected to a Fereday fellowship at St. John's College, Oxford, in 1876, and appointed in 1884 to the staff of the Royal Indian Engineering College, Coopers Hill, where he presently succeeded Wolstenholme as professor of pure mathematics; on the dissolution of the College in 1904 he became a master at Charterhouse, and there he remained until after the Great War.

Lodge's work in mathematics was all of the most elementary kind, but he was an enlightening teacher and a tireless computer. As a teacher he was active in the Association for the Improvement of Geometrical Teaching, and when that society broadened its basis to become the Mathematical Association, he was appropriately the first president to bear the new title; to the end of his life he was a familiar figure at the meetings of the Association.

As a computer, Lodge was a member for fifty years of the British Association Committee on mathematical tables, and it is in the publications of that Committee that his name will survive; if he did little to improve the technique of computing, he laboured incessantly in the practice, and work of his is incorporated in many of the reports, in the volume of miscellaneous tables published in 1931, in a factor table published in 1935, and in a volume of tables of Bessel functions which has just appeared; in addition to computing, he took a willing share in the discussions of the Committee and in the toil of proof-reading.

Sir Oliver Lodge writes of his brother, "He was . . . always willing to slave away in the background. . . . I have many dim recollections of his willing self-sacrifice for the family in early days". He was a secretary of Section A (Mathematical and Physical Sciences) of the British Association from 1888 until 1892, and from 1893 until 1896 he was recorder of the Section, a position so unusual for a mathematician that his appointment must be taken as a tribute to the confidence which he inspired; he served on the Council of the British Association from 1913 until 1915. The volume of tables of Bessel functions which has been mentioned is "Inscribed to their friend Alfred Lodge by his colleagues on the Committee" as a token of the warmest affection. These glimpses, which belong to different periods and come from different directions, converge: Alfred Lodge was a worthy member of the eminent family to which he belonged; his long life was a useful one, and he was a lovable man who was happy in being well loved. E. H. N.

Prof. Otto Warburg

PROF. O. WARBURG, who was well known as a botanist, was born in Hamburg in 1859. He travelled extensively for scientific investigation before being appointed lecturer in botany at the University of Berlin in 1891, later becoming professor in the Oriental seminary in Berlin.

Besides taking a very active interest in Zionism and affairs relating to colonization in Palestine, Warburg was the author of numerous botanical papers, particularly relating to tropical agriculture and economic botany. He was joint founder of the *Tropenpflanzer*, and was editor from its inception in 1897 until 1922, when he was succeeded by Dr. Busse. He was much interested in rubber plants and made an intensive study of the genus *Ficus*, particularly the African species, of which he described a great number, and he published, conjointly with Dr. De Wildeman, an enumeration of the *Ficus* of the Belgian Congo. His book "Die Muskatnus" (nutmegs) is a comprehensive account published in 1897, and still a standard work on the subject, and in the same year he issued a monograph of the family Myristicaceæ. For Engler's "Pflanzenreich" he was responsible for the screw pines (Pandanaceæ).

In his later life, Warburg devoted most of his time to the world Zionist movement, of which he became president in 1911. After the Great War, he was appointed head of the Agricultural Experimental Station in Palestine, being one of the founders, and he was also the director of the Institute of Natural History at the Hebrew University, Jerusalem. He was a man of great charm and of a retiring and scholarly disposition, and was revered by all sections of the Zionist movement.

WE regret to announce the following deaths:

Prof. W. H. Pickering, emeritus professor of astronomy in the Harvard College Observatory, aged seventy-nine years.

Dr. Carlotta J. Maury, palæontologist in the Brazilian Survey, formerly professor of zoology and geology in the Huguenot University College, South Africa, on January 3, aged sixty-four years.

News and Views

Aurora of January 25-26

A BRILLIANT auroral display was visible over most of England and from many places on the continent of Europe on the night of January 25–26. Dr. B. A. Keen, president of the Royal Meteorological Society, has sent the following account of the spectacle : "At Harpenden, Herts, the display was seen from 6.45 p.m. until well after midnight. The early stages appeared as a red glow in the north-west and later in the north-east, with a low broad green arc in between. The area of the luminous sky increased, and by 8.30 p.m. the green colour with areas of red extended well south of Orion. Up to 11 p.m. there seemed to be three periods of brilliant display : the first, and perhaps the best, at 7.45 p.m. when a bright red glow in the north-north-east was traversed by many sharply defined green and white shafts ; at 8.30 p.m. especially in the east ; and again at 9.45 p.m. when diffuse and rapidly fluctuating green streamers appeared between north-east and north-west, directed towards the zenith. Thereafter, the luminosity decreased, but as late as 11 p.m. a broad green arc stretching from north-west to north-east was still clearly visible. About midnight, a fourth display began with red streamers in the north-west, which extended until a broad red band was formed passing through the zenith to the north-east. At 1 a.m. faint red and green glows were still visible.

The Recent Sunspot and Magnetic Storms

THE large sunspot reported on p. 156 of last week's issue was easily seen with the naked eye at about the time of central meridian passage on January 18. The maximum area of the spot was more than 3,000 millionths of the sun's hemisphere ; the spot is, therefore, one of the largest half-dozen spots recorded at Greenwich since 1875. As already reported, a magnetic storm was recorded at Abinger, beginning on January 16, 22½ hr. A second and larger disturbance developed rapidly on January 22 after 5 hr. ; between 9 hr. and 10 hr. a range of 56′ in declination occurred, while that in horizontal force was 600γ. This range in H.F. had not been exceeded at Greenwich since the magnetic storm of May 17, 1921, but the maximum of the present period of disturbance had not been reached. On January 25 (a day after the big sunspot had disappeared over the western edge of the sun) a sudden commencement began at about noon and developed to a remarkable degree. The great aurora which followed is described above. A telephoned account of a preliminary examination of the Abinger magnetic traces stated that large movements of the recording magnets began at 17 hr. and were particularly marked between 20 hr. and 21½ hr. ; the disturbance died down about 3 hr. on January 26. The total ranges during the disturbance were approximately 2·1° in declination, 1,000 γ in H and 550 γ in V. The storm is probably unequalled in the Greenwich records since that of September 25, 1909. As already stated, the big sunspot had passed off the disk on January 24 and there is no other unusual spot at present visible.

Dr. G. M. B. Dobson, F.R.S.

AT the annual general meeting of the Royal Meteorological Society held on January 19, the Symons Memorial Gold Medal awarded for distinguished work in connexion with meteorological science was presented to Dr. G. M. B. Dobson, reader in meteorology in the University of Oxford. Dr. Dobson's earlier researches related to atmospheric electricity and to the structure of the atmosphere as revealed by pilot balloon observations. In 1922, in a paper on the theory of meteors contributed to the Royal Society, Dr. Dobson, in collaboration with Prof. A. Lindemann, adduced the first reasoned evidence of the existence of high temperatures in the atmosphere above 50 km. Since 1923 he has extended most fruitfully the method of Fabry and Buisson for the study of the absorption of ultraviolet radiation in the upper atmosphere and thence the determination of the ozone content of the atmosphere. A photographic method of observation was developed and instruments were distributed to suitable observers in many countries. Later, a photoelectric method was devised to facilitate the routine measurement of atmospheric ozone. Observations made by collaborators in many parts of the world have established the nature of the variation of ozone content with season and latitude, and have revealed close relationships between the amount of ozone, the development of atmospheric pressure at sea-level and certain meteorological characteristics of the atmosphere. Further advances are to be hoped for from an extension of international co-operation in prospect.

Emmanuel Swedenborg (1688-1772)

TO-DAY world-wide celebrations are being held to commemorate the 250th anniversary of the birth of the great Swedish man of science and theologian, Emmanuel Swedenborg, who was born in Stockholm on January 29, 1688, and died in London on March 29, 1772. His death took place at 26 Great Bath Street, Clerkenwell, and he was buried in the Swedish Church, Princes Square, Stepney, whence, however, his remains were taken to Sweden in 1908. He was the second child and eldest son of Jasper Swedberg (1653–1735) a preacher, poet and visionary, who became bishop of Skara. From an early age young Swedberg, a name he bore until he was ennobled in 1719, showed unusual talent, and after studying at the University of Uppsala in 1710 came to England. He also visited France and Holland and in 1716, two years after returning home, published his "Daedalus

Hyperboreus", a kind of repository of contemporary inventions and experiments. In the same year Charles XII made him assessor in the College of Mines. His writings from that time onwards, published and unpublished, ranged over the whole field of science. In 1721 he wrote his "Prodromus Principiorum Rerum Naturalium", in 1722, a work on geology, in 1734 published in three volumes his "Opera Philosophica et Mineralia", in 1741 his "Economy of the Animal Kingdom" and in 1744–45 his "Animal Kingdom", with which his course as a natural philosopher ended. In London in 1749–56 he published his "Heavenly Arcana" and this was followed by some two score of theological works. He himself made no attempt to found a sect, but his followers established "the New Church signified by the New Jerusalem in the Revelation" and 'Swedenborgians' are to-day found all over the world.

THE removal of Swedenborg's body to Sweden in 1908 was but a part of a movement for the recognition of his genius as a man of science. In 1901 Dr. Max Neuberger, of Vienna, gave an address to an assembly of German naturalists and physicians entitled "Swedenborg's References to the Physiology of the Brain", in which he pointed out how Swedenborg had anticipated many modern discoveries. Dr. Neuberger next addressed a communication to the Academy of Sciences of Stockholm in which he expressed his regret that Swedenborg's manuscript on the brain had not been published. A committee was appointed to investigate the matter. On May 29, 1903, Prof. Gustaf Retzius, the president of the Academy, presented a report on the investigation to the Congress of Anatomists at Heidelberg. This led to a further examination of the manuscripts, and Dr. Retzius proposed that the Academy should issue an edition of Swedenborg's scientific and philosophical works. Even before this, proposals had been put forward for the founding of a museum for the preservation of portraits, relics and other Swedenborgiana. Emerson wrote of Swedenborg: "He had great modesty and gentleness of bearing. His habits were simple; he lived on bread, milk and vegetables; he lived in a house situated in a large garden. . . . He is described, when in London, as a man of a quiet, clerical habit, not averse to tea and coffee, and kind to children. He wore a sword when in full velvet dress, and whenever he walked out carried a gold-headed cane. There is a common portrait of him in antique coat and wig, but the face has a wandering or vacant air."

Scientific Delegation to India

OUR correspondent, writing from Bombay on January 15, says: "Some sixty members of the scientific delegation to India, including the president, Sir James Jeans, embarked on the S.S. *Strathaird* at Bombay on January 15 for the homeward voyage. Of these, nearly all had made the whole or part of the tour in Southern India arranged to take place after the Congress in Calcutta. This tour embraced visits to Madras, Mysore, and Bangalore, which none would willingly have missed. After a hot journey south, Madras received the delegation with a very perfect day, during which the University gave a luncheon, and most of the delegates attended a garden party arranged by the city in honour of the Viceroy. The small but very attractive aquarium, and other points of interest, were visited. The wonders of Mysore will never be forgotten by the visitors. They were received as guests of the State throughout their too short sojourn and were shown many of the institutions which are there maintained by an enlightened Government, while when darkness fell they viewed with amazement the illuminated fountains at the great power dam on the Cauvery, and the blaze of lights from the city as seen from Chamundi Hill. At Bangalore the Indian Institute of Science and other institutions were visited, and the party was entertained to tea by the Dewan Sahib of Mysore.

"AT all three cities visited during this southern tour, as indeed at every city visited throughout India, members of the delegation have freely responded to the many calls upon them for lectures, and all, whether so occupied or not, have had constant opportunity for the renewal of contacts with old students now occupying responsible positions in the places visited, and for making new acquaintanceships with workers in their various fields of interest. The whole spirit of the visit has been one of mutual and practical help, and nothing has impressed us more than the immense interest of the community in the delegation, and especially that of the students who have thronged the lectures and incidentally demanded of us inconceivable numbers of autographs. The visit has been said, by many influential Indians, to have been a great event for India: certainly it has been so for the delegation."

Museums and the Research Worker

SOME aspects of recent criticism of ethnographical collections in the museums of Great Britain are considered on p. 179 of this issue of NATURE. It cannot be emphasized too frequently that the great national collections—the question under discussion cannot affect the smaller museums except in so far as they are prepared to specialize—being supported out of public funds, it is their bounden duty to perform a function of public utility; whether that may be, as is now generally required of them, that they should take their share in making efficient and supplementing the machinery of general education, or the more highly specialized function of assisting the research worker. To the latter rather than to an attachment to a traditional system must be attributed the classificatory organization which has been subjected to criticism. For it must not be forgotten that the great national collections, as well as the smaller ethnographical museums, some highly specialized, such as the Pitt-Rivers Museum at Oxford, the Museum of Archæology and Ethnology at Cambridge, or the Manchester University Museum, have been the laboratories for the scientific researches of the technologist in the broader sense, the student of material culture. It is upon this class of evidence that the archæologist, the ethnologist and the student of early culture generally so largely rely. In the modern museum building, however, the trend of development is to make provision for the worker in technological research by withdrawing the bulk of the material in which he is interested from public exhibition, while the public galleries are given over to the more striking objects or to those of most educative value to the public. Doubtless when more space is given to our great public collections, the same method of procedure will be followed, and the public galleries will then be devoted to regional methods of display, in so far as these may have approved themselves as the most effective for purposes of instruction.

Publication of Old Scientific Works

A SMALL committee, presided over by Prof. B. Nemeč, met at Prague on December 3 and 4 to study, on behalf of the International Organisation for Intellectual Co-operation, the possibility of publishing old scientific works. This question had been raised by Prof. Nemeč, on behalf of the Czechoslovak Research Council, and had been adopted as part of the plan of scientific work of the International Organization for Intellectual Co-operation, by the executive committee of the International Council of Scientific Unions, acting as a committee of scientific advisers. The committee at Prague unanimously agreed that it would be desirable to publish a number of manuscripts or works on the exact and natural sciences, printed copies of which are extremely rare or almost inaccessible. A series of this kind would show the common origins of modern scientific culture and would be of great value to all savants interested in the historical development of the sciences. Considering the strictly international character of the undertaking, the committee felt that it should be entrusted to the International Organisation for Intellectual Co-operation. Further, the series should not be confined to one branch of science alone and it should embrace all the periods in the development of science since the Middle Ages.

THE publications envisaged may be divided into two series: Facsimiles relating to very rare manuscripts or works containing engravings or illustrations indispensable for the value of such works; and reprints of fundamental classical works in the development of the sciences, copies of which are extremely rare or no longer obtainable, including manuscripts that have never been printed. The committee suggested the publication in facsimile of the following manuscripts in the order given: (1) "De Revolutionibus orbium coelestium", by Nicolaus Copernicus; (2) "De proprietatibus rerum", by Bartholomeus Anglicus (facsimile reproduction of the illustrations which appeared in all the editions, summary of each chapter of the original work, and a biography of the author); (3) "Micrographia", by Robert Hooke. In addition, the committee suggested the reprinting of the following very rare works and hitherto unpublished manuscripts in the order given: (1) "New System of Chemical Philosophy", by John Dalton; (2) a selection of letters from the scientific correspondence of Johannes Hevelius, astronomer and selenographer, the greater part of which is at the Bibliothèque Nationale, Paris; (3) "Opuscula Botanitii argumenti", by Rudolf Camerarius; (4) "De solido intra solidum naturaliter contento", by Nicolaus Steno; (5) "Origin of Species", by Darwin (a reprint of the first edition, 1859); (6) "Expériences pour servir à l'histoire de la génération des animaux et des plantes", by Lazaro Spallanzani; and (7) "Disquititio de sexu plantarum", by Linnæus.

Excavations in North Syria

AT the Friday evening discourse at the Royal Institution on January 21, Sir Leonard Woolley described "Excavations in North Syria". The object of the North Syrian Expedition has been to trace such relations as may have existed between Asia and the early Greek world, especially during and before the rise of the Cretan civilization. Two sites were chosen on the trade-route afforded by the Orontes valley. One was at al Mina, at the river mouth, one at Atchana in the Amk plain where the road debouches from the mountain range and runs across open country past Aleppo to Carchemish and the Mesopotamian centres. At al Mina, underlying the ruins of the crusading port of St. Simeon, there were found nine further strata giving a continuous record of commercial activity from 300 B.C. back to the beginning of the eighth century. During the fifth and fourth centuries Athens, in spite of the long-drawn crisis of the Persian wars, enjoyed a trade monopoly with Persia. In the sixth century B.C. the bulk of the trade was in the hands of the Rhodian manufacturers, but Corinth, Naukratis and Lesbos secured a certain amount of it and Cyprus was still selling goods in Asia although in greatly reduced measure. In the seventh century, judging by al Mina, Cyprus entirely controlled the market; of all the imported pottery found there scarcely a sherd is not Cypriote. This domination had come about quite suddenly. It was a natural result of the wealth of the Asiatic clientele that the al Mina merchants imported always the best wares that were to be obtained; from each manufacturing centre the finest quality was selected and the centre changed according as its level of production rose or fell.

THE earlier strata of al Mina have been eroded by the river; for the period preceding the eighth century we have to look at the second site. The topmost stratum at Atchana is dated by imported Mycenæan pottery to the twelfth century B.C. In the second stratum below this, dated to the 15th–14th centuries, there are the earlier Mycenæan wares side by side with a remarkable painted pottery which is undoubtedly local, in some aspects identical with the 'Hurrian' wares found on other sites, in others altogether novel in Asia but strikingly reminiscent of Knossos. The city in which this pottery occurs, and that beneath it, down to the Fourth Period, is Hittite; and there are Hittite inscriptions side by side with documents in cuneiform. In the Fourth Period Sir Leonard has begun to excavate a palace the architecture of which both in material and in style seems as essentially Cretan as does the painted pottery; objects in gold and ivory testify to its richness, and cuneiform tablets appear to show that it was a royal building and date it to the sixteenth century B.C. This year's season will be devoted to the clearing of the palace, and its results should certainly throw light on the connexions between Crete and the Syrian mainland.

British Archæological Investigation in France

On more than one occasion recently, French archæologists have expressed admiration for the methods of excavation followed in Great Britain on such sites as Maiden Castle and St. Albans, and at the same time have regretted that a similar procedure had not been introduced into archæological studies in France. In a recently published report (*L'Anthropologie*, 47, 5–6) of the proceedings at the last sitting of the Commission des Monuments historiques (Section de Préhistoire) reference is made to the concession to excavate the fortified site of Artus at Huelgoat (Finistère) granted by the Commission to the Society of Antiquaries of London, of which the direction will be in the hands of Dr. R. E. Mortimer Wheeler and Mr. R. Radford. The report goes on to add that while the antiquities discovered will naturally remain the property of France, a greater gain will be the experience thus to be acquired of methods of systematic investigation, of which archæologists in France have but a very faint idea, not only as regards the work of digging but also in regard to interpretation. through the co-operation of specialists, and the supreme excellence of the planning and photography, to say nothing of the preservation of the stratigraphic record. It is, perhaps, unnecessary to add that in this international exchange the gain of Great Britain will be no less in the acquisition of systematized evidence which may be expected to throw no little light on the relation of the cultures of north-western France and the west of Britain in prehistoric times—a relation which recent discovery suggests may have been even closer than has hitherto been anticipated.

International Telecommunications Conference at Cairo

Radio communication is essentially an international affair, and it is therefore necessary that it shall be conducted according to rules and conventions agreed to by all the principal countries in the world. The necessary regulations are drawn up by international conferences which are held at intervals of about five years and are attended by delegations from the administrations operating the radio services in the various countries. These conferences are organized by the International Telecommunications Union, with headquarters at Berne, Switzerland, the function of which is to co-ordinate telecommunication of all types, telegraph and telephone, cable, wire and radio. At the present time, world radio communication is being conducted under the Madrid Convention which was drawn up at the end of 1932.

On February 1, a new conference will be opened in Cairo with the object of revising the existing convention in the light of progress and developments in the past five years. During this period, the technical aspects of the various questions involved have been studied by international technical committees, such as the Comité Consultatif International des Radiocommunications (C.C.I.R.), which last met at Bucharest in May–June 1937. The general objective of these committees and of the Cairo conference is to revise the existing convention in such a manner as to place telecommunications on the most efficient and equitable basis for the world as a whole. On the radio side, considerable attention is given to the allocation of wave-bands among the claimants representing the various interests involved, which range from commercial services and defence requirements through broadcasting to various scientific and experimental interests. The Cairo Conference is expected to last from six to twelve weeks, and the application of the results may require a year or more to put into effect, so that ample time is provided for industry and the users of communications to prepare for such changes as may be involved.

British Snowfall Survey

At the first meeting of the International Snow Commission held in Edinburgh on September 14–16, 1936, members of the British group emphasized the importance of snowfall in the hilly districts of the British Isles, pointing out, also, that if the climate were to take a slightly colder turn the snowfall would become decidedly impressive over a large portion of the country. Out of this meeting there arose the formation of the Association for the Study of Snow and Ice, and among other activities of this body a scheme has been launched for extending our knowledge of snowfall in Great Britain from observations of the extent, duration and depth of snow-cover. It is thought desirable to begin systematic study with limited areas in such snowy districts as the Cairngorms, the Southern Uplands of Scotland and the northern Pennines, gradually extending the scheme to cover the whole of the country. It is hoped to investigate the permanent, semi-permanent and late-lingering snow-drifts in the Scottish Highlands, and the northern English and Welsh mountains, together with such important phenomena as the long-distance, mass-drifting of snow whereby quantities of snow in severe blizzards may pass out of the drainage basins into which, but for the wind, they would have fallen. The plan will thus supplement valuable information already being obtained from the rainfall stations of the Meteorological Office, and readers interested should communicate in the first instance with the chairman of the Ice and Snow Association, Mr. Gerald Seligman, at Warren Close, Coombe Hill Road, Kingston Hill, Surrey.

Pacific Entomological Survey

On November 2, 1932, a statement of the work and objects of the Pacific Entomological Survey was made before the Royal Entomological Society of London, as a result of which a resolution was passed unanimously inviting Dr. S. A. Neave to write and commend the work in the name of this Society, of which he later became president. On November 26 of the same year an appeal was issued in Nature (130, 802–3; 1932), and further generous support was, despite the depression, forthcoming from various sources in Hawaii and elsewhere. Then, in 1935–37, liberal grants through the trustees of the will of the late Viscount Leverhulme and through the British Museum (Natural History) enabled Mr. E. P. Mumford, director of the Survey, to accept Sir Edward Poulton's invitation to complete the present phase of the work in the Oxford University Museum, where Sir Edward's successor, Prof. G. D. Hale Carpenter, is extending the hospitality of the Hope Department. The work of the Survey is of interest to all countries the territories of which either surround or extend into the Pacific, for, as Dr. Neave points out in the letter referred to above, "a knowledge of the fauna of all the Pacific Islands may well be of the utmost value in the more cultivated and developed ones, in that it may give a clue to the origin of many of the local pests of the latter, and thus point to opportunities for devising their biological control".

The work of the Survey is already well advanced, and some 150 papers have been submitted for publication in Hawaii and elsewhere. It was originally proposed to prepare for publication a résumé and analysis of the findings of the Survey, and a discussion of the bearings thereof on the problems of distribution of insects in the Pacific, but it is becoming increasingly apparent as a result of the researches in Oxford that such an analysis will, to be of any value, have to take into account, not only the fauna of the islands of the Pacific, but also that of other islands. In reviewing (Nature, 130, 797; 1932) a manuscript copy of "Entomological Researches in the Marquesas Islands" (afterwards published in V^{e} Congrès International d'Entomologie, pp. 431–450, Paris, 1933), Dr. Hugh Scott referred to certain groups that are said to be absent from the Marquesas, and stated that the authors, Messrs. Mumford and Adamson, regarded these gaps in the fauna as strong evidence against the existence in past ages of extensive land areas in the Pacific, but, as Dr. Scott points out, some of these groups are also absent from the faunas of islands not of volcanic and purely oceanic origin. Furthermore, some of these groups that are thought to be absent from the Marquesas have been taken in supposedly oceanic islands elsewhere. Though Cicadas are unknown in the Marquesas, a remarkable genus has been described from Samoa, which island group Prof. Buxton considers to be oceanic. Caddis-flies and may-flies, supposedly absent from the Marquesas, have been taken in Samoa as well as in the 'crypto-oceanic' Canary Islands and Madeira, and froghoppers, which were not met with by Messrs. Mumford and Adamson in the Marquesas, are known from Tonga, Samoa, the Society Islands, and Rapa. In bringing these extensive studies to a focus in Oxford, and at Farnham House Laboratory by courtesy of Dr. Thompson, Mr. Mumford and his assistants have received every assistance and co-operation from specialists throughout the world. Correspondence concerning island faunas may be addressed to the Hope Department of Zoology (Entomology), University Museum, Oxford.

Progress towards Internationalism

The October–January number of *Science and Society* is devoted to a discussion of the conditions of progress towards internationalism. Prof. E. Jäckh, in an article on "The Changing International Relations", stresses the necessity of development into supra-national relations. Supra-national science has made possible and indeed necessary the organization of an international society. The tempo of such development, in which science shows the way, is determined by the extent to which humanity values technical civilization, science and their world-changing effect as bursting asunder the frontiers between peoples. Prof. H. J. Fleure contributes an article on "Society and Liberty" in which he shows that society must be studied ecologically with a deep realization that no one has the whole truth; we are all seekers, and the truth is far above us all. He urges that it is our duty, in the name of science, to plead for freedom of conscience not only as an essential for scientific thought, but also as the only way in which in the long run society can keep in touch with the ever-flowing changes in the world. "Anthropology and racialism" is the subject of an article by J. C. Trevor, who, directing attention to some of the inherent difficulties in the consideration of problems of race, points out the danger to world peace which the accentuation of racial disparities may offer if identified with nationalistic aspirations.

Adrian Stephen's article on "War and Emotional Development" discusses some difficulties in a supra-national authority and suggests that a hopeful line of progress lies in learning to regard countries or nations as pieces of machinery with definite functions for the promotion of human happiness rather than as idealized mothers and fathers. The application of science to political and international affairs at the present juncture is urged by C. A. Mace, in a thoughtful article "Planning Peace", to be less a matter of using specific material from the relevant social sciences than of infusing politics with some respect for the scientific spirit and the scientific point of view. Mr. Mace stresses the need for a system of publication, without fear or favour, of tested matters of fact, as essential to restore public confidence and to give intelligence to public judgment. R. H. Pender's survey of the political phases of Western Society leads him to the conclusion that any re-integration of society has to be achieved consciously and can only be tackled after an adequate idea of the nature of a society has been gained. This is in the first place a task for social science, since science alone has sufficient authority to get its conclusions adopted universally as a basis for action.

Science and University Teaching

AN article by Dr. W. H. George on "Science and University Teaching" in the *New University* of November, emphasizing the value of the widespread use of scientific methods in dealing with the social problems of to-day, points out that an education which includes one or more sciences does not necessarily foster scientific action. Even a knowledge of science up to university degree standard does not necessarily guarantee ability to think or act scientifically within the scope of the sciences studied. While, however, teaching is the best way of promoting the use of the scientific method, Dr. George points out that, in general, science but no scientific method is taught to science students and that scientific method, but no science, is taught to a small proportion of arts students and this teaching is separated from that of the student's main subject of study.

National Forest Park near Snowdon

A COMMITTEE was appointed by the Forestry Commissioners on March 31 last to advise as to the steps which might be taken to form a national forest park on their properties in the vicinity of Snowdonia. It has now issued its report on the "National Forest Park Committee" (H.M. Stationery Office, 1937). The Forestry Commissioners had expressed an intention of designating areas, such as the one here under consideration, 'National Forest Parks'. It is pointed out that this type of park has no affinity with the 'National Park' as described in the report of the National Park Committee. The area here in question is the Gwydyr Forest of about 18,000 acres. The Forest forms a fringe of the wild and open mountain land culminating with the Snowdon range with its large stretches of foothills and rough grass, heather and rock-strewn spaces. The central Snowdon region is mostly in private ownership. The land in Gwydyr Forest which has been, or will be, planted by the Forestry Commissioners comprises about three-quarters of the area and forms the lower slopes on the east and south-east of the Snowdon range, in which group of mountains is included the Glyders and Carnedd mountains. There are numerous roads, tracks and footpaths, many of which afford delightful walks, climbs and views. The district includes some of the finest mountain scenery in North Wales and attracts a very large number of holiday-makers in the summer. The larger part of the Forest is held by the Commissioners on long leases subject to certain reservations. Local hostels exist, and certain other facilities in this respect and camping facilities are recommended, it being suggested that Government be asked to provide funds for the Commissioners' use in these developments. Such funds should surely be obtainable from the region which will benefit by the provision of this national forest park.

Acquisitions at the British Museum (Natural History)

AMONG the specimens presented to the Department of Mineralogy of the British Museum (Natural History) is a collection of about three hundred rock and mineral specimens, made by Mr. H. St. J. B. Philby, between Mecca and Mukalla, during his last journey of exploration through West and South-West Arabia. The collection is not only of academic interest. There is evidence of the presence of oil in the richly bituminous limestones and oil-soaked shales outcropping in the neighbourhood of Shabwa, and farther north, near Jizan, Mr. Philby collected specimens of hæmatite, an important iron-ore. This mineral is also present in several quartz-reefs, of which he brought back samples. By his careful and complete field-records of each occurring type, Mr. Philby has brought to light a number of salient features in the geological structure of a region previously unknown to Europeans, and has made it possible to prepare an approximate geological map of the region through which he travelled.

Vital Statistics in Great Britain

ACCORDING to a return published by the Registrar-General, the birth-rate in England and Wales during the year 1937 is provisionally estimated at 14·9 live births per thousand of the population, and the crude death-rate at 12·4 deaths per thousand of the population. The number of deaths of children under one year, per 1000 live births, was 58. The birth-rate for 1937 is 0·1 above that for 1936, 0·2 above that for 1935 and 0·5 above that for 1933—the lowest on record. The crude death-rate is the highest recorded since 1929 and is 0·3 above that of 1936, an increase which is largely associated with the heavy influenza mortality of the first quarter of the year. The infant mortality is 1 below that of 1936, and only 1 above that of 1935—the lowest recorded.

Rheumatic Fever as a Protozoal Disease

DR. G. ARBOUR STEPHENS, 61 Walter Road, Swansea, referring to a recent Colonial Office Medical Report on the Falkland Islands, states that although the weather there is described as very damp and "permanent October" weather, and although the houses are damp, the soil acid, the food so poor that the school children wear dentures, and septic tonsillitis (due to *Streptococcus*) is so common, nevertheless rheumatic fever does not occur. This, he claims, supports the view that rheumatic fever is due to a protozoon (something like the malarial parasite), for the necessary insect carriers, such as harvest bugs, midges and fleas do not exist on the Islands.

Current Titles

WE have received the first part of a new monthly journal, *Current Titles*, published by Engineering Journals, 928 Broadway, New York, the subscription being 3 dollars yearly (4 dollars outside the United States). The journal gives the tables of contents of a large number of scientific, technical and engineering journals in English. We note that these include

Government publications, and that geology, physics, metallurgy and chemistry are well covered; biology is not dealt with, as there is a similar journal in this field. The new journal will serve a very useful purpose, since it gives at a glance the titles of papers in a wide field. The format is very convenient.

Fifth Glass Convention

THE fifth Glass Convention will be held at the Norbury House Hotel, Droitwich, on May 18–21 under the presidency of Mr. H. S. Williams-Thomas. This year will be an important one in the history of the British glass industry because in London the Society of Glass Technology has just concluded its twenty-first anniversary celebrations, and in April the *Daily Mail* Ideal Home Exhibition at Olympia will have glass as its outstanding motive. A subject which is engaging the attention of industrialists at the moment is the trade cycle, on which Mr. Harold Macmillan, M.P., will speak during one of the business sessions. Mr. Ronald Cartland, M.P., will give an address on "Recent Industrial Legislation". The presidential address will be entitled "Craftsmanship in Industry". Prof. W. E. S. Turner will lead the discussion on the presidential address. Of no less interest are the technical sessions arranged by the Society of Glass Technology, the subjects being "Glass Finishing Processes" and "Plastics and their Relation to the Glass Industry".

Announcements

SIR JOHN SNELL, chairman of the Electricity Commission, has been awarded the Faraday Medal of the Institution of Electrical Engineers. The Medal is awarded once a year either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the institution. Mr. Frank Gill, past president of the Institution, has been elected an honorary member of the Council of the Institution.

THE Messel Medal of the Society of Chemical Industry has been awarded to Prof. L. H. Baekeland, honorary professor of chemical engineering in Columbia University. Prof. L. H. Baekeland is the founder of the plastics industry and his own name is perpetuated in the well-known commodity 'Bakelite'. He was also responsible for the 'Velox' patents used in modern photographic industry. The Messel Medal is awarded every two years for meritorious distinction in science and its application to industry.

DR. E. W. RUSSELL has been appointed Goldsmiths' Company's soil physicist at the Rothamsted Experimental Station in succession to Dr. G. W. Scott Blair, who has been appointed head of the Dairy Chemistry Department at the National Institute for Research in Dairying, Shinfield, Reading. Dr. Russell studied soil science at Zurich under Prof. Wiegner and in Russia under Prof. Polynov; for the past few years he has been assistant in the Soil Physics Department, Rothamsted, and has published various papers on soil texture.

AT the annual general meeting of the Royal Meteorological Society on January 19, Dr. B. A. Keen, assistant director, Rothamsted Experimental Station, Harpenden, was elected president in succession to Dr. F. J. W. Whipple. Other officers elected include: *Secretaries*, H. W. L. Absalom, W. Dunbar, E. L. Hawke; *Treasurer*, W. M. Witchell; *New Members of Council*, C. E. Britton, Dr. R. F. Fox, Major H. C. Gunton, R. S. Read, Gerald Seligman and Dr. R. C. Sutcliffe.

THE following have been elected officers of the Royal Microscopical Society for the present year: *President*: J. E. Barnard; *Hon. Treasurer*: C. F. Hill; *Hon. Secretaries*: Prof. R. T. Hewlett and J. Smiles; *New Members of Council*: Dr. J. A. Murray, J. H. Pledge, T. E. Wallis and S. R. Wycherley; *Hon. Editor*: Dr. G. M. Findlay; *Hon. Librarian*: Dr. C. Tierney; *Hon. Curator of Instruments*: M. T. Denne; *Hon. Curator of Slides*: N. Ingram Hendey.

THE forty-first Bedson Lecture will be delivered by Prof. J. Kenner, professor of technological chemistry, University of Manchester, at King's College, Newcastle-upon-Tyne, on Friday, February 4. Prof. Kenner will take as his subject "Aliphatic Diazo Compounds".

PROF. BERNARD NOCHT of Hamburg has been awarded the shield of nobility of the German Reich.

PROF. RICHARD KUHN, director of the Kaiser Wilhelm Institute for Medical Research at Heidelberg, and Dr. Ernst Spath, professor of chemistry at Vienna, have been elected honorary members of the Société de Chimie Industrielle of Paris.

PROF. MAX EUGLING, who is well known for his climatic and hydrological researches, has succeeded Prof. Grassberger as chief of the Institute of Hygiene of the University of Vienna, where he has been assistant for the last thirty years.

THE second Darling prize of the League of Nations for original work on malaria published during the previous five years has been awarded to Prof. N. H. Swellengrebel, professor of tropical parasitology at Amsterdam, and will be awarded to him during the Third International Congress on Malariology in September 1938.

THE Association for Education in Citizenship has arranged a secondary school conference on methods of training for the responsibilities of citizenship, to be held at Morley College, Westminster Bridge Road, London, S.E.1, on March 4–6. Applications to attend the conference, accompanied by a fee of 5*s*., should reach the secretary of the Association, 10 Victoria Street, London, S.W.1, not later than February 5.

Letters to the Editor

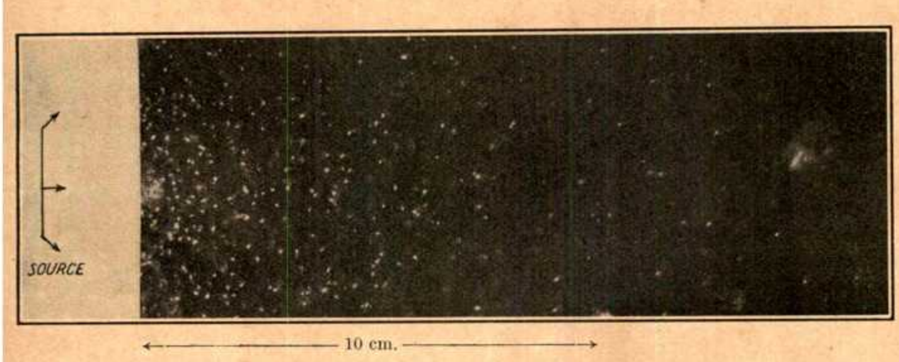
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 207.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nuclear Transformation by *K*-Electron Capture

THE theoretical expectation that a nucleus which emits positive electrons may, as an alternative mode of transformation, change by capturing a *K*-electron, was recently demonstrated experimentally by Alvarez[1], who was able to detect by means of a counter arrangement the fluorescent X-radiation which follows *K*-capture. Earlier experiments by Jacobsen[2], using an active isotope of scandium in an expansion chamber, had not shown any evidence of such fluorescent radiation. Alvarez's observations were made on titanium which had been bombarded by fast deuterons. Walke[3] had previously shown that one of the products of the bombardment is an isotope of vanadium, of mass number 48 and half-life 16 days, which emits positrons and thus transforms to ^{48}Ti. Alvarez concluded from his experiments that ^{48}V also transforms to ^{48}Ti by the capture of a *K*-electron, the two modes of transformation being about equally probable.



We have recently been able, through the kindness of Mr. Walke, to examine, in the expansion chamber, the activity of a specimen of titanium which had been bombarded by fast deuterons about five months ago. (This source was activated in the Radiation Laboratory, Berkeley, and was a gift to Mr. Walke from Prof. E. O. Lawrence.) The photographs obtained showed a number of tracks due to negative electrons, but very few due to positive electrons. When a magnetic field was applied to bend away these electrons, a large number of very short tracks was observed. These tracks show that a soft X-radiation is emitted from the titanium specimen, indicating, in a striking way, a *K*-capture transformation. The energy of the photo-electrons produced by the *K*-radiation of titanium (or of a neighbouring element) is only about 4,000 volts, so that their tracks appear as spots in the photographs. In the photograph reproduced here there are about 300 of these short tracks.

The photographs show the decrease in intensity of the radiation due to absorption in the gas of the chamber. This gas was oxygen at a pressure of 66 cm., which for titanium *K*-radiation has a linear absorption coefficient of about 0·07 cm.$^{-1}$. Preliminary counts of the spots in photographs taken with a collimated source, to avoid errors due to the limited depth of focus, gave an absorption roughly in accordance with this, indicating, actually, a parent atom of atomic number 21 ± 1 (Ti = 22). Further experiments will enable us to decide definitely the atomic number of the element responsible for the radiation.

The noteworthy feature of this example of *K*-capture is its large probability compared with that of the alternative process of positron emission. Indeed, unless positrons of very low energy are emitted, this ratio is of the order of 1000 : 1. Even this estimate assumes that the few positrons observed represent the same nuclear transformation. This may well not be the case, and it is not unlikely that the transformation by positron emission is energetically impossible (its threshold being about 2 mc^2 higher than that for *K*-capture).

In Alvarez's experiments on newly activated titanium, the number of *K*-captures was approximately equal to the number of positrons from ^{48}Ti. The latter decays with a period of 16 days and would thus have now about 1/1000 of its initial activity. The fact that we find about 1 positron for every 1000 *K*-captures is not inconsistent with Alvarez's results if we assume that the positrons are due to ^{48}Ti and the *K*-capture to a nucleus with a very long period. We should also mention that the recoil electrons produced by the γ-rays from the present source bear a much smaller ratio to the fluorescent quanta than in Alvarez's experiments, indicating that the bulk of the initial γ-ray activity is not associated with the *K*-capture process. Further observations will be made to elucidate the origin of the various radiations emitted by the source.

E. J. WILLIAMS.
E. PICKUP.

George Holt Physics Laboratory,
University, Liverpool.
Dec. 22.

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[1] Alvarez, L. W., *Phys. Rev.*, **52**, 134 (1937).
[2] Jacobsen, J. C., NATURE, **139**, 879 (1937).
[3] Walke, H., *Phys. Rev.*, **51**, 1011 (1937).

Altitude Effects in the Red Part of the Auroral Spectrum and the Two Types of Red Auroras

IN a previous note in NATURE[1], I described observations made at Oslo of an auroral display which showed red upper limits, while the lower part had the ordinary greenish-yellow colour. Spectroscopic observations gave an enormous enhancement of the red oxygen line 6300 with increasing height. In a later paper[2], I described quantitative measurements of spectrograms corresponding to auroras of ordinary colour, which also gave a considerable enhancement of the red line 6300 with increasing altitude. It became a matter of importance to make further measurements in order to see if the altitude effect on the red line was a general occurrence.

During auroral displays which were observed at Oslo on the two nights of October 11–13, 1937, I obtained on panchromatic plates four pairs of spectrograms. For each pair the spectrograms were taken as quickly as possible in succession, one from the lower, the second from the upper limit of the auroral streamers. Photometer curves of the spectrograms covering the red part and the green line 5577 are shown in the accompanying illustration. The first pair, I, was taken on the evening of October 11, the other three pairs II, III, IV during the following night.

Although the relative intensity of the red line is very different for different pairs, we find that *for each pair the relative intensity of the red line increases as we pass upwards from the lower to the upper limit.* By means of an intensity scale taken by means of a light source of known intensity distribution, we found the following intensities (I_r) of the red line relative to the green one :

Pair	I_r (upper)	I_r (lower)	$\frac{I_r \text{ (upper)}}{I_r \text{ (lower)}}$
I	2·74	1·15	2·38
II	0·82	0·60	1·37
III	0·75	0·36	2·08
IV	1·07	0·34	3·15

Mean, 2·25

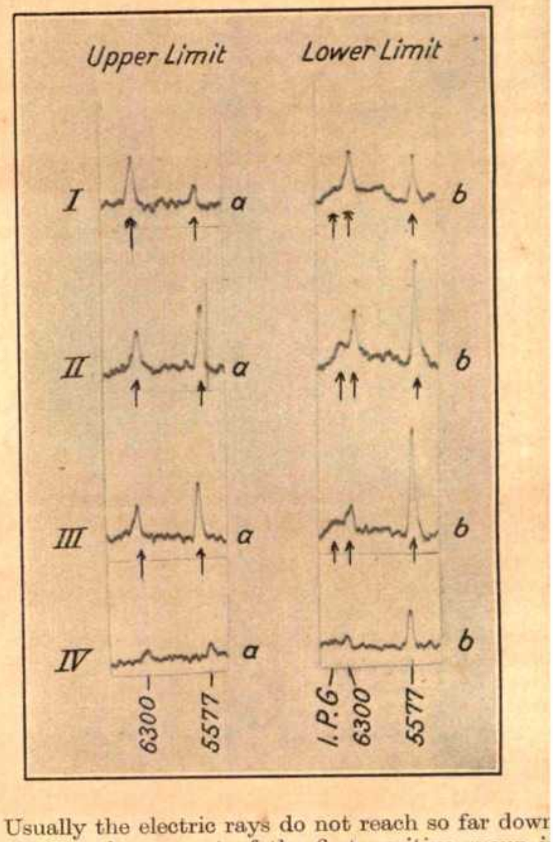
On an average, the relative intensity of the red line at the upper limit is 2·25 times that at the lower.

The numbers also confirm the result previously described[2] that the red line 6300 may obtain an intensity considerably greater than that of the green line, a result which shows that the $^1D_2$-state is excited by a certain process, which acts independently of that which excites the $^1S_0$-state, and which results in the emission of the green line.

The photometer curves for the lower limit all show distinctly the bands of the first positive group, while these bands are absent on all the curves corresponding to the upper limits showing the existence of a pronounced altitude effect of the first positive group, and in such a way that its intensity relative to that of the green line *increases as we pass downwards in the auroral region.* The altitude effects of the red line 6300 and of the first positive group have an interesting bearing on the two types of red auroras called A and B.

As I have shown, the red colour of type A is due to the enhancement of the red line 6300, which is particularly prominent during sunspot maxima and when the atmosphere is exposed to sunlight.[3] *The altitude effect of this line means that this type of red aurora has a tendency to be more intensively red towards the upper limits of the streamers.* The enhancement is shown to be due to an excitation process which brings the O-atom directly to the $^1D_2$-state, and this process is associated with some component of the atmosphere formed by the action of short-wave radiation from the sun. This component is probably ozone, and the $^1D_2$-state is excited through collisions between ozone molecules and nitrogen molecules in the metastable $A(^3\Sigma)$-state (cf. ref. 2).

Type B is characterized by an intense red colour along the *lower border* and was shown to be due to the enhancement of the first positive group, which is particularly pronounced when the aurora reaches a very low altitude. The results given in this note show that the enhancement is not restricted to regions near the lower limit, but *the first positive group shows a gradual enhancement as we pass from the upper limit downwards.*



Usually the electric rays do not reach so far dowr that the enhancement of the first positive group i sufficient to give the aurora a red lower border. A weak reddish lower border is fairly frequent, bu auroral bands with an intense and fairly broa red lower border are very rare and *seem to be mos frequent at times of sunspot minima*[4], showing that th electric rays obtain the greatest maximum energ at sunspot minima.

L. VEGARD.

Physical Institute,
Oslo.
Dec. 15.

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[1] Vegard, L., NATURE, **138**, 930 (1936).

[2] Vegard, L., *Z. Phys.*, **106**, 108 (1937).

[3] Vegard and Tönsberg, NATURE, **137**, 778 (1936).

[4] Vegard, L., *Geophys. Pub.*, **10**, No. 4 (1933).

Origins of the Zodiacal Light

I refer to an important paper[1] by Prof. H. P. Robertson of Princeton, tracing out the effects of the Poynting principle of suction of fine orbital dust or gas into the sun or other strongly radiating star. It concerns me directly as in an amendment of the numerical factor for the reprint in Poynting's "Collected Papers" I inadvertently doubled the final value by adding the effects in the two frames of reference, that of the sun and that of the orbital particle, instead of taking them as alternative.

There could not be a permanent zodiacal light at all unless the particles that deflect it were sustained against falling into the sun, and that could only be by an orbital motion of planetary type for each particle, whose centrifugal influence holds it up against gravitation to the sun. The perhaps unexpected result is here involved that the rather thick disk around the sun, extending beyond the earth's orbit, which shines permanently throughout astronomical times, must be a residue of the original whirling solar nebula, which its presence indeed goes far to establish: for it can scarcely be conceived as formed by ejection of particles nearly tangentially from the sun's surface. Perhaps this arresting conclusion may not really be unfamiliar: Poynting had possibly known of it. The radiation incident from the sun exerts according to his principle a dynamical retardation which gradually converges each orbit spirally into the sun in a time not great on the astronomical scale, provided, however, the particles are not large compared with the wave-length of the radiation. This gradual subsidence demands a renewal from outside, in a steady stream, which is more rapid and so less dense for the smaller particles or gaseous atoms and ions. The particles must not collide as in a gas, else all would be broken up soon, and the gas ultimately sustained otherwise as a close-fitting atmosphere in Maxwellian manner.

Thus we are led to contemplate a nebula surrounding the sun, which has now become of the type of the rings of Saturn, but enormously less close packed. This favouring paucity of collisions is reasonable if only on account of the extreme tenuity of the distribution, like that in a comet's tail, the mean distances of neighbouring particles being comparable with miles. The mode of slow subsidence of a gaseous rotating nebula of this non-colliding type would perhaps be an interesting subject for mathematical analysis after the manner of the Saturn ring theory, conceivably even connecting up with a distribution of atoms not entirely negligible throughout the depths of space.

The immediate cause of this note is, however, a recent announcement from the MacDonald Observatory in Texas by C. T. Elvey and P. Rudnick[2] that the zodiacal light is ordinary reflected sunlight and shows no sensible proportion of a Stokes-Rayleigh scattering such as produces the blue sky. This shows, as they remark, that the particles which mainly deflect it have dimensions of the order of several wave-lengths at least. We note here in confirmation that by the Poynting analysis, smaller particles would, as *supra*, be sucked into the sun far more rapidly and be gradually winnowed out, more rapidly the nearer the sun, and therefore for given influx from beyond the replenishing stream would have far smaller density: the distribution of the larger particles would, in fact, require little replenishment, but could scarcely extend out indefinitely.

Diffuse nebulæ are held likewise to shine by illumination from blazing stars located in front of them, because they send the same kind of light; but for them the sideway scattered bluer light would have little chance of being important. No inference as to size of particles in these nebula would thus arise. This perhaps clears up the general question of colour in nebular cosmogony. The inference from colour as regards the zodiacal light would likewise be vitiated if the effective length of the source that is in the line of sight is large compared with distance of that line from the sun, which may be not improbable. But however that be, the Poynting dynamical train of reasoning here presented for the solar nebula would remain firm.

Joseph Larmor.

Holywood,
N. Ireland.
Jan. 5.

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[1] *Mon. Not. Roy. Astro. Soc.*, **97**, 423–38 (1937).

[2] *Astrophys. J.*, Oct. 1937, as quoted in *Science Abstracts*, Dec. 1937.

The Liquid State of the Primitive Earth

It has often been suggested that the earth must have been in a liquid state at an epoch near the very beginning of its formation. I wish to give an argument which confirms this view. If we suppose that the earth was originally in a gaseous state, we can imagine a model, which we call the globe, defined as a polytropic gas sphere of mass 6×10^{27} gm., equal to the present mass of the earth. Assuming (following Jeffreys) that the central temperature must have been equal to the effective temperature of the sun at the time of formation, that is, about 6000° K., and considering the polytropic indices $n = 3$, 1 or $\frac{1}{2}$, one finds a radius of $2{\cdot}2 \times 10^{10}$, $1{\cdot}28 \times 10^{10}$ or $1{\cdot}24 \times 10^{10}$ cm. The smaller values of n correspond to a lower compressibility than is generally assumed for the stars (Eddington). The values of the density are such that the material of the globe is very nearly a perfect gas. The pressure and temperature in the globe can then be calculated from Emden's tables, as functions of the distance from the centre.

On the other hand, by means of the Clapeyron-Clausius law, one can estimate the boiling temperature of the metallic vapours as a function of the pressure, and consequently as a function of the distance from the centre in the globe.

If the polytropic temperature and the boiling temperature of iron (the most abundant metal) are plotted against this distance, it is found that in a thick outer layer of the globe, the conditions are such that the iron must condense into liquid metal and consequently precipitate in drops towards the centre. Any other reasonable choice of the characteristics of the globe such as would give a good model of the earth leads to the same conclusion. This condensation may be considered as spontaneous. The thickness of the layer is about $\frac{3}{4}$ of the radius of the globe for $n = 3$, and about $\frac{1}{2}$ for $n = 1$ and $n = \frac{1}{2}$.

This conclusion provides an explanation of the occurrence of the iron core which is generally regarded as occupying the centre of the earth.

A full account of this theory will appear shortly in the *Archives des Sciences physiques et naturelles*.

André Mercier.

Institut for teoretisk Fysik,
Copenhagen.
Dec. 2.

Westward Extension of the Ranikot Sea

IN a previous letter[1] I showed that the Ranikot (Palæocene) Sea of India must have extended over the whole length of the Himalayas, from eastern Tibet to Waziristan. More recently, some interesting fresh evidence has been found regarding the extent of the Ranikot Sea; for Mr. A. G. Davis, who is working for the Anglo-Iranian Oil Company, informed me that he had found Ranikot fossils in collections made by Dr. J. V. Harrison of that Company from a section near Shamshir-i-Quli (lat. 33° 30′ N.; long. 47° 10′ E.) on the western borders of Persia.

These collections Mr. Davis has since shown to me, and I have been able to confirm his opinion, identifying the following species as present: *Nummulites nuttalli* Davies, *N. thalicus* Davies, *Operculinoides* cf. *sindensis* Davies, *Miscellanea stampi* Davies, *M. miscella* D'arch. and Haime, *Sakesaria* cf. *cotteri* Davies and *Alveolina globosa* Leymerie. The thickness of Upper Ranikot beds at Shamshir-i-Quli is at least 500 feet; and the succeeding less fossiliferous beds, with forms which I referred to *Alveolina lepidula* Schwager, *A.* cf. *oblonga* D'Orbigny and *Orbitolites* cf. *complanatus* Lamarck, would seem to be of Laki age. Although true Ranikot fossils have not yet been found in any other collections received by Mr. Davis, the existence of the Ranikot at Shamshir-i-Quli is unquestionable.

The occurrence is worth recording, since Ranikot beds have never before been certainly located much farther west than long. 68° E. Taken in conjunction with my discovery[2] last year of an abundant Upper Ranikot fauna in Sir Henry Hayden's collections from Kampa Dzong, due north of Calcutta, this last discovery shows that the Upper Ranikot Sea extended in an east-to-west direction from the vicinity of Lhasa to that of Bagdad.

I am indebted, for permission to publish these facts, to the courtesy of the Anglo-Iranian Oil Company.

L. M. DAVIES.

8 Garscube Terrace,
Edinburgh, 12.
Dec. 24.

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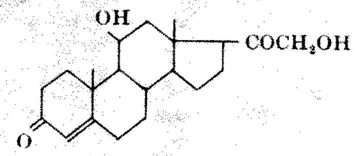
[1] "Extent of the Ranikot Sea", NATURE, **139**, 414–415 (1937).

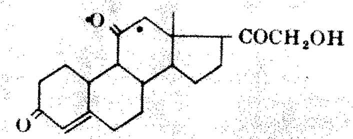
[2] "Eocene Beds of the Punjab Salt Range", *Pal. Indica* (N.S.), **24** Mem. 1, Appendix, 68–71 (1937).

Chemical Structure of Corticosterone

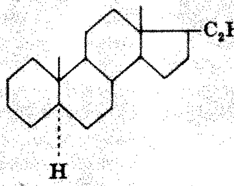
THE adrenal gland produces a hormone which is essential to life. During the last two years, several workers have succeeded in isolating, from purified preparations of the cortical hormone, a number of crystalline compounds. Among these substances corticosterone and dehydro-corticosterone possess the greatest biological activity. The structures (I) and (II) were proposed for corticosterone and its dehydro-derivative[1,2]. These formulæ were not definitely proved, but were chiefly based on the assumption that corticosterone might possess a constitution similar to some of the above-mentioned compounds, which have been isolated from the adrenal gland and which have been found to contain one more atom of oxygen in their molecules. These substances, which can be designated as the C_{21}-O_5-group, contain the sterol ring-system since they can be converted into the hydrocarbon androstane[3]. The suggestion that corticosterone contains the same ring-system has so far not been supported by any experimental evidence.



(I)
Corticosterone



(II)



(III)
Allo-pregnane

By means of a series of reactions, the details of which will be published in the *Helv. chim. Acta*, corticosterone can be transformed into the hydrocarbon allo-pregnane (III) (m.p. 84°, $[\alpha]_D^{21} = +12\cdot7°$ in chloroform). The same hydrocarbon was also obtained by a Clemmensen reduction of allo-pregnane-dione-3·20[4]. This evidence appears, therefore, to prove the presence of a steroid structure in corticosterone.

MARGUERITE STEIGER.
T. REICHSTEIN.

Laboratorium für organ. Chemie,
Eidg. Techn. Hochschule,
Zurich.
Dec. 18.

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[1] Kendall, E. C., Mason, H. L., Hoehn, W. M., McKenzie, B. F., *Proc. Staff Meet. Mayo Clinic*, **12**, 136 (1937). *J. Biol. Chem.*, **120**, 719 (1937).

[2] Reichstein, T., *Helv. chim. Acta*, **20**, 953 (1937).

[3] Reichstein, T., *Helv. chim. Acta*, **19**, 979 (1936); **20**, 978 (1937). Steiger, M., and Reichstein, T., *Helv. chim. Acta*, **20**, 817 (1937).

[4] Butenandt, A., und Westphal, U., *Ber. deut. chem. Ges.*, **67**, 1440 (1934). Butenandt, A., Westphal, U., und Hohlweg, W., *Z. physiol. Chem.*, **227**, 84 (1934).

Treatment with Ascorbic Acid of the Plasma of a Fowl affected by Erythroblastosis

IN the course of researches aiming at investigating the nature of the virus of aviary erythroblastosis, the following observations were made.

By adding to the plasma (plus sodium oxalate) of a fowl seriously affected by erythroblastosis (O. G. strain which we owe to the kindness of Prof. Oberling) ascorbic acid in determinate proportions, a turbidness was noticed in the plasma itself which, after having been kept in the ice-chest for some hours, became transformed into a precipitate. 0·1 gm. of ascorbic acid was dissolved in an 8 per cent sodium chloride solution. This solution was added to the plasma *as soon as the ascorbic acid was dissolved.* The final concentration of ascorbic acid in respect to the plasma was 1 : 150.

The following tests were made:

(1) Comparison of the activity of the plasma injected immediately after the ascorbic acid had been added with the same plasma not treated. *It was seen that the activity was not appreciably modified.*

(2) Comparison of the activity of the two fractions obtained from the plasma after treatment with ascorbic acid; kept in the ice-chest for three hours and centrifugal separation of the precipitate from the liquid above it. (The precipitate was washed on the surface with saline solution.)

Supernatant fluid	Precipitate
Animals inoculated	Animals inoculated
(1) died of erythroblastosis after 9 days	(1) survives
(2) ,, ,, ,, ,, 12 ,,	(2) ,,
(3) ,, ,, ,, ,, 14 ,,	(3) ,,
(4) ,, ,, ,, ,, 17 ,,	(4) ,,

(3) Comparison of the activity of the fraction obtained after treatment of the plasma with ascorbic acid and elimination of the precipitate in the way mentioned above, with the same plasma not so treated.

Plasma (+ oxalate) not treated			Ascorbic acid plasma supernatant fluid		
Animals treated	Positives	Average time of survival of positives	Animals treated	Positives	Average time of survival of positives
21	15	19 days	21	19	15 days

It seems, therefore, that the activity of the plasma treated with ascorbic acid (contrary to the results obtained by Claude[1,2] by acidification with other acids of watery extracts of Rous's sarcoma) remains altogether in the supernatant fluid; and indeed, the activity seems in some degree to be increased in respect to the normal plasma.

Other researches are being carried out with plasma of fowl affected by erythroblastosis brought, by means of lactic acid or galacturonic acid, to the same *p*H, so as to ascertain whether in reality the elimination of an inactive substance from the leukæmic plasma and its successive activation is, as would seem from purely preliminary observations, the consequence of an elective action on the part of the ascorbic acid itself.

E. MORELLI.
A. VERCELLONE.

Istituto di Perfezionamento in Chimica
Industriale "Giuliana Ronzoni",
Via Giuseppe Colombo, 81
Milan (4/43).
Dec. 22.

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[1] Murphy, J., Sturm, E., Claude, A., and Helmer, O., *J. Exp. Med.*, **56**, 91 (1932).

[2] Claude, A., *J. Exp. Med.*, **61**, 27 (1935).

Role of Manganese in the Biological Synthesis of Ascorbic Acid

SPECULATION on a possible explanation of the difference in ascorbic acid contents of different plants led me to the idea that this difference may be due to the activating influence on the synthesis of ascorbic acid by plants of some mineral or minerals which are not detectable by ordinary analytical methods. A close study of the paper by Boyd and De[1], who have made a spectrographic analysis of a number of vegetable and animal products, revealed the fact that the manganese lines are very prominent in those vegetable products and animal tissues which are generally rich in ascorbic acid content. This led me to the investigation of the role of manganese in the synthesis of ascorbic acid by plants and animals.

By germinating Bengal gram (*Cicer arietinum*) in distilled water and in dilute manganese sulphate solutions containing manganese equivalents of 1 in 10^6, 1 in 10^5 and 1 in 10^4 for six days under identical and sterile conditions, it has been found that the ascorbic content of gram germinated in dilute manganese solutions is higher than that of gram germinated in distilled water, the respective amounts synthesized being 63·7 mgm., 75·5 mgm., 86·6 mgm. and 84·7 mgm. per 100 gm. of the original dry grams. The ascorbic acid assay was made by a modified Tillmann method after reducing the dehydroascorbic acid in the extracts with hydrogen sulphide. The germination was better in 1 in 10^6 and 1 in 10^5 manganese solutions and more stunted in 1 in 10^4 manganese solution than in distilled water.

Fuller details of this and experiments on animals which are in progress will be published elsewhere.

M. N. RUDRA.

Department of Medical Chemistry,
The Prince of Wales Medical College,
Patna.
Dec. 23.

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[1] Boyd, T. C., and De, N. K., *Ind. J. Med. Res.*, **21**, 109 (1933).

Absorption of Carotinoids from the Human Intestine

IT is generally supposed that, for human beings, carotene of vegetable origin is the principal source for vitamin A. If this is true, it is important to know the absorbability of leaf carotene. We have investigated this on two healthy male adults (namely, ourselves).

Test dose			Excretion in fæces			
	carotene	xanthophyll	carotene	%	xanthophyll	%
50 gm cooked spinach	1080γ	3675γ	1017γ	94	2478γ	67
50 gm. cooked spinach + 30 gm. lard	1660	4805	1573	95	3893	81
100 gm. cooked carrots	5700	370	5643	99	163	44
β-carotene dissolved in oil	1056		437	41		

For one to two weeks a diet was followed which was very poor in carotinoids (bread, rice, lard, meat, Marmite and 50 mgm. ascorbic acid daily). Then the excretion of carotinoids in the fæces was determined before and after intake of a test dose of vegetables containing a known quantity of carotinoids. The fæcal carotinoids were extracted with alcoholic potash, shaken out with peroxide-free ether and after evaporation of the ether dissolved in petroleum ether. The carotinoids were estimated colorimetrically with the Zeiss stepphotometer after chromatographic analysis according to Tswett with activated aluminium oxide (Brockmann).

While on this diet, 6–10γ carotene and 57γ xanthophyll per 20 gm. fæces were excreted. In the accompanying table the results are summarized of the determinations of the excretion above this level after intake of different test doses.

From these data it follows that nearly the total amount of vegetable carotene was excreted. Much better absorption took place when the carotene was dissolved in oil. Vegetable xanthophyll was absorbed to a greater extent than carotene.

Experimental details and a discussion of the facts from a dietetical point of view will appear elsewhere.

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Dec. 30.

Vascular Supply of the Pedicel and the Ovule in Species of Dilleniaceæ

THE vascular anatomy of the flower in many families of plants has been studied in recent years; but the family Dilleniaceæ has escaped attention. For this reason the floral anatomy of *Dillenia indica* Linn., *Wormia triquetra* Rottb. and *Wormia Burbidgei* Hook. has been investigated. The study has brought to light a number of interesting points, but the vascular supply of the pedicel and the ovule particularly has been found to be very unusual.

The pedicel in angiosperms normally shows in a transverse section either a complete ring of xylem and phloem or a ring of collateral vascular bundles surrounding a central pith. In these plants it has been found to show, through its greater length, several rings of vascular bundles. In *Wormia triquetra* there are five such rings arranged again in a ring-like fashion on the periphery of the pith (Fig. 1).

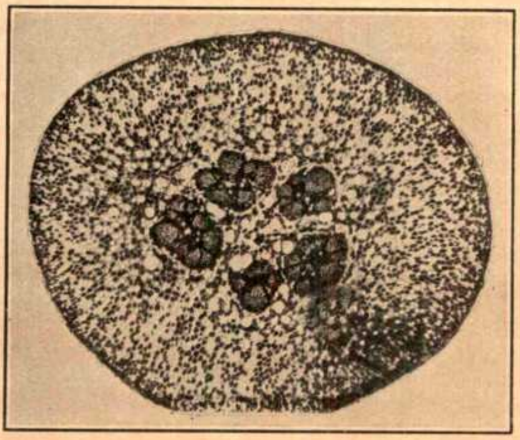

Fig. 1.
TRANSVERSE SECTION OF THE PEDICEL OF *Wormia triquetra*.

Each ring consists of 7–10 collateral vascular bundles with endarch protoxylem. In *Wormia Burbidgei* there are 8–10 rings; in *Dillenia indica* there are five such rings of vascular bundles. The pedicel thus in every case shows polystelic structure. Such a condition is not known in the flowers of any other angiosperms.

The ovule in angiosperms is generally supplied by a single vascular trace which travels up the raphe and ends at the chalaza. Rarely it may also penetrate the nucellus and reach the chalazal end of the embryo-sac. Exceptions to this condition are known only in some Amentiferous families, in which the ovular trace divides in the chalaza and sends branches to the integuments. In the above-mentioned Dilleniaceæ quite a new modification of the ovular vascular supply is seen. The ovular trace does not run unbranched up to the chalaza. It divides repeatedly during its course. About one third the way up, it bifurcates; the two branches divide again and then again. Ultimately all of them anastomose to form a plate of vascular tissue just at the base of the nucellus. The exact situation is shown in Fig. 2, which is a reconstructed diagram of the vascular supply of the ovule from a series of transverse and longitudinal microtome sections. Like the vascular supply of the pedicel, such a behaviour of the ovular trace has not been recorded for any other flowering plants.

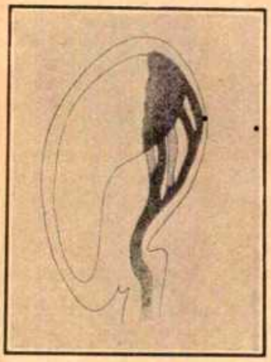

Fig. 2.
DIAGRAM OF THE VASCULAR SUPPLY OF THE OVULE IN *Wormia triquetra*.

The material for the investigation has been supplied by Prof. A. C. Joshi, and I am much indebted to him for suggesting the investigation and for guidance during its progress.

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Nov. 29.

Genetic Control of a Morphogenetic Substance in *Drosophila melanogaster*?

STURTEVANT[1] has shown by the study of elimination mosaics involving an X-chromosome carrying the 'gene' Bar (reducing the number of facets in the eye of *Drosophila melanogaster*) that "the presence of tissue that is genetically 'not-bar' in some manner induces the formation of facets in tissue that is genetically bar and that would not normally have developed facets". The obvious conclusion was that these facts had to be interpreted "in terms of some influence that is intercellular in nature".

Transplantation experiments of Beadle and Ephrussi[2] have shown that Bar eyes, contrary to wild type eyes, do not produce the 'vermilion substance' required in the pigment formation of wild type. Unpublished results of Beadle and Ephrussi seem to indicate that several other genes influencing the size and the shape of the eye, such as Lobe or eyeless, partly or totally inhibit the production of the 'vermilion substance'. It was thought, therefore, that the vermilion substance and a '*facet-forming substance*', suggested by Sturtevant's experiments, might be developmentally and, possibly, chemically related. Consequently, experiments were performed in which Bar larvæ have been supplied with *Calliphora* extracts rich in vermilion substance[3]. The flies were raised at a constant temperature ($25 \pm 0 \cdot 1°$ C.). Three different concentrations of nitrogenous extract were tested: 4, 8 and 16 per cent.

The results of the experiments are very clear, especially in the case of the highest concentration, where the eye size shows an obvious increase. Some facet counts have been made; the following table summarizes the results of the counts made on males only :

	Observed facet numbers	Mean
Control	102, 97, 111	103
4 per cent extract	124, 134, 107, 120, 236	144
8 „ „	294, 211, 175, 337, 205	244
16 „ „	480, 486, 502, 4183, 89	455

(Among the treated females the observed maximum number of facets has been so far 382, as compared with the mean value of 85 in control females. Several heterozygous (*ClB/lz*) females have been observed: here the maximum facet number was 619 against 303 in the untreated control.)

It is clear that in these experiments the facet number has gradually increased up to about five times that of the control flies. There is considerable variation in the facet number within each experiment, which corresponds, in our opinion, to the variation of age of the larvæ at the time of treatment (in these experiments the age of the larvæ has been controlled only within 24 hours).

We interpret the above results as indicating that the extracts used contain a special morphogenetic (facet-forming) substance, the action of which is under genetic control.

The findings of Muller, Prokofjeva and Kossikow[4] and of Bridges[5], according to which the Bar effect is due to a small duplication, constitute a point of additional interest.

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Dec. 30.

[1] *J. Exp Zool.*, **46**, 493 (1927).
[2] *Genetics*, **21**, 225 (1936).
[3] Khouvine, Y., and Ephrussi, B., *C.R. Soc. Biol.*, **124**, 885 (1937).
[4] *C.R. Acad. Sci. U.S.S.R.*, n.s., 1, 87 (1936).
[5] *Science*, **83**, 210 (1936).

New Method for the Storage of Nematode Larvæ

THE following method of storing the infective larvæ of parasitic nematodes has been used at this Laboratory during the past twelve months and has proved to be very satisfactory. It has several advantages over the old method of storing in shallow water or in the fæces culture medium ; it is clean and convenient, it requires a minimum of special apparatus, it lends itself admirably to proper indexing, it makes a tremendous saving in storage space and is very favourable to the longevity of the larvæ.

After having been drawn off from the Baermann's separation apparatus, the infective larvæ which are intended for storage are flooded, in a small amount of water, on to one or more 9 cm. wide filter papers (Whatman No. 42) standing on several thicknesses of blotting paper. As soon as the excess water has soaked into the blotting paper, the wet filter papers are taken up and placed on a second pad of several thicknesses of blotting paper, where they are allowed to remain for from fifteen to twenty minutes, until all of the wetness has soaked away. Controlled observations have shown that the optimum point for the most successful storage of the larvæ lies somewhere between the time of the disappearance of the shining wetness, and the first signs of cockling of the filter paper, due to dryness at the edges. This point is reached in between fifteen and twenty minutes after the wet filter paper has been placed on the second pad of dry blotting paper, the required time varying with the temperature and dryness of the atmosphere of the laboratory.

The moist filter papers (with particulars of the larvæ written on the back) are now placed face to face in a 9 cm. wide petri dish, a piece of adhesive tape is fastened round the dish, between the lid and the bottom, to prevent evaporation, and the whole is put away in a cool room at 36–40° F.

When larvæ are afterwards required for any purpose, one or more filter papers may be taken out of the petri dish or, if only few larvæ are wanted, part of a filter paper may be cut off with a pair of scissors ; the paper is then placed, larva-side downwards, in a small amount of water in a petri dish or watch glass, when the larvæ quickly leave the paper and sink to the bottom of the vessel clean, and completely free from the debris that usually comes through the Baermann's apparatus along with the larvæ.

The method is also suitable for the transit of larvæ through the post, when the moist filter papers carrying the infective larvæ may be rolled up and placed in a test tube which is plugged with a tightly-fitting rubber stopper or treated in any other way which will prevent the evaporation of moisture from the filter paper.

The success of this method presumably depends upon the immobilization of the larvæ (through lack of actual wetness) and the provision which it makes for free contact with air in a water-saturated atmosphere. Examination of test cultures of trichostrongyloid larvæ stored in this way more than twelve months ago, show that 91 per cent of the larvæ are still alive and active. But apart from the convenience and efficiency of the method, the saving of storage space is enormous ; it is possible to store some five hundred cultures of larvæ in the eleven petri dishes held by an ordinary copper petri-dish container, which only takes up some 9 square inches of shelf room, whereas by the old fæces culture-medium storage previously used here that number of cultures would take up no less than 31 square feet, unless placed specially in petri dishes in the copper containers above-mentioned, in which case it would take up more than 3 square feet.

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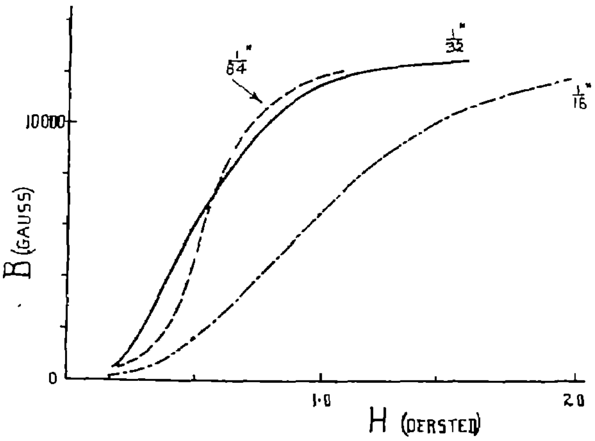
Jan. 7.

Magnetic Quality of Iron Wire as Influenced by the Diameter

IN a previous note[1] test data were given which showed how the permeability of nickel wire could be notably increased by surface treatment.

In the accompanying graph are given the magnetization curves for Armco iron wires of diameters 1/64 in., 1/32 in., and 1/16 in., respectively. The curves were obtained after each wire had been heated to 1200° C. in a stream of hydrogen until the permeability had reached a maximum value. From these and other test data it is inferred that :

(i) There is one diameter for which the permeability has the highest value, and the permeability falls off rapidly as the diameter is increased or decreased from this critical value. The critical diameter for Armco wire is about 1/50 in., in which case the permeability is about 15,000. For a wire of 1/100 in. diameter the permeability is about 12,000 and for a wire of 1/8 in. diameter it is only about 4,000.



(ii) There is a surface layer of the wire which is magnetically harder than the core, and this surface layer has a dominant influence on the magnetic quality of wires of small diameter.

(iii) By coating the wire with suitable material and afterwards heat treating, the magnetic quality may be controlled over a wide range. On one hand, the permeability may be increased and the coercive force diminished, and on the other hand, the permeability may be decreased and the coercive force increased. For example, it has already been shown that when nickel wire has been copper plated and then heat treated, the permeability is notably increased.

Similar tests have shown that there is also for nickel wire a critical diameter which gives maximum permeability.

Full details of these investigations are now in course of preparation for publication elsewhere.

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Dec. 11.

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[1] NATURE, 139, 928 (May 29, 1937); also, *Engineer*, August 13, 1937.

Nomenclature of the Seasons

IN a recent letter to NATURE[1], Dr. John R. Baker proposes a new nomenclature of the seasons. The eight new names formed by him (boredune, borepheuge, notodune, notopheuge; homodune, homopheuge, heterodune, heteropheuge) are to make good the lack of denominations for periods longer than a month and independent of the geographical situation of the place where the speaker is living or of which he is speaking. I believe, however, that the introduction of eight new scientific terms of Greek extraction is quite unnecessary for this purpose.

Dr. Baker says that a statement like "in south-west Ceylon winter is the hottest season" is absurd—which it is obviously *not*, for the speaker is, of course, thinking of the winter to which he is accustomed, that is of the winter of the temperate zone of the northern hemisphere, or of the months December–February. The sentence quoted above may be a little surprising for the first moment, but certainly no more so, and no more absurd than expressions such as: 'At the Cape of Good Hope January is the hottest month', or 'In the temperate regions of the southern hemisphere summer comprises the months December to February'. Certainly nobody would object to statements of this kind, and it seems, therefore, that a mental abstraction which is easy enough in some cases is considerably more difficult in other cases, though I cannot well see why this should be so. There were no such difficulties for the first European settlers in the tropics and in the southern hemisphere. They called the hot or dry season 'summer' and the cold or wet season 'winter' without any regard to the seasons at home, and in many instances even without regard to the temperature at the place where they were living: in several regions of tropical America the year is divided into the four seasons of *verano* ('summer': long dry season), *invierno* ('winter': long wet season), *veranillo* ('little summer': short dry season), and *invernillo* ('little winter': short wet season), in spite of the fact that the temperature is highest during the rains, thus during the local 'winter'.

Any difficulty in the denomination of the seasons can be overcome by simply putting 'northern' (or 'north') and 'southern' (or 'south'), respectively, before the ordinary names of seasons every time when a misunderstanding may be anticipated. This is much simpler than burdening the language by a number of new scientific terms and will be understood also by persons who have no knowledge of Greek. It also does not seem very practical to use, like Dr. Baker, the astronomical seasons: for meteorological and biological purposes as well as in everyday life, the meteorological seasons are to be preferred. We have thus: northern winter or southern summer: December–February; northern spring or southern autumn: March–May; northern summer or southern winter: June–August; northern autumn or southern spring: September–November.

A few examples may be given. If a man living in Europe says that he was in London last summer, or a man living in South Africa says that he was in Cape Town last summer, this is quite clear, and there is no need of adding 'northern' or 'southern'. If a man living in Europe says that he spent last summer in Cape Town, this might cause misunderstandings, and it would be advisable to state whether the northern or southern summer is spoken of. There is no possibility of misunderstandings in statements like the following ones: 'I spent the summer of 1937 in London', or 'I spent the summer of 1936–37 in Cape Town', or 'In south-western Ceylon the north winter is the hottest season', or 'The migratory bird *X* spends the northern summer in Europe and the northern winter in South Africa', or 'The bird *Y* breeds in England as well as in New Zealand during the (local) summer months', or 'The bird *Z* breeds in England as well as in New Zealand during the northern spring', or 'In certain regions of tropical America the northern summer is the wettest and hottest season, though locally called winter'.

CARL HANNS POLLOG.

In den Ziegelhöfen 1,
Basle.
Dec. 27.

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[1] NATURE, 140, 890, 1937

Codeine in Indian Opium

AN anomaly has crept into my article on "Chemistry of Indian Opium" published in NATURE of July 17, 1937 (140, 92–93).

On p. 92 (col. 1), the figure for the codeine content of Indian opium is correctly given as 1–2 per cent. On the same page (col. 2), at the end of the first paragraph, the codeine content of opium is shown as 2–4 per cent. This latter figure was taken from a departmental report rather difficult of access, and is the figure given by Prof. Dunston. The reference was given in the original article, but was unfortunately eliminated in the process of compression.

In his "A.B.C. of Narcotic Drugs", O. Anselmino also gives this figure for codeine in opium in the words: "Said to be 2 to 4% at Jeypore". It is not stated upon what analytical basis these figures are quoted, but it should be made clear that the usual codeine content of Indian Excise opium is between 1 and 2 per cent.

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Dec. 20.

Points from Foregoing Letters

FURTHER evidence for nuclear transformation by the capture of a K-electron from the extra-nuclear structure is provided by Wilson-cloud photographs, submitted by Dr. E. J. Williams and E. Pickup, of the photo-electrons produced by the K-characteristic radiation, the emission of which follows the removal of the K-electron. The striking feature is that, for the active nucleus concerned in these experiments, the capture of a K-electron appears to be at least 1000 times more probable than the emission of a positive electron, a process which would lead to the same final nucleus.

Auroral spectra obtained by Prof. L. Vegard show that the relative intensity of the red line 6300 A. increases in passing to the upper part of the aurora (type A), while the relative intensity of the green line 5577 is greater in the lower auroral region. Prof. Vegard suggests that the enhancement of the red at the higher altitude may be due to oxygen atoms excited to the $^1D_2$ state through collisions between metastable nitrogen molecules and ozone molecules, produced by the short-wave radiation from the sun. Type B of red auroras have a red colour along the lower border due to an increase in the intensity of the first positive group of red lines, in the infrequent cases when the aurora reaches very low altitude.

In connexion with the hypothesis concerning the origin of the zodiacal light, Sir Joseph Larmor directs attention to an error for which he was responsible in reprinting Poynting's Collected Papers, which resulted in doubling the value of the suction of fine orbital dust into the sun. Sir Joseph envisages a nebula-like thick disk around the sun, remains of the original whirling solar nebula, still existing beyond the earth's orbit. This nebula may be considered of the type of the rings of Saturn, only enormously less closely packed. Its particles, as shown by the fact that the zodiacal light shows no scattering effect, must be larger than the wave-length of light.

Dr. A. Mercier states that if one tries to define a model of the primitive earth as a polytropic gas sphere, the conditions in its interior are found to be such that metallic vapours, particularly iron, must condense in a thick outer layer, from which the iron core usually postulated is produced.

Lieut.-Colonel L. M. Davies reports the discovery by A. G. Davis, recently confirmed by himself, of characteristic Upper Ranikot (Palæocene) fossils in beds on the western frontier of Persia. This is much the most western location of true Ranikot beds yet to have been recorded.

Further evidence concerning the probable structure of corticosterone (an active crystalline compound from the adrenal gland) is reported by M. Steiger and Prof. T. Reichstein, who find that corticosterone can be chemically transformed into the hydrocarbon allopregnane. The presence of a steroid structure is supported by the new data.

By adding ascorbic acid to the blood plasma, plus sodium oxalate, of a fowl affected by erythroblastosis (a disease characterized by the presence in the bone marrow of large numbers of colourless nucleated cells thought to be rudimentary red blood corpuscles) Dr. E. Morelli and Dr. A. Vercellone find that an inactive material is precipitated while the clear fluid becomes more active than before in producing the disease in other fowl. This result differs from that obtained by Claude and co-workers; in a somewhat analogous case, they found that the activity of the plasma in the case of fowls suffering from Rous sarcoma, the active principle was carried down by the precipitate upon acidifying the liquid.

By germinating Bengal gram in distilled water and in solutions with manganese equivalents of 1 in 10^6, 1 in 10^5 and 1 in 10^4, M. N. Rudra finds that the amounts of ascorbic acid synthesized in the latter solutions are higher than those produced in distilled water.

An experiment indicating that the carotene and xanthophyll in cooked spinach and carrots is almost entirely excreted in the fæces, is described by M. van Eekelen and W. Pannevis. Better assimilation takes place when the carotene and xanthophyll are dissolved in oil.

The study by K. C. Misra of the floral anatomy of *Wormia triquetra*, *W. Burbidgei* and *Dillenia indica*, three members of the Dilleniaceæ, has brought to light two very unusual features. First, the flower stalk contains several conducting strands, and secondly, the ovular trace branches repeatedly within the ovule.

Boris Ephrussi, Yvonne Khouvine and Simon Chevais find that *Calliphora* extracts considerably increase the number of facets in the eye of the Bar mutant of *Drosophila melanogaster*. They think that the extract contains a morphogenetic (facet-forming) substance under genetic control.

From tests on Armco iron wire, Dr. T. F. Wall infers that there is one diameter for which the permeability of the wire is a maximum and that the permeability rapidly falls off as the diameter is increased or decreased from this critical value; also that there is a surface layer of the wire which is magnetically harder than the core; and that by coating the wire with suitable material followed by heat treatment, the magnetic quality may be controlled over a wide range.

Research Items

Microliths from the Central Provinces, India

THE excavation of a rock-shelter, Dorothy Deep Shelter No. 1, west-north-west of Pachmari in the Mahadeo Hills, Central Provinces, India, by Dr. G. R. Hunter has brought to light an extensive series of microlithic quartz implements. An important feature is that the finds are stratified. In interim and final reports (*Nagpur Univ. J.*, 1, 1935; 2, 1936), the excavation of the shelter, which began in 1932 and was continued in 1934 and 1935, is described in detail. Two periods of occupation were distinguished: one of a later people using pottery, and an earlier civilization with quartz implements of characteristic Tardenoisian geometric form, without pottery or any trace of metal. The two strata of occupation were not separated by a sterile layer. This might have been expected from the fact that the character of the shelter was not such as would lead to the accumulation of deposits, except as the result of occupation. There is, in fact, an overlap of the two stratifications owing to the disturbance of the surface of the lower level during the later occupation. A human skeleton was found in the lower deposits, which was evidently not a burial by the later inhabitants. Unfortunately the remains were not sufficiently well preserved to admit of any conclusions as to the racial characters of the early inhabitants. As the find of worked or partially worked implements is roughly proportionate to the number of flakes, it seems probable that the shelter was a mesolithic factory. Quartz pebbles are abundant in the neighbourhood. The greatest depth at which pottery belonging to the later culture was found was twenty inches. No evidence was found of habitation earlier than mesolithic. As regards the evidence of stratification, there appears to be a true sequence of development in the microliths, but this still has to be worked out in detail. It should provide important evidence for the chronology of Indian microliths and possibly for those of other parts of the world.

Holy Days among Serbian Gypsies

DR. ALEXANDER PETROVIĆ continues his investigations among the Serbian gypsies with an examination (*J. Gypsy Lore Soc.*, Ser. 3, 17, 1) of the institution of the Slava, which they have adopted from the Serbs, but with modifications due to their own ideas and needs, as well as to misunderstanding of the true character of this institution. The Slava is a custom essentially Serbian, and found among no other Slavic nation. It is supposed that when the Serbs adopted the Christian religion, each individual or group chose a Christian saint to act as the protector of the house and family, and to fill the void created by abandoning the family or tribal spirit associated with ancestor worship. To the Slava saint, his domestic protector, the Serb appeals when he fears calamity; and the Slava is celebrated as the feast of this patron saint. Some Serbian families celebrate a 'Preslava' during the summer. Both Slavas are inherited in the male line. The Slava is celebrated solemnly and as richly as possible, a great number of guests being invited. The gypsies, while adopting the Slava, failed to understand the difference between it and the holy days of the Church, and came to the conclusion that every Christian feast, including Christmas, Easter, etc., might be turned into a Slava. Some recognize a slight difference, making a 'kola' (a wheat flour cake) which is carried into the church on holy days. Others make a kola on all occasions. Generally the gypsy adopts a new Slava only in case of some misfortune, usually illness, when the new saint, to whom an obligation is incurred, is chosen by means of a ceremony in which the patient chooses one of three candles each dedicated to a saint. He prays to the chosen saint, and if he recovers, honours him with a Slava, which may be kept throughout the remainder of the patient's life. This Slava is not observed after his death by his children, except possibly by the offer of a candle. An individual may observe more than one Slava and in one instance the devotee observes five.

North American Collembola

BULLETIN 168 of the United States National Museum (1937) consists of a monograph on North American Collembola of the family Isotomidæ, by the late Dr. J. W. Folsom. All the known nearctic species of Isotomidæ have been considered in this monograph, and of the 66 species and 16 varieties dealt with, 28 species and 2 varieties are described as new. Not only has the author examined all the type specimens of the species of Isotomidæ described from North America, but he has also compared most of these with palæarctic specimens. Of the nearctic forms, 21 species and 9 varieties are found to be also palæarctic in distribution. Isotomidæ are generally regarded as having originated from forms resembling *Achorutes*, and in the species of *Guthriella* (described in this work) a better link has been found, between the Isotomidæ and Achorutidæ, than was hitherto known. Dr. Folsom's monograph, which is illustrated by 460 figures, is one of the most exhaustive studies of any group of Collembola yet published.

Decapod Larvæ from Madras

MR. M. KRISHNA MENON describes a number of planktonic larvæ in his recent paper "Decapod Larvæ from the Madras Plankton" (*Bull.* Madras Government Museum. New Series. Natural History Section, 3, No. 5, 1937). As he obtained several post-larval stages from the later larval stages, certain of his species are identifiable; in other cases he only gives the genus and even this is often queried, although good series of larvæ were available and their characters noted in great detail. As so little is known of the life-histories of Indian decapods, these notes are valuable and contain much that is new. Specially interesting is the fact that the author finds 12 pairs of gills in the fourth larval stage of *Albunea symnista* and 13 in the fifth larval stage, the adult only having 10 pairs. The megalopa of *Ethusa investigatoris* from the last larva resembles the adult very closely, and it was found that even at this early stage it covers its body with anything that is handy. It is hoped that Mr. Menon will continue these studies of the life-histories of Indian decapods, which are for the most part practically unknown.

Antarctic Crinoids

THREE species of crinoids are described by D. Dilwyn John, all obtained at four points not far removed from one another to the west of Graham Land (Expédition antarctique Belge. Résultats du Voyage de la Belgica en 1897–99. Rapports Scientifiques publiés au frais du Gouvernment belge, sous la direction de la Commission de la Belgica. Zoology. Crinoidea. 1937). The collection, as the author points out, is of historical interest as being the first from the south of the Antarctic Circle and near the coasts of the continent, and it is important in including the only known specimens of the stalked crinoid *Ptilocrinus antarcticus* (here redescribed). The two other crinoids collected are the common Antarctic species *Promachocrinus kerguelensis* and *Anthometra adriani*. More than a hundred specimens of the former have been taken in the recent "Discovery" Investigations in the Falkland Section of the Antarctic, from the south of which the present material comes. Notes on these are shortly to be published in the Discovery Reports confirming A. H. Clark's opinion that *Promachocrinus vanhöffeni* and *P. joubini* are synonyms of *P. kerguelensis*, which is found to vary widely.

Mycologically Produced Chemicals

AN interesting paper by Mr. R. P. Cook on "Moulds and the Chemical Industry" appears in the *Scientific Worker* of November (9, No. 8, pp. 203–206). It describes the production of citric acid by fermentation of sugar in shallow receptacles. A felt of *Aspergillus niger* is grown therein, and is potent to ferment four or five refills of sugary liquid run successively beneath it. Gluconic acid, ink and oxalic acid can be produced by similar means. Ink and oxalic acid are made by fermentation with species of *Aspergillus*, whilst gluconic acid requires the ministrations of a *Penicillium* mould. Alcohol may be formed from starch directly by many species of *Mucor* and *Aspergillus*, which first effect the hydrolysis of starch into sugar, and later its subsequent fermentation to alcohol. The paper is of wide general interest, but many of the processes described retain their detail within closely guarded commercial secrets.

Spiral Hyphæ of Dermatophyte Fungi

THE fungi which attack mammalian skin have provided many problems for the mycologist, and the intensive study which they have evoked helps to elucidate more general questions. Messrs. A. M. Davidson and P. H. Gregory have investigated the occurrence of spiral hyphæ in five species of the genus *Trichophyton* (*Trans. Brit. Mycol. Soc.*, 21, Pts. 1 and 2, 98, Oct. 1937). These structures are believed to be organs of attachment which play a part in the infection of animal hosts from saprophytic sources. They are sticky, and when they adhere to an object, can break away from the mycelium. A large amount of inoculum would thus be transferred to the new host.

Nyasa-Shire Rift Valley

THE rift zone fractures in eastern Africa have been regarded as of late Tertiary age although certain associated volcanic rocks in the Tanganyika area and the Lower Zambezi date from the Cretaceous period. The Nyasa-Shire rift, forming part of this rift zone, has been generally regarded as due to the uplift and fracturing of a Miocene peneplain, but recently discovered Cretaceous beds within the northern Nyasa rift introduce a new factor. In the *Geographical Journal* of January, Mr. F. Dixey discusses the history of the Nyasa-Shire rift in the light of the evidence now available, including the relict uplands such as Nyika, Vipya and Zomba of 6,000–7,000 feet which surmount the Miocene peneplain. These are remnants of a great late Jurassic or early Cretaceous peneplain, or even of greater antiquity. Mr. Dixey contends that the instability which gave rise to the Nyasa-Shire rift and probably the Rukwa and Tanganyika rifts can be traced back to the early Cretaceous period with renewed movement in late Tertiary and post-Tertiary times.

Meteorological Depressions

GEOPHYSICAL MEMOIR No. 72 of the Meteorological Office, Air Ministry, is a discussion by A. H. R. Goldie of the structure of certain depressions that have passed across or near the British Isles in recent years. As the title of the memoir, "Kinematical Features of Depressions", suggests, it is a study primarily of the nature of the air motion in these depressions, and has been carried out in order to discover the type of vortex to which such storms approximate, with the view of arriving at an explanation of their development and life-histories. The greatest difficulty in studies of this kind is to derive from available wind data a general picture of the air movement such as could be obtained from a close network of well-exposed anemographs and pilot balloon stations, were such available. The author does his best to surmount this difficulty, with some measure of success as regards surface movement. He finds that except in an area around the barometric minimum, the average surface air movement is in accordance with that of a simple vortex (speed varying inversely as the distance from the centre); that in the part of the central area occupied by polar air the wind is sometimes proportional to distance from the centre, with some evidence that this area becomes larger with increasing age of the depression. Detailed analysis of this area showed a cell-like structure with convergence of both cold and warm air below 2 km. towards the main front through the centre of the depression, and upward motion above. The conclusion is reached that the energy for a depression is derived mainly from the high speed of the tropical winds, particularly in the higher levels, that is, from the planetary circulation, and that the vortex is started by the warming and humidifying of the polar air near a warm front. The results support modern Norwegian theory in a general way, although the typical structure of depressions seems to be arrived at through the circular and converging movement which is impressed upon the edges of the polar air mass.

Black Phosphorus

IT is nearly twenty-five years since Bridgman showed that white phosphorus was irreversibly transformed to a black modification at pressures of the order of 12,000 atmospheres and temperatures of about 200° C. He noted that for the first ten to fifteen minutes the transformation proceeded very slowly, and afterwards took place with almost explosive characteristics. A reinvestigation of this transformation in the same laboratory by R. B. Jacobs has just been published (*J. Chem. Phys.*, 5, 945; 1937). White phosphorus has been heated at approximately 13,000 atmospheres to about 205° C. for six different periods, all less than fifteen minutes and varying from each other by two-minute intervals. Then the pressure was reduced to half its highest value in order to retain the phosphorus in the solid state, and, on washing with carbon disulphide, a carbon-like powder was obtained in amounts bearing a close correlation to the times of heating. Visually this powder differed from the usual black phosphorus. Its density was 2·25 compared with 2·69. Whereas the usual black phosphorus gives distinct X-ray diffraction lines corresponding with an orthorhombic type of crystal structure, the 'new' black phosphorus gave no diffraction lines, and therefore it is either amorphous or microcrystalline. Measurements of the differences in the total heats between the various forms of phosphorus were obtained from the heats of reaction of the different modifications with bromine. These data indicated that the new black phosphorus is amorphous and a separate polymorphic modification. It has also been shown that the stable form of phosphorus below 560° C. is the crystalline black modification, and data illustrating the progression of stability of the different forms of phosphorus are given. Prolonged heating of amorphous black phosphorus at about 125° C. yields a brilliant violet modification of red phosphorus.

Examination of Colliery Ropes

FOR a number of years, the Wire Ropes Research Committee of the Safety in Mines Research Board has been conducting investigations into the deterioration and failure of colliery winding and haulage ropes, and has, from time to time, published accounts of these investigations. Colliery ropes are highly stressed and relatively complicated pieces of machinery liable to accidental damage and gradual deterioration which may gravely affect their strength, and the consequences of a failure, when men's lives depend on them, may be most serious. The law requires that each rope must be subject to two distinct forms of examination—a daily examination to ensure that it remains intact and is free from gross faults—a special examination carried out at least once every month when the condition of the rope is closely inspected and the progress of any deterioration is particularly noted. The former provides for cursory examination of the whole rope; the latter provides for detailed inspection at a number of places spaced out along its length. Out of 57 winding ropes which broke in service as a result of gradual deterioration it is stated that only 11 had been reported as showing signs of weakening. On investigation, the remaining 46 were found to exhibit such signs of deterioration as should have been noted by a vigilant examiner. For the information and use of those persons who are directly responsible for the examination of ropes, the Board has now issued a booklet entitled "The Examination of Colliery Ropes in Service" (London: H.M.S.O). It can be conveniently carried in the pocket, and sets out briefly the types of deterioration met with due to wear of different kinds, fatigue and corrosion, explaining their causes and how they may be recognized. The parts of the rope which should be examined with particular care, the methods of measurement and of examination and the limits of deterioration allowable are all set out clearly and concisely.

Refractive Powers

DURING the last thirty or forty years, the older definitions of the refractive power of a transparent substance, $\frac{\mu - 1}{\rho}$ of Gladstone and Dale, and $\frac{\mu^2 - 1}{\rho}$ of Newton, Selmeyer and Drude have been replaced by the $\frac{\mu^2 - 1}{\mu^2 + 2} \cdot \frac{1}{\rho}$ of Lorentz and Lorenz, where in each case μ is the refractive index for a definite wave-length and ρ the density. In the November and December issues of the *Journal of the Franklin Institute*, S. S. Kurtz and A. L. Ward make use of the available data for the refractive indices, dielectric constants and densities of liquid hydrocarbons over ranges of temperature often exceeding 100° C. and of pressure up to 12,000 atmospheres to test the relative values of the three definitions with regard both to light and to electricity, where the dielectric constant k replaces μ^2. Their conclusion is that the Lorentz-Lorenz expression should not be used except for rough approximations, that the Newton-Selmeyer-Drude should be used for the correlation of dispersion data for hydrocarbons, and that the form $\frac{\mu^2 - 1}{\mu^2 + 0 \cdot 4} \cdot \frac{1}{\rho}$ suggested by Eykman in 1919 should be used for the effects of temperature and pressure on both the refractive index and the dielectric constant.

Objective Prism Observations of Nova Lacertæ (1936)

D. T. Edwards and D. R. Barber have recently issued a paper with this title (*Mon. Not. Roy. Astro. Soc.*, 98, 1, Nov. 1937), in which they give an account of the spectrum of this nova up to September 3, 1936. The instrument used at the Norman Lockyer Observatory was the 12-in. McClean telescope with a 20° prism, and the plates were Barnet "Super Press". The first photograph showed the typical α Cygni absorption spectrum, and this was followed by different stages of mixed absorption and emission, ending with the purely emission spectrum of nebular type. Three tables are given in which are indicated the more prominent absorption and emission lines, in addition to notes regarding their characteristics, widths and dates of appearance. Other tables show absorption-line and emission-line velocities. In the case of the latter, there is a systematic progression of velocity from positive to negative values, both for *H* and metallic lines, and this presents some puzzling features. It is suggested that the effect may be caused by masking of the red edges of the bands by absorption, or unmasking of the violet edges, and may not be a velocity effect. There is no doubt, however, about the progressive changes of the apparent displacement, and independent work by Bobrovnikov has recently confirmed these.

Isotopic Composition of Ordinary and Uranium-Lead

IN the paragraph appearing in NATURE of January 1 (p. 43) under the above heading, data reported as having been found for uranium-lead actually referred to ordinary lead, and vice versa. Thus, ordinary lead chloride was found to have the isotopic composition ^{204}Pb, $1 \cdot 1_5$, ^{206}Pb, $24 \cdot 5_5$, ^{207}Pb, $21 \cdot 3_5$, and ^{208}Pb, $52 \cdot 9_5$ per cent, giving 207·21 for the atomic weight of ordinary lead, in exact agreement with the value given in the International Table for 1937. Uranium-lead from Katanga curite was found to have the isotopic composition ^{206}Pb, 95·1, ^{207}Pb, 4·9 per cent, giving an atomic weight of 206·01 (O = 16).

Industrial Organic Chemistry

New Dyestuffs Laboratories of I.C.I., Ltd.

THE unprecedented character of the Dyestuffs (Import Regulation) Act of 1920 was both an expression by Parliament of its conviction that an active and flourishing dyestuffs industry is essential to the life of Great Britain, and a recognition of the technical difficulties of developing such an industry in face of the priceless experience and established position of foreign manufacturers. An exhaustive review at the end of the period of ten years, for which the measure was originally enacted, resulted in 1934 in its being made permanent.

The largest of the interests thus sheltered is now known as the Dyestuffs Group of Messrs. Imperial Chemical Industries, Ltd., and the opening on January 11 of its new research laboratories at Blackley afforded a further opportunity of considering the results of the legislative venture of 1920. The event was thus one of most unusual interest and importance, and attracted a large gathering representative of academic, administrative and manufacturing interests. The impressions gathered can scarcely have been other than of deep satisfaction.

Apart from all that has been done by the Dyestuffs Group in developing the manufacture of products already known, the early discoveries of the ionamine and duranol series of dyestuffs for acetate silk have latterly been supplemented by the solacet and phthalocyanine series. Further, much progress has been made in the direction of that broadening of activity into other closely allied branches of applied organic chemistry which marked the growth of the Continental industry. This must be regarded as a normal and essential feature of healthy development, and one which will confer on the industry as a whole increased stability. Indeed, it is this expansion to include, for example, modern detergents and textile assistants generally, plastics and rubber, medicinal chemicals, insecticides and fungicides, which has led to the provision of the new laboratories. The close interrelationships of these various fields of work were illustrated in the laboratories by an extremely well-organized series of exhibits representative of "Chapters in the Development of Industrial Organic Chemistry", and described in a well-illustrated presentation volume bearing that title, as well as by demonstrations to conducted parties of visitors.

Prior to this, in a happily informal speech which prefaced his performance of the opening ceremony, Mr. John Rogers had indicated the general outlook of the Dyestuffs Group and discussed the conditions which make for success in the type of research for which the new laboratories are designed. His faith in the productivity of abstract research work and the following up of unexpected results, his plea for a long-term policy and his appreciation of the co-operation both with users of his Company's products and with academic institutions, must all meet with the most cordial approval. It cannot be doubted that adherence to this attitude will provide a sure foundation for the future success and prosperity of the Dyestuffs Group and at the same time a most potent stimulus to the development of organic chemistry in Great Britain.

The laboratories have been designed by Mr. Serge Chermayeff and are intended to be only the first instalment of a larger programme. They take up the main block of a three-storey building, 400 ft. long, running north and south, and are entered from a corridor on each floor extending along the whole of the west side. Twenty-one separate laboratories of uniform type are thus provided, each with a partial subdivision, by shelving, into units which accommodate one chemist and offer him a measure of privacy. Fume cupboards glazed on both sides and provided with electrical, gas, steam, compressed air, vacuum, and water services back on to the corridors, where removable panels allow easy access to the service pipes. Continuous windows along the east and west sides of the building give a maximum of continual daylight in the laboratories with protection from too great heat of the sun. Ventilation is entirely by conditioned air, separate ducts, of course, being provided to carry away gases from the fume cupboards. The flooring of cork tile eliminates noise from the laboratories, whilst an air of cheerfulness is contributed by the use of different colours against a background of white.

It will thus be seen that to a thoroughly well-informed and progressive outlook there have now been added amenities which are first-rate from both the æsthetic and the immediately practical points of view. We tender to Messrs. Imperial Chemical Industries, Ltd., our sincere congratulations on these most favourable auspices and at the same time our best wishes for the future success of their enterprise.

J. K.

Wool Industries Research Association

THE Wool Industries Research Association's previous report, reviewed in NATURE of January 16, 1937, was an innovation issued for the information of the general public and firms outside the Association, in view of efforts then being made to secure a statutory levy. It is now reported that insufficient additional support has been forthcoming to warrant the introduction of an enabling Bill into Parliament, and this scheme has been dropped for the time being. It is, however, emphasized that nothing has been left undone to urge the claims of research, and the need for its financial support on a scale more adequate to the magnitude of the industry's interests. Meanwhile, generous response has been made by a number of individual firms for the purpose of meeting a serious and unexpected deficit in revenue, and the

Council has decided upon a substantial increase in the rate of subscription for the processing sections of the industry.

The report refers to two circumstances which may delay the development by a research association of new processes—'teething' troubles accompanying their translation to commercial production, and requiring a willingness on the part of the industry to experiment, and the smaller incentive to bear the brunt of these troubles when results must be common property than when the knowledge gained is the exclusive property of a private firm.

Comment is again mainly devoted to the development of the processes, referred to in last year's report, for rendering wool 'unshrinkable' and for producing a permanent bleach.

The loss of 'handle' on chlorination is largely restored by 'fixanol'—this suggestion emanated from the Textile Chemistry Research Department of the University of Leeds—and it is now reported that substances of this type, which unite with wool substance, form a chemical link between the fibre and rubber latex, and a patented process has been evolved for rubberizing yarns to give water-repellent, moth-proof, and wear-resistant properties, and make available low-twist yarns of good strength.

Stress is laid on the importance of accurate measurement of fibre diameter as a fundamental necessity "for any progress to be made in the understanding of the manufacturing performance of wool", and "for the farmer to have reliable numerical data on which to base his breeding policy".

It is maintained that the fear expressed in some quarters that measurement of fineness in wool tops may become a bugbear in commercial dealings, could only be realized if it were used as a measure of quality, with the rather ambiguous comment that the latter is "a development which it is within the hands of the Trade alone to prevent".

Statistical analysis has also been applied to the variability of woollen card slubbing with the view of reducing uneconomic margins of tolerance.

Other subjects referred to as having received attention are the examination of proposed alternatives to olive oil for combing, of new detergents for wool scouring, and of the effect of various dyeing processes on the spinning power and handle of wool. An increased demand on the part of members for the investigation of special problems is also reported.

Thus it is evident that the Association is energetically pursuing investigations on the technical and statistical sides, which may disarm any criticism of the restricted output of publications in scientific journals. Readers appreciating the functions of organized research in industry will, perhaps, feel more confident than the Director of Research that the non-participating section will diminish, but this will follow less from the reproof he administers than from a conviction borne of a fuller demonstration that it is missing benefits by standing aside.

Rothamsted Experimental Station

THE form of the Rothamsted Report* for 1936 differs from those of former years in that a number of investigations which have extended over a period of years have been selected for detailed discussion, thus summarizing the results up to date. This type of annual report has an undoubted advantage in presenting the results of agricultural research, where a number of variable factors, such as seasonal effect, enter, tending to give uneven progress towards final conclusions; the results of one year may not give a representative picture of the work in hand. Though the work at Rothamsted is mostly of a fundamental type, the practical needs of the farming industry are kept continually in mind, the research programme being under constant scrutiny so as to follow up immediately those results likely to have a practical bearing. With long-period research, such as that embracing some of the field experiments which have been in progress for half a century, the need for such a policy is apparent, and it probably explains much of Rothamsted's secret of interesting both the research worker and the farmer.

The results of the various investigations on grassland problems come at a time when pasture management is a subject of topical interest and, for that reason, occupy most of this note; it may be mentioned that the recent International Grassland Congress visited Rothamsted in order to examine the Park grass plots. The Land Fertility Scheme, again, lends interest to the trials on the effects of manures on the botanical composition and yield of pastures. Attention is directed to the difficulties of drawing correct conclusions on the variations in the proportions of individual species as the result of manuring, because a decrease in one species may not, for example, be due to the direct action of the fertilizer, but to its being suppressed by an increase in another. Thus, the well-known effect of sulphate of ammonia in causing a decrease in the proportion of legumes in a mixed sward that is not closely grazed is due to their suppression by the greater growth of grasses resulting from this manure. It is interesting to note that the effect of lime has been most marked on the liberally manured plots, the plots standing out even in winter. Again, liming helped the sward to stand extremes of climate, heavy frost and drought having killed the herbage on the unlimed plots treated with sulphate of ammonia and mineral manures, while the grass on the limed plots was not affected. In the experiments with phosphatic manures, it has been observed that, by analysing the herbage and getting the figures for the percentage recovery of added phosphate, it has become much easier to interpret the results of the trials than by merely observing yields of hay. This is the sort of information that should be kept in mind when the time arrives for assessing the success or otherwise of the Land Fertility Scheme.

The effect of the composition of the original seeds mixture sown when laying down a field to grass has been studied in a ley put down eight years previously. Research of this type has established the fact that, under most conditions, there is no particular advantage in sowing a large number of species, since, in a few years, these become reduced to a few, such as perennial ryegrass, wild white clover, etc.; exceptions to this sometimes come to light, such as when Percival observed that, in the Thames Valley, all the species of plants sown were still found after nineteen years. In the ley studied at Rothamsted, the ryegrass, cocksfoot, timothy, rough-stalked meadow grass and wild white clover formed the overwhelming bulk of the herbage after eight years. It is interesting to contrast some features of these results with those found by Alun Roberts at a number of centres in Wales, where the rainfall is higher, and where there is hard winter grazing by sheep. At Rothamsted, cocksfoot, and particularly timothy, survived much better than at the Welsh centres. Again, in the west, Italian ryegrass had completely disappeared at every centre in three years, while at Rothamsted this variety proved unexpectedly persistent, contributing largely after eight years; it must be assumed that this persistence was due to self-seeding. The Rothamsted experiments are important for large tracts in the drier parts of England, where economic conditions have forced many to put down land to grass.

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* Rothamsted Experimental Station; Lawes Agricultural Trust. Report for 1936. Pp. 294. (Harpenden: Rothamsted Experimental Station, 1937.) 2*s*. 6*d*.

The experiments on the composition of ryegrass are of particular interest in view of the position regarding the various methods of grass conservation. The high proportion of fructosan, which is soluble in cold water, found in spring grass when the panicle emerges, and the decrease in this substance on further maturity, indicates that research in this direction may throw important light on such questions as losses in conserving young and more mature grass by various methods, and the relative values at different times of the year of pasture grass having similar chemical composition when expressed by the conventional method.

Experiments on the relation of cultivation to crop yield have been in progress since 1926, these being concerned with a study of the effects of the standard operations, and with a comparison of standard methods with rotary cultivation. There is a considerable body of evidence from other countries that yields are not increased either by extra or deeper cultivation above a certain minimum well below what British farmers would accept, and eleven years experiments on heavy soil at Rothamsted and on light soil at Woburn tend to confirm this. Rotary cultivation, which produces a tilth in one operation, has given no harmful results when carried out on the same land year after year, provided that—for certain crops—it is done sufficiently deeply.

Other sections of the report, such as those dealing with the work of the Fermentation Department and of the Departments of Fungicides and Insecticides, and also of Entomology, are equally important because of the amount of valuable information contained in them.

Display and Reference Exhibits in Museums

By Samuel G. Gordon, Department of Mineralogy, Academy of Natural Sciences of Philadelphia

THE new mineral gallery of the Academy of Natural Sciences of Philadelphia contains seven sections devoted to educational exhibits, the William S. Vaux Collection, Pennsylvania minerals, the fluorescent minerals, meteorites, gem stones, and special exhibits (radioactivity, new accessions, loan collections, etc.)

Frameless cases, virtually glass envelopes (described in the *Museums Journal*, November 1936) were designed in which the plate-glass is supported by a minimum of metal. Such construction was found possible in large wall cases, table cases, floor cases and pedestals, with the result that visitors are less 'case-conscious'. The educational exhibits (What is Geology? What is a Mineral? What is a Crystal? The Interior of the Earth, etc.) are in wall cases lined with black suède-like paper which gives the incisiveness of a blackboard sketch. The labels, a tersely written *sequence*, are combined with the illustrative material (rigidly selected specimens, charts, maps, transparencies, models, instruments, etc.) in a *layout* in which lines, designs, colour, and other symbolic devices are used to develop a logical continuity. All other lines, arbitrary designs, meaningless colour, coarse textures, hardware, supporting accessories, ornamentation and distracting effects are avoided.

Less than 10 per cent of the minerals of the Academy collections are shown in the systematic series, about half in wall cases, and the rest in high table cases. Care was taken that each individual specimen, shown against black velveteen, was set up to the best advantage (four specimens took two hours apiece for this operation). Supporting means (mostly glass tripods) are unobtrusive. The green colour of glass shelves was found to be due to total reflection (within the plates) of the back edges; the colour was eliminated by painting the back edges black. Labels were printed on plastocele (cellulose acetate) with a lino-scribe, a device which uses printers' type and cuts. There is also an index with cross references to the minerals. Lighting (outside the cases) is concealed, and unobtrusive valances were used at strategic points in the wall cases to eliminate reflections.

The fluorescence exhibit (the first in America, following soon after that in the British Museum (Natural History)) is at the turning-point of the gallery. When reopened, it will be set in operation by the visitor passing a pair of photo-electric cells, and the automatic cycle (electric lights, ultra-violet lamps, darkness) will be synchronized with a four-minute record explanatory of the phenomena.

The focal point of the next section is another educational layout: "What are meteorites?" Elaborate series of cut gemstones, jades, birth-stones, ornamental stones are shown in the succeeding bay. The last section includes an exhibit of radioactivity, in which the story of its discovery precedes a demonstration using an ionization chamber connected with a circuit terminating in a neon lamp which flashes as gamma radiation enters the chamber.

Thus modern technical resources are being used to make exhibits educational and to stimulate interest in natural history. But what about the many specimens of which the rarity, obscure character, or specialized interest do not make it feasible to give them expensive display space ? How are these to be made available to the serious student ? What is to happen to the many specimens cluttering up museum cases when these are relegated to storage cabinets ?

It is probable that the answer will be found in the development of reference museums. We have all admired the efficient organization of libraries, where staffs have been trained in the cataloguing and care of books, and their preservation in fire-resisting structures. The huge bulk of accumulated natural history specimens in many of the older museums presents a storage problem. With the gradual extinction of many species of wild life, the growing scarcity of others, and the increasing difficulties of collecting, it is essential that what we already have be assured permanent preservation and greater accessibility to students.

Such collections could be compactly stored in metal cabinets in vermin-proof, fire-resisting library-stack-like structures. Specially trained curators could receive, prepare, catalogue, place and care for the specimens received by the museum. The distribution of specimens to research workers in their own and to other institutions, and of loan collections of duplicates to schools, would be in their hands. No small part of their activity would be to bring out of the stack, for examination at close hand, any specimen desired by a serious student.

An experiment in this direction will soon be made by the Mineralogical Department of the Academy. Visitors will be advised that any specimens they desire to see, if not on exhibition, will be placed by a member of the staff in a special, well-lighted case for their examination.

The German North Atlantic Expedition*

HAVING almost completed their examination of the data brought home from the South Atlantic Ocean by the *Meteor* in 1925–27, German oceanographers have set out to make a thorough investigation of the North Atlantic, and as the result of a conference between the Commander-in-Chief of the Navy, the council of the Deutschen Wissenschaft and the director of the Institut für Meereskunde, the German North Atlantic Expedition has been organized.

The plan of the new expedition is to complete the network of modern oceanographical observations over the Atlantic Ocean, linking up the work of the *Meteor* in the south with her subsequent investigations in Iceland and Greenland waters, and with the work of the American *Marion* and *Atlantis* expeditions in the Davis Strait and the western North Atlantic. The area to be covered extends from 15° N. to 64° N. between the west coast of Europe and Africa and a line from the West Indies to Nova Scotia.

The main objects are the study of the physico-chemical structure of the sea, and meteorology. It is hoped that a large number of scientific and practical problems, many of them connected with the Gulf Stream, will be solved, and Prof. A. Defant, who is directing the work, is confident that information likely to be of material assistance in long-range weather forecasting will be obtained.

The *Meteor*, now re-engined as a motor-vessel with a cruising radius of 9,000 miles at an average speed of 12 knots, is to be used, and the Institut für Meereskunde, the Deutsche Seewarte, the Marine Observatories of Wilhelmshaven and Kiel, and the State Meteorological Department, are co-operating with the Navy. The whole project is not to be accomplished in one commission, but by a number of shorter voyages.

The first voyage, partly a trial cruise, and mainly an addition to the original programme, was started in February and completed in May of last year. The region from 10° N. to 28° N. between the African coast and 30° W. was examined; about seventy stations were worked at 60-mile intervals on six east-to-west lines, half of them falling between the African coast and the Canary and Cape Verde Islands. At each of the inshore stations hourly observations were made over a period of 60 hours, and one series of current observations over a period of 48 hours was made with the ship anchored in deep water. Six oceanographers, two meteorologists and two magneticians were carried, and the officers and crew numbered 121.

Only a very preliminary account of the results is available, but it is clear that much important information has been gained. The whole of the coastline of this part of Africa is marked by upwelling, and although the water comes to the surface from relatively shallow depths, the surface temperatures may be 5° or 6° C. colder than those farther offshore. The region also has a rich plankton population. The continuous hourly observations reveal changes of very short period, and show that the conditions in the thermocline at a depth of 25–60 metres respond very quickly to changes at the surface. The chemical work included determinations of silica, phosphate and nitrite.

A large number of observations were made on the upper-air currents, 209 balloons being followed by the new radio-ranging method, which seems much better adapted for work in an unsteady ship than the usual theodolite method. The nautical staff carried out an extensive programme of echo-sounding, and made researches into the reliability of modern instruments and methods of fixing positions at sea. Magnetic observations were made in the Canary and Cape Verde Islands.

During the three and a half months voyage, much was accomplished, and it is evident that the investigation of the greater part of the North Atlantic Ocean by similar methods will produce most important results.

G. E. R. D.

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* "Bericht über den ersten Teil der Deutschen Nordatlantischen Expedition des Forschungs- und Vermessungsschiffes *Meteor*, Februar bis Mai, 1937", Von A. Defant. Sonderausgabe aus den *Sitzungsberichten der Preussischen Akademie der Wissenschaften, Phys.-math Klasse*, 19 (1937).

Science News a Century Ago

Locomotives on the Liverpool and Manchester Railway

AT a meeting of the Institution of Civil Engineers on January 30, 1838, Edward Woods, the chief engineer of the Liverpool and Manchester Railway, read a paper containing an account of the alterations which had been found necessary in the first locomotives used on that line. These alterations, he said, consisted principally in strengthening every part of the engines, and the consequent increase in the weight was such that it became necessary to re-lay the whole of the line with stronger rails, and as a temporary provision to add a third pair of wheels behind the fire box. Woods then went on to refer to certain necessary conditions in the structure of locomotives, and the means adopted to obviate the rocking motion and the unsteadiness arising from lateral undulations. With respect to the objections urged against the use of six-wheeled carriages, he observed that the adhesion though less was sufficient, and that the additional weight did not exceed two hundredweight, or produce a diminution of traction amounting to more than one two-hundredth of the whole; and that the additional strain and friction on passing curves may be entirely obviated. He then discussed the distribution of the whole weight of the engines on the wheels, which weight on the average amounted to eleven and a half tons. Woods was twenty-four years of age when he read this paper. About fifty years later he served as president of the Institution.

Heat of the Earth

AT a meeting of the Geological Society on January 31, 1838, an extract from a letter addressed by Sir John Herschel to Lyell, dated Feldhausen, June 12, 1837, was read. It contained some additional observations relative to the writer's views respecting the increment of temperature which may be produced in some places within the crust of the earth, by the distribution of additional beds of sediment over the bottom of the ocean, and the consequent elevation of those tracts. In this letter, Sir John Herschel expressly alluded to Mr. Babbage's view on the subject given in a paper on the Temple of Serapis read in March 1834, but he stated that he was not aware of that gentleman having speculated on the same mutual reaction of the surface and the interior of the globe, until his attention was recently directed to the circumstance.

Ornithological Society

IN the report of the Council of the Ornithological Society read at a meeting held on February 2, 1838, it was stated that Mr. Blyth had been appointed assistant secretary and curator of the museum, the latter post being rendered necessary by the munificent loan of the Hon. W. T. Fiennes. It was announced that the collection of living birds had sustained little injury from the severity of the winter. Mr. Blyth then commenced a discourse on the geographical distribution of birds by enumerating first a variety of groups and species which are confined to particular regions; and secondly, others, and some of comparatively trivial value, which are diffused over the greater portion of the world. He illustrated the subject by adducing various phenomena of geology and botany; enumerated and explained some of the more interesting analogous adaptations of different types of form, geographically separated; surveyed theories of zoological provinces, particularly commenting on Dr. Richardson's, and directed particular attention to the fact that those North American birds which have no generic representative in Europe, and those European genera which have no species proper to America, are almost without exception, migratory.

Dr. Neil Arnott's Stoves

DR. NEIL ARNOTT, F.R.S., in 1838, published his work "On Warming and Ventilating: with Directions for Heating and Using the Thermometer Stove". The book was reviewed in the *Athenæum* of February 3, 1838. "Dr. Arnott", said the reviewer, "has already established his reputation as a practical benefactor to mankind, and now he has come before the public again with another application of philosophic principles to domestic use, which will add in no ordinary degree to the comforts of all, but most especially of the humbler classes. . . . The superiority of the apparatus consists in the power of so regulating the afflux of air to the fuel as to consume no more of the latter than is absolutely necessary to heat the apartment to the required degree. . . . During the winter Dr. Arnott kept his library at 60–63° F. with an expenditure of 6 lbs. of Welsh coal a day. . . . The stove is with us all important, and we have thought it our duty to bring it under the consideration of our readers. There is no mystery—no concealment in the matter. In this as in the water bed, Dr. Arnott has not even sought to derive pecuniary benefit from his labours and discoveries; instead of securing a fortune by patent privileges, he has with a noble liberality, worthy of national recognition, made the discovery public."

State of Medical Science in Spain

THE issue of the *Lancet* of February 3, 1838, contains a letter with this heading from William Lambton, late surgeon attached to the British Army Legion, illustrating the lack of respect shown to the medical profession in Spain in contrast with the high esteem in which it was held in France and England.

According to Lambton, when the British Legion went to Spain in 1835, it was notorious that the medical officers had the worst billets, and with but few exceptions received the most cavalier treatment from the Spaniards. "The surprise", continues Lambton, "which this want of respect created in my mind was entirely eradicated on perusal of the following advertisement, which appeared in a Madrid paper: 'Wanted a medical man who will undertake to attend a parish four leagues from Madrid: the salary is 4000 reals (about £40) a year, out of which he is to pay 375 reals for the maintenance of the poor. His keeping of a barber's shop, however, will prove no detriment to his capacity for the office, as it is understood that he will be allowed to make what he can by shaving. He must, however, be a chartered member of the Madrid faculty'. . . . Spanish surgeons", says Lambton, "are without exception the coolest operators I ever saw in my life, for when engaged in an operation in their own hospital they are generally to be seen with a pipe or cigar in their mouths, swearing at the cries of the patient or at any mishap which may occur during the operation. Nor are they by any means proud of their position, for they resign the knife to any professional bystander who is willing or anxious to operate."

University Events

CAMBRIDGE.—The Iron and Steel Industrial Research Council has approved of a grant being made by the Alloy Steels Research Committee (a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation) at the rate of £500 a year from January 1 for research on corrosion fatigue under the direction of Dr. U. R. Evans. Although this grant is made for one year only, it is understood that there is every intention of renewing it for 1939. A former grant from the Iron and Steel Industrial Research Council in aid of Dr. Evans's research was made in 1936.

At Clare College, W. B. Reddaway, of King's College, has been elected into an official fellowship. He gained a first class in the Mathematics Tripos, Part 1, in 1932, and a first class in the Economics Tripos, Part 2, in 1934.

EDINBURGH.—At a graduation ceremony on December 17, the degree of D.Sc. was conferred on Kalipada Biswas, superintendent of the Royal Botanic Garden, Calcutta, for a thesis entitled "Studies on the Systematic Botany of India", and on Sanford Sterling Munro, for a thesis entitled "Studies on the Genetics and Physiology of Reproduction in the Fowl".

LEEDS.—Dr. Geoffrey Holmes has been appointed to a newly instituted honorary lectureship in medical hydrology.

Mr. Charles Ludwig has been appointed to a demonstratorship in physiology.

OXFORD.—The Herbert Spencer Lecture will be delivered on February 25, at 5 p.m., in the Examination Schools by Prof. Ernest Barker, Laura Spelman Rockefeller professor of political science in the University of Cambridge. The subject of Prof. Barker's lecture will be "Natural Law in the Political World".

Societies and Academies

London

The Royal Society, January 20.

D. KEILIN and E. F. HARTREE. Mechanism of the decomposition of hydrogen peroxide by catalase. A new explanation of the mechanism of the decomposition of H_2O_2 by catalase is proposed. According to this explanation the reaction is brought about by the successive reduction of the catalase iron by H_2O_2 and its reoxidation by molecular oxygen. This explanation is supported by experiments. The inhibitors of catalase can be separated into two groups, those like KCN, H_2S, C_2H_5OOH which inhibit the reduction of catalase iron by H_2O_2 and those like azide, hydroxylamine and hydrazine which inhibit the reoxidation of the reduced catalase by molecular oxygen (Keilin and Hartree, 1936). The decomposition of H_2O_2 by pure catalase preparations is not inhibited by CO in presence of even a very small concentration of oxygen, which shows that the reduced catalase has a much greater affinity for oxygen than for CO. Some catalase preparations have been obtained which show a more or less marked light-sensitive inhibition by CO. Pure catalase preparations become sensitive to CO in presence of a very small concentration of azide, cysteine or glutathione, substances which apparently inhibit the reoxidation of reduced catalase.

H. J. A. DARTNALL, C. F. GOODEVE and R. J. LYTHGOE: The effect of temperature on the photochemical bleaching of visual purple solutions. The theoretical considerations developed previously for the photochemical bleaching of a light-absorbing substance have been extended to include the case where the products absorb light. Twenty-five out of twenty-nine experiments with visual purple were found to be in accordance with the previous theory. In the remaining four, the decomposition of a coloured product, 'transient orange', proceeded at a rate comparable with the rate of bleaching of visual purple. The quantum efficiency of the bleaching process was found to be independent of temperature over the range 20° to 60° and of pH from 7 to 9·2. It is concluded that the quantum efficiency is equal to or not much less than unity, and that the molar extinction coefficient ($\lambda = 506\text{m}\mu$) is $1{\cdot}41 \times 10^4$.

J. W. HUGHES: The monaural threshold: effect of a subliminal contralateral stimulus. The change of threshold intensity in one ear when a note of fixed subliminal intensity is sounded in the other has been determined by direct experiment. The results of the investigation show that for two notes in unison, the total energy required in the two ears at the 'binaural threshold' is equal to the energy required in one ear at the monaural threshold, independently of the actual division of energy between the two ears.

Paris

Academy of Sciences, December 13 (*C.R.*, 205, 1189–1268).

MARIN MOLLIARD and ROBERT ECHEVIN: The secretion of the fly-catching Caryophyllaceæ. The Caryophyllaceæ present a series of secretions localized in the upper part of the plant, consisting essentially of a sugary material. The secretions vary slightly from one species to another.

DRAGOSLAV S. MITRINOVITCH: The differential equation of the geodesic lines of spiral surfaces.

GEORGES KUREPA: The hypothesis of the continuum and partially ordered ensembles.

STEFAN BERGMANN: A connexion between the theory of elliptical partial differentials and that of the functions of a complex variable.

CAIUS JACOB: The problem of Dirichlet in two dimensions.

JULIEN KRAVTCHENKO: The problems of conformal representation of Helmholtz: the study of a limiting case in the theory of the (ship's) wake in a perfect fluid.

LUCIEN HIBBERT: The surface of the moduli and automorphy of the polynomials and of integral functions.

J. KAMPÉ DE FÉRIET and A. MARTINOT-LAGARDE: The distribution between the mean motion and motion of agitation of the energy dissipated in the turbulent flow of an incompressible fluid.

ALEXANDRE FAVRE: Study of the Toussaint-Carafoli tunnel and of hydrodynamic movements in two dimensions.

HENRI MINEUR: The equilibrium of star clusters when the differential rotation is neglected.

HERVÉ FABRE: The absolute orbits of Gyldén.

TCHENG MAO-LIN: The spectrophotometric study of the minima of Algol. According to earlier work, the minimum of Algol is produced later for the blue rays than for the red. This is not confirmed by the author, who concludes from his observations that for all radiations in the interval 3900–6500 A. the minimum of Algol is produced at the same time within 1 or 2 minutes.

Constantin Salceanu : The measurement of the velocity of sound in liquids by a resonance method. A modification of Bungetzianu's method has been applied to measuring the velocity of sound in seventeen liquids and the results compared with those obtained by A. Cisman by a direct method.

Albert Zmaczynski and Albert Bonhoure : The boiling point of water as a function of the pressure. Owing to the discovery of an error in the temperature coefficient of the bridge resistances of the platinum thermometers used in earlier work, the formula given (*C.R.*, **189**, 1069) is now corrected.

Jacques Vorobeitchik : A new objective method of heterochrome photometry.

Maurice Parodi : Study of the transmission of blende and of some halogen derivatives of copper and of cadmium in the extreme infra-red.

Michael Duffieux and Jean Bollot : A method for the study of the hyperfine structure and the width of absorption lines.

Raymond Ricard, Marguerite Givord and Françoise George : The spark spectra of cæsium.

Jacques Solomon : The disintegrations produced by electrons of very great energy.

Pierre Jacquet : The electrolytic polishing of aluminium. The electrolytic method of polishing previously described can be applied with advantage to a soft metal such as aluminium.

G. Austerweil and A. Fiedler : The preparation of a purified water comparable with distilled water by the exchange of ions.

Mme. Raymonde Duval and Clément Duval : Differential electro-titration.

Paul Goissedet and Robert Despois : Some camphoric *N*-alkyldiamides.

Georges Zbyszewski : The discovery of new deposits of terrestrial vertebrates in the Neogene in the neighbourhood of Lisbon, Portugal.

Mlle. Suzette Gillet : The presence of the Pontian in the region of Salonika.

Albert Roubaux and Marc Bernatzky : The effect of primary faults during the deposition of secondary strata in Lorraine.

Louis Dubertret : The marine Pliocene in the neighbourhood of Antioch (Syria).

Charles Emile Brazier : Contribution to the study of the relations between the insolation and the components of the total radiation in the climate of Paris.

Paul Rougerie : The study of the lunar effect on the earth currents recorded in the north-south line at the Observatory of Parc Saint-Maur.

Paul Bertrand : The successive and sudden appearance of different groups of vascular plants.

Fernand Obaton : The variations of the quantities of water in the floral peduncle of *Papaver Rhoeas* in relation with its straightening in the course of flowering.

Mlle. Madeleine Friant : The interpretation of the brain of the hippopotamus by the study of an embryonic stage.

Marc Romieu, Mlle. Gabrielle Linas and Georges Jullien : The morphological characters of the Purkinje plexus of the human heart.

Baruch Samuel Levin and Leo Olitzki : The diminution of the pathogenic action of some microbial strains cultivated in a medium containing lecithin.

André Paillot : A new type of pseudo fat-body observed in the larvæ of *Euxoa segetum*.

Rome

National Academy of the Lincei (*Atti*, **25**, 529–674; 1937).

F. Severi : Systems of equivalence of any species on one algebraic variety, as rational systems (1).

O. Scarpa : Possibility of the electrolytic working up of very impure copper and on the formation of cathodic tree-like growths in the industrial refinement of copper.

A. Stella : A gabbro-diorite and kinzigite formation in the Alta Valtellina.

S. Cherubino : Application of holomorphous functions of matrices to systems of linear differential equations (1).

B. D'Orgeval : An extension of the principle of degeneracy to the theory of algebraic surfaces.

M. Ghermanescu : Regarding a theorem of Mauro Picone.

F. Giaccardi : One condition for which a periodic analytical function reduces to a trigonometric polynomial.

R. L. Gomes : A new demonstration of the equivalence of two systems of Dirac.

B. Manià : A notable lemma for the problems of Mayer, and one of its applications.

L. Toscano : Secular equation with a circulant matrix.

G. Colonnetti : Elastic equilibrium of systems in which non-elastic deformations also occur (3).

E. Frola : Dynamic generalization of the theorem of Betti different from that of Lord Rayleigh.

G. Lampariello : Vortex rings which generalize the scheme of Bénard-Kármán for the hydraulic resistance.

O. Zanaboni : Evaluation of the maximum error which arises from the application of the principle of de Saint-Venant in an isotropic solid.

G. Agamennone : Scientific results from a large mine explosion.

S. Franchetti : Calculation of the penetration of electrons of some millions of volts (2).

G. Racah : Isotropic tensors which show particular symmetries (2).

A. Baroni : Sulphides, selenides, and tellurides of thallium (1). Thallium selenides.

L. Cavallaro : Absorption bands in polar substances at very high radio frequencies (3). Measurements with *n*-propyl and octyl alcohols.

W. Ciusa : Oxidation of α-oxyacids.

A. Iandelli and E. Botti : Crystal structure of compounds of the rare earths with metalloids of the fifth group (4). Compounds of neodymium.

G. Tedeschi : Velocity of dissolution of lead in acids (1).

P. Comucci : A singular rock from the Baltoro glacier (Karakoram) (1).

P. Piepoli : Observations on the copper pyrites deposits of Champ de Praz in the Valle d'Aosta.

M. Fedele : Further remarks concerning the non-existence of a peripheral nervous system in Tunicata.

A. Vecchi : Observations on the gonads of sterile and masculinized hybrid hen-pheasants.

A. de Niederhäusern : Influence of a tropical climate on the consumption of oxygen during working.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, January 31

UNIVERSITY OF LEEDS, at 5.15.—Dr. H. Jeffreys : "Scientific Method".*

Wednesday, February 2

IMPERIAL COLLEGE OF SCIENCE (ROYAL COLLEGE OF SCIENCE), at 5.30.—Dr. F. Walker : "The Geology and Scenery of the West Indies" (Swiney Lectures. Succeeding lectures on February 4, 7, 9, 11, 14, 16, 18, 21, 23, 25 and 28).*

ROYAL SOCIETY OF ARTS, at 8.15.—C. J. Galpin : "World Air Routes".

Thursday, February 3

CHEMICAL SOCIETY, at 5.—Discussion on "Associated Liquids" to be opened by Prof. J. D. Bernal, F.R.S.

BIRKBECK COLLEGE, LONDON (Natural History Society), at 8.—Prof. T. G. B. Osborn : "Australian Vegetation from the Centre to the Sea".*

Friday, February 4

ROYAL INSTITUTION, at 9.—Prof. E. J. Salisbury, F.R.S. : "The Plants of the Sand Dunes and why they grow there".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.

EXAMINER in the Aeronautical Inspection Directorates Test House, Kidbrooke, S.E.3—The Secretary (S.2.d.), Air Ministry, Adastral House, Kingsway, W.C.2 (February 5)

LECTURER IN BACTERIOLOGY in the University of Aberdeen—The Secretary (February 18).

HEAD OF THE CHEMISTRY AND BIOLOGY DEPARTMENT, and VICE-PRINCIPAL of the Portsmouth Municipal College—The Registrar (February 19).

NON-PROFESSIONAL ASSISTANT (bacteriology) in the Public Health Laboratory of Northumberland County Council—The County Medical Officer, County Hall, Newcastle-upon-Tyne, 1 (February 21).

PROBATIONARY ASSISTANT ENGINEERS in the Post Office Engineering Department—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (March 3).

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Air Ministry : Aeronautical Research Committee : Reports and Memoranda. No. 1781 (2702) : Measurement of the Water Resistance of a 1/2·4 Scale Singapore IIc Hull. By J. L. Hutchinson. Pp. 14. 2*s.* 6*d.* net. No. 1783 (2032 and 1937) : Note on the Whirling of Radial Engines on their Mountings ; Mathematical Analysis and Experimental Observations. By B. C. Carter. Pp. 25. 3*s.* 6*d.* net. No. 1784 (2604) : Tests of the N.A.C.A. 11-A Model Hull in the R.A.E. Seaplane Tank. By L. P. Coombes and F. G. Brown. Pp. 12. 2*s.* net. No. 1785 (2715). Comparison of Results of Tests of the Singapore IIc Model Hull in Five Tanks. By Dr. J. P. Gott. Pp. 16. 2*s.* 6*d.* net. No. 1789 (2958) : Tests on Rivets and Backward-Lapped Joints, in the Compressed Air Tunnel. By D. H. Williams and A. F. Brown. Pp. 6. 1*s.* 3*d.* net. No. 1790 (2914) : The Influence of End Constraint on the Torsional Stiffness of a Rectangular Section Tube. By J. C. K. Shipp. Pp. 7. 1*s.* 3*d.* net. No. 1791 (2865) : The Development of a High Speed Induced Wind Tunnel of Rectangular Cross-Section. By A. Bailey and S. A. Wood. Pp. 16. 2*s.* 6*d.* net. (London : H.M. Stationery Office.) [51

Battersea Polytechnic. Report of the Principal for the Session 1936–37. Pp. 35. (London : Battersea Polytechnic.) [61

Ministry of Health. Sanatoria : List of Sanatoria and other Residential Institutions approved by the Minister of Health for the Treatment of Persons suffering from Tuberculosis and resident in England and Wales, with the Names of the Administrative Counties and County Boroughs in which the Institutions are Situate. (List 10f.) Pp. 28. (London : H.M. Stationery Office.) 6*d.* net. [61

Public Social Services (Total Expenditure under certain Acts of Parliament.) (Cmd. 5609.) Pp. 20. (London : H.M. Stationery Office.) 4*d.* net. [61

Other Countries

Transactions of the San Diego Society of Natural History. Vol. 8, No. 27 : A New Snake of the Genus Sonora from Mexico. By Laurence M. Klauber. Pp. 363–366. Vol. 8, No. 28 : A New Sea-Urchin from the "Oligocene" of Oregon. By Hubert Lyman Clark. Pp. 367–374 + plate 24. Vol. 8, No. 29 : An Extinct Puffin from the Pliocene of San Diego, California. By Prof. Loye Miller. Pp. 375–378. Vol. 8, No. 30 : An Upper Pleistocene Fauna from the Baldwin Hills, Los Angeles County, California. By George Willett. Pp. 379–406 + plates 25–26. (San Diego, Calif. : San Diego Society of Natural History.) [51

Memoirs of the Kyancutta Museum. No. 4 : Further Notes on Archaeos (Pleospongia) from the Lower Cambrian of South Australia. By R. and J. Bedford. Pp. 27–38 + plates 27–41. (Kyancutta : Kyancutta Museum.) [51

Scientific Reports of the Imperial Agricultural Research Institute, New Delhi, for the Year ending 30th June, 1937 ; with a Brief Survey of Three Decades of Research at the Institute. Pp. iv + 177 + 8 plates. (Delhi : Manager of Publications.) 3 rupees ; 5*s.* 3*d.* [51

Bulletin of the Madras Government Museum. New Series, General Section, Vol. 2, No. 4 : Social and Physical Anthropology of the Nayadis of Malabar. By A. Aiyappan. Pp. iv + 141 + 12 plates. (Madras : Government Press.) 3.2 rupees. [51

New Zealand : Department of Lands and Survey. Annual Report on Public Domains and National Parks of New Zealand. Pp. 8. (Wellington : Government Printing Office.) 6*d.* [51

League of Nations : Convention for Limiting the Manufacture and Regulating the Distribution of Narcotic Drugs of 13th July, 1931. Estimated World Requirements of Dangerous Drugs in 1938. Statement issued by the Supervisory Body under Article 5. (Official No. : C 544. M. 381. 1937. XI.) Pp. 60 + 4. (Geneva : League of Nations ; London : George Allen and Unwin, Ltd.) 2*s.* 6*d.* [51

Annalen van de Sterrewacht te Leiden. Deel 18, Stuk 2 : Photographic Measurements of the Six Double Stars η Cassiopeiae, γ Virginis, ξ Bootis, 44i Bootis, σ Coronae borealis, 70 Opiuchi, and the Computation of their Orbits with special attention to these Measurements. By K. Aa. Strand. Pp. 138. (Leiden : Sterrewacht.) [51

U.S. Department of Agriculture. Circular No. 452 : Experiments with certain Copper Compounds as Bunt Fungicides. By O. A. Nelson and R. W. Leukel. Pp. 8. 5 cents. Leaflet No. 132 : Den Hunting as a Means of Coyote Control. By Stanley P. Young and Harold W. Dobyns. Pp. 8. 5 cents. Leaflet No. 146 : Bedbugs. By E. A. Back. Pp. 8. 5 cents. Leaflet No. 149 : Silverfish. By E. A. Back. Pp. 4. 5 cents. (Washington, D.C. : Government Printing Office.) [51

Bulletin of the American Museum of Natural History. Vol. 74, Art. 2 : Interrelationships of the Elasmobranchs with a Key to the Order Galea. By E. Grace White. Pp. 25–138 + 51 plates. (New York : American Museum of Natural History.) [51

League of Nations. Handbook of International Organisations (Associations, Bureaux, Committees, etc.). Pp. 491. (Geneva : League of Nations ; London : George Allen and Unwin, Ltd.) 12*s.* 6*d.* [51

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 42, Part 1 : A Contribution to the Knowledge of the Braconid Fauna of the Empire of Japan. By Chihisa Watanabe. Pp. 188 + 5 plates. (Tokyo : Maruzen Co., Ltd.) [51

Indian Central Cotton Committee : Technological Laboratory. Technological Bulletin, Series A, No. 39 : Technological Reports on Standard Indian Cottons, 1937. By Dr. Nazir Ahmad. Pp. iii + 104. 1.8 rupees. Technological Bulletin, Series A, No. 40 : The Effect of Different Degrees of Compression on the Fibre Properties and Spinning Quality of Indian Cottons. By Dr. Nazir Ahmad. Pp. ii + 14. 8 annas. (Bombay : Indian Central Cotton Committee.) [51

State of Connecticut : State Geological and Natural History Survey. Bulletin No. 58 : The West Wall of the New England Triassic Lowland. By Girard Wheeler. Pp. 73 + 7 plates. Bulletin No. 59 : Sixteenth and Seventeenth Biennial Reports of the Commissioners of the State Geological and Natural History Survey, 1933–1936. Pp. 24. (Hartford, Conn. : State Geological and Natural History Survey.) [51

Suomen Geodeettisen Laitoksen Julkaisuja. No. 24 : Bestimmung der Schwereunterschiedes Helsinki—Potsdam im Jahre 1935 und Katalog der Finnischeen Schwerestationen. Von R. A. Hirvonen. Pp. 36. (Helsinki.) [51

Department of Agriculture, Fiji. Annual Bulletin of Divisional Reports, 1936. Pp. iv + 105. (Suva : Government Printer.) 2*s.* 6*d.* [51

Tanganyika Territory : Department of Lands and Mines, Geological Division. Annual Report, 1936. Pp. 30. (Dar es Salaam : Government Printer.) 1*s.* 6*d.* [51

Ministerio de Instrucción Pública y Sanidad. Anuario del Observatorio Astronómico de Madrid para 1938. Pp. 304. (Madrid : Observatorio Astronómico.) [51

Calendario del Santuario e delle Opere di Beneficenza Cristiana di Pompei. Pp. 192. (Pompei.) [51

Gold Coast Colony. Report on the Gold Coast Survey for the Year April 1936 to March 1937. Pp. 12. (Accra : Government Printing Office ; London : Crown Agents for the Colonies.) 1*s.* [51

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 40, Part 2 : On the Development of the Tusser, *Antheraea pernyi* Guérin-Meneville, with Special Reference to the Comparative Embryology of Insects. By Saburo Saito. Pp. 35–110 + 11 plates. (Tokyo : Maruzen Co., Ltd.) [61

Catalogues, etc.

Wild-Barfield Heat-Treatment Journal. Vol. 2, No. 15, December. Pp. 85–97 + v. (London : Wild-Barfield Electric Furnaces, Ltd.)

Towers' Electric Furnaces, Ovens, etc. Pp. 12. (Widnes : J. W. Towers and Co., Ltd.)

The Book of Dunns Farm Seeds, 1938. Pp. 92. (Salisbury : Dunns Farm Seeds, Ltd.).

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Science in Administration

THE position and functions of the scientific or technical expert have been the subject of many discussions and much difference of opinion. The general view of administrators is that "The expert should be on tap but not on top" ; but this arises from a widespread official assumption that intimate knowledge of a particular subject—unless it is of a literary or historical character—is a disqualification for an administrative post. The point of view of the professional civil servant was stated in a leading article in the November issue of *State Service*. The article suggests that a remedy of current social and economic maladjustment can only be found in the intensive use of the methods of scientific research and inquiry in problems which have hitherto generally been regarded as outside their province. If the achievements of the chemist, the physicist, the biologist and the engineer are to be correlated with the processes of public administration, and not stultified or misapplied through the inability or reluctance of politicians and administrators to appreciate the significance of new scientific development, the expert's processes of thought and action must be extended into fields of human activity where they are at present rarely encountered.

These reasons themselves have led the Institution of Professional Civil Servants to maintain insistently that, in the interests of efficient government, the heads of professional, scientific or technical branches of the Civil Service should be given an unconditional right of access to Ministers in charge of their department on all matters in which their special knowledge provides them with a particular qualification to advise. The soundness of this contention is now scarcely challenged, however practice may depart from the principle. There is, however, another point of view, which was very ably advanced by Dr. G. W. C. Kaye in his address to Section A (Mathematical and Physical Sciences) at the British Association meeting at Nottingham. Dr. Kaye challenged the dictum that qualities of leadership are more likely to be developed by the old humanitarian studies than by the natural or mechanical sciences, and ridiculed the idea that technical or scientific workers invariably require to be mothered by full-blooded non-scientific or quasi-scientific administrators.

A scientific training may be the medium for the development of latent administrative ability as much as any other career and probably more than most. Restriction of the opportunity of scientific men who possess administrative ability to advance to the highest positions of administrative responsibility, whether in the State service, in industry or elsewhere, is not only unfair to the scientific worker as a class but is also a danger to the State, by limiting the resources upon which it can draw for a type that in any event is not easy to find. The significance of this point is well illustrated in Sir Josiah Stamp's recent address on the administrator and a planned society to the Institute of Public Administration, although he nowhere referred to it explicitly.

Sir Josiah sees the problem of administration as fundamentally that of securing a greater fitness to achieve approved ends, rather than obtaining any vision of a changing task which might be more than a question of degree and involve a different type of administrator. The responsibilities of the administrator are now so wide and numerous that the question arises whether a new kind of administrative technique and ability is required, whether different aptitudes and temperaments are logically involved, and whether the mental training should have some radical redirection.

This question of the type of administrator is all the more important in that the further question of the type of administration required in modern society has been raised in many quarters, for example, in the study of "British Experiments in Public Ownership and Control" by Mr. T. H. O'Brien, promoted by the Institute of Public Administration, or Sir Daniel Hall's discussion of possible modifications in the administration of democratic Governments to promote planning and efficiency, recently contributed to the *Nineteenth Century*. The two questions are interlocked, but we cannot be sure that we are getting the best out of the existing system unless we are using the best type of administrator in that system.

Equally, of course, it is true that an existing administrative system may be condemned as inadequate because by recruiting on too narrow a basis or through other deficits it fails to obtain or develop the best type of administrator. For this reason the recently published series of essays on "The British Civil Servant", some of which originally appeared in the *Political Quarterly*, are of special interest and significance, particularly the essay by Mr. F. A. A. Menzler on the expert in the Civil Service, and the discussions of the recruitment and training of officers in the Civil Service and the Local Government Service.

It is indeed strange that in the multitude of books on planning there is little reference to the administrative problem, and the fact that the new responsibilities involved in such corporate enterprises demand new qualities and new skills which may be the very antithesis of those required in the development of a successful one-man concern is largely ignored. As Dr. Robson suggests in reviewing a century of municipal progress, a more constructive type of administrator is required who sees possibilities and opportunities rather than difficulties and dangers, and who possesses creative ability and the capacity to promote energetic and far-reaching projects.

Under such conditions administrative ability is of greater rather than less importance, even if we are concerned with a slightly different type of administrator. Technical factors have to be assessed, but possibly technical factors in not one but half a dozen or more fields, and the administrator must consider the indirect as well as the direct effects of the proposed action or policy. The task of the administrator in the future is, in fact, as Sir Josiah Stamp points out, increasingly to secure the maximum net social product, and success of a measure or policy cannot be judged merely by sectional statistics but only by the effect on the national welfare when all repercussions have been taken into account.

This in itself clearly indicates the unsuitability for such responsibilities of the business man of the single management type, accustomed to fixing his own goal and achieving it in a competitive world, as well as the exactly trained civil servant accustomed to the analytical application of a legislative programme in a statute and working to the elaboration of a completely static programme. As a corollary it again emphasizes the importance of tapping all channels to secure an adequate supply of men of the requisite ability and vision.

If, however, it is essential that the highest administrative posts should be recruited from the widest possible field, technical and scientific as well as others, the question of training as well as of final selection remains. In this field, the idea of the staff college has only been tentatively explored, and the possibilities of vocational selection in regard to the higher posts as distinct from entrance to industry have scarcely been probed. Indeed, vocational guidance only becomes possible when the requirements for the post to be filled can be defined with some exactitude.

Obviously in this field such bodies as the National Institute of Industrial Psychology, the Institute of Industrial Administration, and the Institute of Public Administration have important contributions to make. What, however, in the first instance delays progress is the general failure, due to mis-education, to realize that scientific research and technical advance are producing strains and stresses in the structure of society which, if they do not receive prompt attention, may bring about the destruction of the social order. The status of the specialist in the Civil Service is merely symptomatic of society's general attitude towards those who are reshaping social environment.

The present unsatisfactory position has been pointed out authoritatively on repeated occasions in recent years. A report of the British Science Guild in 1931 strongly condemned the inefficiency of the practice of excluding officers of the expert class from the important administrative positions responsible for the direction of the work, and contrasted this position with the success of the opposite policy pursued in large-scale progressive industry. The report of the Royal Commission on the Civil Service, which appeared almost simultaneously, disappointed any hopes of this position being rectified at an early date, and instead betrayed a fundamental failure to appreciate the significance of the expert in public administration. In contrast with this, the Bridgeman Committee, reporting on the Post Office in 1932, was the first public inquiry committee to give full recognition to the scientific expert in the Civil Service, and proposed in effect that he should take his place on level terms with the administrative expert and the financial expert, and have his say in the formulation of policy as in the control and execution of the routine operations.

There is thus at least one instance of public recognition of the principle that a technical man who has shown that he possesses administrative talent should be eligible for other appointments. Meanwhile progress is slow. In the Local Government Service, as has been pointed out in the P E P report and elsewhere, little or no attempt has been made to implement the recommendations of the Hadow Report of 1934 regarding the recruitment, training and promotion of local government officers, and Sir Ernest Simon is still able to direct attention to our neglect of the universities in recruiting for this service, to the absence in many of our local rulers of the scientific quantitative thinking which is the basis of wise action in social affairs, and to the need of selecting and promoting men with a single eye to the highest degree of administrative ability. Here, no less than in the Civil Service itself, is there scope for the recruitment of administrators with a wider culture that embraces a real and intimate understanding, acquired from study, of the significance of science and scientific discovery in the evolution of modern society.

The contribution of the scientific or technical expert in every sphere of life grows more and more important, and the security of society makes it imperative that his services shall be fully and wisely used. Equally the burden upon the administrator grows heavier, and we can less than ever afford to miss the rare administrator of first-class ability wherever he may be found.

Origins and Growth of Chemistry

A Short History of Chemistry
By Prof. J. R. Partington. Pp. xiv + 386. (London: Macmillan & Co., Ltd., 1937.) 7*s*. 6*d*.

THE history of chemistry, like that of Ko-Ko, "may rank with most romances", and lends itself perhaps too easily to the picturesque rather than to the accurate style of narration. As Dr. Sarton has recently observed, however, "accuracy is as fundamental in the historical field as in the scientific one, and . . . has the same meaning in both fields"; so that we may properly require an unswerving adherence to fact as the prime qualification of a historian of chemistry. The second qualification must be a first-hand acquaintance with as much as possible of the original literature and a critical familiarity with secondary authorities, while the third—of equal indispensability—is a sound knowledge of chemistry from the practical point of view. All these qualifications Prof. Partington possesses, happily backing them with a pleasant style and thus softening, without in the least obscuring, a precision of thought and an economy of words that might otherwise have appeared somewhat prim. That he has attained his expressed aim of being objective, impartial, and innocent of conventional platitudes, will be agreed by everyone who reads his present book, which affords a survey of chemistry from the earliest days to the first decades of the twentieth century.

After a preliminary chapter on ancient metallurgy, glass-making, and kindred arts, Prof. Partington deals with the origins of chemistry *qua* chemistry, adopting the generally accepted view that the birthplace of the science was Alexandria. He then describes, very briefly, the diffusion of alchemy in Arabia, India, China, and Europe. This chapter could well have been enlarged without upsetting the balance of the book, but even in its succinctness it makes clear what is not always understood, namely, that early Chinese alchemy of the centuries immediately preceding the Christian era dealt mainly with the medicine of immortality, in contrast to the transmutatory alchemy of the West, out of which chemistry arose. Incidentally, it may be remarked that Prof. Partington seems to be under some misapprehension about the "Sabeans" of Harran. The Syrian heathens of this celebrated ancient town called themselves Sabæans to avoid persecution from the Caliph Al-Ma'mun; the true Sabæans or Mandæans lived between Basra and Wasit, that is, in the region formerly known as Chaldea.

With the rise of iatrochemistry, Prof. Partington's treatment becomes fuller, and he rightly devotes several pages to the work of that accomplished chemist Johann Baptista van Helmont (1577–1644), who invented the word "gas", made extensive use of the balance in his scientific researches, expressed clearly the law of the indestructibility of matter, and emphasized that metals when dissolved in acids are not destroyed but can be recovered by suitable means. The scientific spirit was reaching adolescence, though even van Helmont believed in alchemy, and gives, indeed, one of the most circumstantial accounts of a transmutation to be found in the whole of alchemical literature.

In the late seventeenth century, and throughout the eighteenth century, the phenomena of combustion formed the focal point of chemical investigation, which had at length shaken itself free from alchemy and from subservience to medicine. Boyle (1627–1691) explained the increase in weight of metals on calcination by assuming the fixation of ponderable particles of fire, though he seems to have suspected, in certain cases at least, that the increase might possibly be due to something taken by the metal from the air. The progress made by Boyle, Hooke, Mayow and others towards a satisfactory explanation of combustion was, however, interrupted by the "false theory" of phlogiston, of which Prof. Partington gives a very clear description (though it may be argued that the adjective *false* cannot be strictly applied to a scientific hypothesis or theory—*inadequate* is less open to objection). The fall of phlogiston, through the discoveries of Priestley, Cavendish, Black and Scheele and their reinterpretation by Lavoisier, leads us on to the great days of the early nineteenth century and the foundation of modern chemistry; Dalton and Davy, Berzelius and Gay-Lussac occupy the stage, and perform Herculean deeds of intellect. The materials for the historian now become embarrassingly rich, and perhaps only those who have tried to write the chemical history of the last century and a half can fully realize the magnitude and complexity of the task.

Prof. Partington has chosen what seems to be the only method of treatment suitable for a limited space; that is, to take individual topics or individual branches of chemistry and consider them separately, showing, however, their interconnexion wherever it is possible to do so. He devotes, for example, two or three chapters to organic chemistry, one to the theory of valency, another to physical chemistry, and the final two to the periodic law and the structure of the atom respectively. His account of substitution and the unitary and type theories is remarkably lucid for such an involved subject, and the chapter on physical chemistry is equally good. But the method has its disadvantages: it is bound to occasion some lack of coherence and to give greater prominence to the trees than to the wood, while in this particular case it has led to a noticeable neglect of the progress of general inorganic chemistry—the only serious fault in an otherwise excellent book.

There are very numerous portraits and other illustrations; summaries of, and supplements to, most of the chapters; biographical sketches; a bibliography; and indexes of names and subjects. The most striking feature of the book, however, is the skill with which the author makes his reader feel the æsthetic appeal of chemistry. A chemist may be "a poet who has taken the wrong turning", but Prof. Partington will convince us that the turning was not so very wrong—and did not Wordsworth send some of his poems to Davy for criticism?

E. J. HOLMYARD.

Archæology in South Africa

Mapungubwe:
Ancient Bantu Civilization on the Limpopo. Reports on Excavations at Mapungubwe (Northern Transvaal) from February 1933 to June 1935. Edited on behalf of the Archæological Committee of the University of Pretoria by Leo Fouché. Pp. xiv+183+44 plates. (Cambridge: At the University Press, 1937.) 50*s*. net.

THE treasure-seeker has often been the enemy of real archæology. Yet sometimes, like the honeybird, he has revealed the path to those wiser and better instructed than himself. So it has been with the romantic story of Mapungubwe. Five farmers in the northern Zoutpansberg district set out to explore a lonely hill in the wildest and most desolate part of the Transvaal. To the natives it was known as the "Hill of the Jackals", and they regarded it with superstitious dread. It was sacred to the Great Ones among their ancestors. The five adventurers started to dig, and found close under the surface a skeleton with numbers of gold bangles, a bowl of gold plating, and parts of a gold-plated headrest, together with small figures of rhinoceroses in gold plating. The total weight of gold in this single find was 75 ounces.

Fortunately, two of the farmers were men of education, and the younger of these two was a graduate of the University of Pretoria. He, very wisely, reported the whole history to his former college professor, and the result eventually has been the scientific expedition of which a first preliminary record is published in this beautiful volume, splendidly illustrated with photographs, coloured plates, and a series of workmanlike plans and diagrams.

It must have been a proud moment for Mr. Van Graan when he learned that the Prime Minister, General Hertzog, had declared the exploration of Mapungubwe to be "a matter of national importance". General Smuts, then leader of the Opposition in Parliament, showed also the keenest interest. So that, in 1933, the Government bought the farm outright, and made an agreement with the University of Pretoria by which the University should undertake to excavate for five years, receiving from the Government two pounds for every pound raised by its own efforts. There was then formed the Archæological Committee of the University of Pretoria, on which the Government, the public, and the University were all represented. The City Council of Pretoria and various private citizens immediately contributed a substantial sum, with which operations were begun in June 1933.

The whole history of this undertaking and its reception by the Government and the general public is most inspiriting. It shows a degree of enlightenment as rare as it is admirable, and may stand as a great example for other and older countries. South Africa, indeed, has always been alive to the importance of its antiquities. It was Cecil Rhodes himself who saved Zimbabwe from the destroyer, and the Chartered Company soon afterwards appointed a custodian for the principal ruins in its own territory. Both Rhodesia and the Union have passed in recent years very effective laws for the preservation of their archæological heritage.

It was, perhaps, inevitable that, thirty or forty years ago, when Southern Rhodesia was still a new country, the zeal of untrained explorers should outrun their discretion. Excavations at Zimbabwe and other sites about the turn of the century and for some years afterwards were very badly conducted, and much evidence was unwittingly destroyed by those whose official duty it was to conserve it. Since 1905, however, this has been remedied, and only competent workers are allowed. Nevertheless, gold seekers, adventurers, and others had destroyed so much in Rhodesia, where the finest ruins are situated, that it is most fortunate that outlying stations of the same culture have been discovered in the bordering countries, in Portuguese territory on the east, and on the southern banks of the Limpopo in the Transvaal. These, though outwardly less spectacular, may be expected to add very greatly to the sum of evidence, and ultimately to provide the complete solution of the problem.

For it is now generally recognized that Zimbabwe is by no means unique ; it is only the most striking and the most sophisticated example among a large number of stone-walled kraals belonging to a medieval and post-medieval Bantu culture. While the earliest of these may very possibly have been founded about the ninth or tenth century after Christ, the majority were at their most flourishing stages in the sixteenth and seventeenth centuries. Mapungubwe is dated to about 1500 ; neighbouring sites noted in this volume are later, and it is well established that the culture persisted in many places until it was destroyed by the Matabele invasions of the nineteenth century.

I have reason to remember that the opinions just expressed were very unpopular thirty years ago, though even then they were shared by many of those who knew the country and the natives best. But the work of several unprejudiced students, among whom should be especially mentioned two contributors to this volume, Mr. Schofield and the Rev. Neville Jones, has greatly changed the viewpoint of even the least scientifically minded. Miss Caton-Thompson's researches in 1929 routed the last desperate adherents of the Queen of Sheba, and it may now be considered that the "Oriental mirage" has disappeared for ever. Student and settler alike now realize that the Zimbabwe cultures represent the history of native African peoples in a period contemporary with medieval and modern history in Europe. In such a changed atmosphere we may look forward to a great development of knowledge analogous to that which has taken place in America in the last half-century. Only forty years ago the world had very slight and inaccurate knowledge of the great civilizations of the Mayas and the Aztecs. Mists of fantasy and wild speculation enwrapped them also. But now excavation and study have made the archæology of Central America a part of the established history familiar to every cultured man. There is no reason why the African Monomotapa should not be as familiar to our grandchildren as Montezuma has long been to ourselves. He is quite as authentic, and was probably quite as important.

Not only to South Africans, but also to all who are interested in a most fruitful and promising field of history and ethnography, this admirable book may be warmly recommended. It is rightly and properly technical, written with the greatest economy of words, and with little elaboration of theory, but it describes its material thoroughly and exhaustively with a completeness and precision that leave nothing to be desired. Especially worthy of attention are the minute discussion of the pottery by Mr. Schofield, and the excursus on beads by Mr. H. C. Beck, the highest living authority on that subject. The description of the field work by the editor and by Mr. Neville Jones shows that South African excavators completely understand their problems, and are using their local knowledge as well as the experience of excavators in other fields to develop a technique suitable to the rather peculiar local conditions.

D. RANDALL-MACIVER.

The Presentation of Applied Physics

(1) Elementary Engineering Science
By Dr. Arthur Morley and Dr. Edward Hughes. Pp. xi + 290. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 3*s*. 6*d*.

(2) Engineering Science
By H. B. Brown and A. J. Bryant. Vol. 1: Mechanics and Hydrostatics. Pp. xv + 403. (London: Macmillan and Co., Ltd., 1937.) 5*s*.

(3) Further Mechanics and Hydrostatics
By A. W. Siddons, K. S. Snell and N. R. C. Dockeray. Pp. viii + 184. (London: Edward Arnold and Co., 1937.) 3*s*. 6*d*.

(4) Physics for Technical Students:
Mechanics and Heat. By Prof. W. B. Anderson. Third edition. Pp. ix + 378. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 15*s*.

(5) Physics in Industry
By Karl T. Compton, E. C. Sullivan, Zay Jeffries and E. Q. Adams, Paul D. Foote, J. P. Den Hartog, John Ely Burchard, Oliver E. Buckley, Clark B. Millikan, Joseph Slepian, Homer L. Dodge, A. R. Olpin. Pp. xiv + 290. (New York: American Institute of Physics, 1937.) 1.50 dollars.

"SCIENCE increases the power of the rulers, giving them control over the sources of modern life. A wise nation, a people who intended to remain free would get to know all about science too." These words recently appeared as a random note in a daily newspaper and if there is one branch of science to which, in particular, they could be taken to refer, that branch is physics, with its many practical applications. Each of the books quoted above deals with one or more aspects of applied physics, and each, in its way, aims at promoting its study. Their perusal leaves a strong impression of the stultifying influence of the examination system — teachers, students and writers being cabined, cribbed, and confined within the limits of the syllabus chosen.

(1) In the first example, the National Certificate code provides the limitation, by which term is to be understood such restriction of view as is ensured, in a physical sense, by the blinkers in the harness of a horse so that he may see no more than lies directly ahead. The book provides a course of instruction in engineering science for students in the first year of their preparation for the Ordinary Certificate in Mechanical or Electrical Engineering and, as such, it is a very good course consisting mainly of elementary mechanics with a modicum of heat and electric technology.

The basis of the treatment is the principle of work, which certainly provides an easy approach, but the book suffers from the effects of compression, as, for example, in the condensing of a phrase until it lacks precision. To the teacher, it will certainly be useful as the foundation of a session's work.

(2) Messrs. Brown and Bryant's book on "Mechanics and Hydrostatics" is somewhat more advanced and includes two years' work for the Ordinary National Certificate and sufficient preparation for preliminary professional and entrance examinations. The authors have adopted an easier style and have freely used such elementary mathematics as is necessary for the adequate presentation and solution of problems. The treatment is based on a scheme of experimental work, which is fully outlined, and throughout the book reference is made to practical examples.

The clarity of the argument and the excellence of the diagrams make it likely to prove a helpful text-book in the early stages. The later chapters on strength and testing of materials, hydraulic machinery and the mechanics of fluids provide excellent preparation for the higher stages.

(3) It is for a different class of student that Messrs. Siddons, Snell and Dockeray have prepared the series entitled "Mechanics", of which the present volume constitutes the third part. It meets the needs of those who are in the early stages of their preparation for the Mechanical Science Tripos at Cambridge or for higher mathematics in the Army Entrance Examinations. Here a much more academic treatment of the subject is adopted, and readers require a sound knowledge of mathematics including some calculus. The formal method of presentation will be found very suitable for those students who have had a well organized and directed education and have been trained to study methodically.

(4) While each of the three preceding books is good in its way and within its limitations—which are those of examination syllabuses—and may be accepted as a reliable medium of instruction, they lack enthusiasm. They work methodically and conscientiously through the allotted task, but will not evoke in the student a wider interest in the subject. In sharp contrast, Prof. Anderson takes up his subject with an obvious sense of its importance and of its absorbing interest. While writing for students of science, agriculture, engineering and other branches of applied physics, he urges its cultural value to all. This is not to suggest that his treatment departs from the logical and recognized course, but rather to indicate the spirit in which the instruction is given and the easy introduction of practical topics to illustrate and reinforce it. For example, after dealing with fluids in motion and reduction of pressure with increase of velocity, he leads up to a discussion on carburettors, ship collisions, pitot tubes, the rotor ship, venturi meters, steam injectors, organ pipes and several other examples. With such a book the student will gain greatly in his mental outlook.

(5) The last of these volumes is in a different category. It contains a symposium of essays on the applications of physics in industry by different American authorities in the glass, metal, oil and other industries. Though by no means equal in quality, they all, with perhaps one exception, reach a high standard of interest and of technical value. It is a book which should be read not only by every scientific worker and engineer but also very widely by the general public, to whom it would convey the vast importance of physical science in modern life.

Analysis of Animal Foods

The Structure and Composition of Foods
By Dr. Andrew L. Winton and Dr. Kate Barber Winton. Vol. 3 : Milk (including Human), Butter, Cheese, Ice Cream, Eggs, Meat, Meat Extracts, Gelatin, Animal Fats, Poultry, Fish, Shellfish. Pp. xxv + 524. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1937.) 40*s*. net.

WHEN the two preceding volumes of "Winton and Winton" were issued, we believed, as did the authors, that the third volume would complete their work. Apparently, however, they had under-estimated the range of products needing survey, and they have now had once more to postpone the end of their labours. The publishers state that volume 4, in preparation, will cover the remaining foodstuffs—sugar, syrup, tea, coffee, cocoa, spices, extracts, etc. Volume 3, however, will be for many the climax of this important and useful work, for the analysis and control of animal foods offer, broadly speaking, greater difficulties to the technologist than do even some of the knottier problems in the control of cereals and seed oils.

Books of this type must always suffer from one inherent disadvantage. In this volume, for example, it must have been very difficult to decide exactly how much space to allot to milk and milk products ; actually they receive 209 pages. Eggs (in Part 2) occupy a further 50, miscellaneous animal products some 30, meat and meat products just under 140, fish and fish products a further 50. The remaining pages are devoted to batrachians and reptiles and to an index.

It is clear that 200 pages about milk and milk products constitute, in effect, a monograph on the composition and analysis of dairy products—matters that have been very adequately treated in a number of specialized books. Is there really any call for its treatment at such length here ? If, on the other hand, it had been decided that much shorter treatment would be satisfactory, the authors would immediately have laid themselves open to the charge of inadequacy.

We must admit that this is a problem that we are glad not to need to face. The authors, however, have had to face it and, granted the premises that decided their editorial policy, have done so with considerable success. It is, of course, impossible to check anything but random samples of the facts summarized in such a book. References appear to be brought up to 1936, and include such recent information as the Levene formulæ for yeast nucleic acid and thymus nucleic acid, and for inosinic acid.

The book is unfortunately not free from gross printer's errors. For example, "Greatine" on page 275. Also, much of the information collected by the authors about the effect of cooking on meat (and other foods) has now been rendered obsolete by the studies of McCance and Widdowson. Nevertheless, the book will remain permanently useful, not only as a record of facts, but also as a record of the kind of facts that have been recorded.

A. L. B.

The Conquest of the Stratosphere

By Chas. G. Philp. Pp. ix + 205. (London: Sir Isaac Pitman and Sons, Ltd., 1937.) 7*s*. 6*d*. net.

MR. PHILP'S two books are of very different value; their defects are alike, their merits dissimilar. Both are marred by a superficial and far from accurate handling of scientific facts and hypotheses, and both suffer from that adjectival rash which infests so many works of popular science—"hazardous risks", "intrepid explorers", "unknown regions", "entrancing story", "astounding information", "tremendous height" and so on. As for "evaporizing", "stratonaut", "astronautist"—what words!

The merits of "Stratosphere and Rocket Flight", which was published some time ago, lie in its exaggerations, its failure to present a fairly balanced picture of the great practical difficulties that must be overcome before the great theoretical possibilities of reaction propulsion are converted into directed achievement. They are merits, because they are sufficiently obvious to a reader of the most modest intelligence, and because they will compel the reader to think and question at every page. "The Conquest of the Stratosphere" opens inauspiciously with a chapter in which our incomplete knowledge of the atmosphere is presented in obsolete and misleading form. Scientific facts and the scientific results of stratospheric flight are not presented in a form which will convince the average reader that justification of the pains is yet in sight.

But a clear majority of the pages are devoted to vivid and straightforward description of each of the historic manned balloon flights into the stratosphere, from Glaisher and Coxwell in 1862 to Stevens and Anderson in 1935. The stories, which are mainly based on a close (sometimes too close) following of the actual logs, are absorbingly interesting, and the modest price of the book is handsomely earned in this connected narrative of exploration. It can be most cordially commended to everyone who needs reassurance that grandeur can still in the twentieth century be attained in communal organization and in individual courage, freed from passion and self-interest. For those not yet tormented by philosophic doubts and fears, it is a fine story book.

Insects of the British Woodlands

By Dr. R. Neil Chrystal. Pp. xiii + 338 + 33 plates. (London and New York: Frederick Warne and Co., Ltd., 1937.) 7*s*. 6*d*. net.

THIS book is intended primarily for those who are concerned with the management of British forests and woodlands. Through the operation of the Forestry Commission, extensive tracts of land have been taken over in Britain for planting with forest trees. These trees include both native and alien species and, as the work goes forward, increasing attention will be directed to their various insect enemies. There has been a very evident need for a good practical manual on the insect enemies of the forester and, in fact, of trees in general. Such a work requires to be up to date and treat of the insect concerned in close connexion with methods of forestry practice.

This want may be regarded as being adequately met by the present book. Those who use it will find sufficient introductory matter to become acquainted with the essential features of insect biology and structure. They will also be able to name, without undue difficulty, the more important insects encountered and, at the same time, gain an insight into their habits and relation to forestry. The various conditions and circumstances which govern insect outbreaks in woodlands are explained: both natural enemies and artificial methods of repression are clearly discussed, while simple methods for the collection and study of insects are given.

Written by an author who has had much first-hand experience with the subject, the book provides the sort of information that is required. It is not overburdened with technicalities, and the clear, straightforward style in which it is written should commend it also to the notice of nature study teachers and others interested in insect life. It is well and fully illustrated and very reasonably priced.

A. D. I.

Sound-Recording for Films:

a Review of Modern Methods. By W. F. Elliott. Pp. xi + 134 + 12 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1937.) 10*s*. 6*d*. net.

THE accuracy of aim, clarity of conception, and exactness of expression which characterize Mr. Elliott's work are well illustrated in its title. His book is not one on "Sound Recording on Film", with detailed description of the physics and chemistry of the sound track and the related apparatus. It is a shrewd and stimulating discussion of the art of that highly skilled, imaginative, ingenious, agile and patient collaborator in film-making who bears the regrettable though comprehensible title of "recordist". A very few inexactitudes and obscurities in the brief references to acoustic physics are quite unimportant in a book full of wisdom, common sense and sound artistic judgment.

Although it is designed as a practical guide to the technician, the book is of a much wider interest. Its claim to be the first of its kind is justified, and it should be read not only by every recordist but also by every director. The general reader will find it enthralling and illuminating. He will get a fair impression of one aspect of that almost incredibly onerous labour, that meticulous care, and that more than humanly patient iteration which goes to the making of a good film, and of which direct evidence must be completely absent from the good film.

Nearly everything that Mr. Elliott says is so right that there is a temptation to call it obvious. A visit to an average film show will cure the temptation, and will renew the feeling that such a visit must be a somewhat painful experience for Mr. Elliott and for any recordist of his high quality and ideals.

A word must be said for the ingenious "post-synchronization" of the dust-cover, which shows on the front a typical film scene and on the back the battery of technical aids which stands—in this case literally—behind the scene.

Iodine*

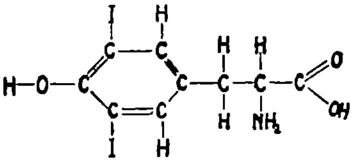
By Prof. Irvine Masson

OF the two aspects of iodine and its chemistry which are here surveyed, the first is that of the part played by the element in terrestrial economy, whether inorganic or organic or both. In the total make-up of the earth, iodine is not one of the fourteen elements which compose 99·95 per cent of the mass, but is one of the rarest of the non-metallic elements. Nevertheless, it is scattered almost everywhere, in minute traces ; a ton of average rock contains some 300 milligrams, a ton of sea water about 17 milligrams.

The chemical reactions of geology have very rarely segregated any of these widely dispersed traces ; there are scarcely any minerals containing iodine as an essential constituent, and the few that have been found are out-of-the-way mineralogical curiosities, small specimens rather than deposits or ores. Only in one place in the world have solid iodine compounds come together in quantity, and that is in the nitrate deposits of Chile, high up against the western slopes of the Andes. There the element occurs as inorganic iodate, and there are uncounted thousands of tons of it. Yet, even so, the iodate is not by itself in veins or beds, but is simply one of the minor impurities in the great accumulations of sodium nitrate. We might be able to explain how the iodate got there if we knew how the nitrate had got there ; but, in spite of much interesting work, all that seems really safe to say about the origin of Chile nitrate is that no single hypothesis has yet met all the known facts. What is indubitably true is that the world's commercial supply of iodine (with trifling exceptions) comes from the Chile nitrate factories, from which it is exported at the rate of nearly 1,000 tons of the element yearly.

It seems from these facts that during the 2,000 million years which span geochemistry, iodine has played a part that was practically nothing, and that had the element never been created, the inorganic earth would not be appreciably different from what it is. But with the origination of organic life (800 million years ago, or earlier), iodine began to matter. First it became not wholly dispersed, but partly to be segregated from solution in the sea into the colloids of living organisms floating there. Then, as the forms of living things developed, the iodine was not only taken up into them, but also became a chemical part of some of them. They developed still further and more variously ; and now, the vertebrates, and we ourselves, could not continue without iodine, either as individuals from month to month or as species from generation to generation.

Looking more closely into this from a biochemical point of view, we learn from many recorded analyses of vegetable and animal materials that three living creatures stand out far beyond the rest as being rich in iodine. These three are seaweeds (brown and red), bath sponges, and certain classes of corals. One of these is vegetable, two are animal, but all three are marine ; and this is so notwithstanding the fact that the sea water is excessively poor in iodine compared, for example, with many soils and most rocks. The iodine content of these organisms is thousands or even millions of times more than in the sea water in which they live ; it may reach one half per cent of the weight of the dry tissue in seaweed, one per cent or more in the sponges, and in a coral as much as eight per cent. The chemical form of this iodine is undecided in the case of seaweed ; but as to the horny sponges and horny corals, the work of Drechsel (1896) and of Wheeler and his associates (1905–7), confirmed by that of Mörner (1907–13), showed, surprisingly, that the skeletal protein releases its iodine as the definite aromatic amino-acid, 3 : 5 di-iodo-tyrosine :



3 : 5 DI-IODO-TYROSINE

It is improbable that this substance is supplied to the animal cells ready-made in their plant food ; such food no doubt brings them the common protein ingredient, tyrosine, but the iodination would seem to go on in the cell. For this purpose, the very minute traces of dissolved inorganic iodine salts in sea water are drawn upon ; and if these are iodides, the co-operation of an oxidizing agent is obviously necessary (an oxidase naturally suggests itself). The direct iodination of tyrosine in the laboratory, with elementary iodine as the reagent, was easily accomplished by Oswald (1909) and has lately been studied in more detail, as a part of protein chemistry, by Bauer and Strauss (1935).

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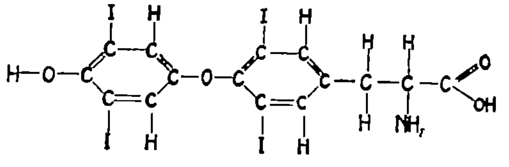
* Substance of a Friday evening discourse at the Royal Institution, delivered on December 3, 1937.

It is particularly to be noted that organic halogen compounds of any kind are extraordinarily rare among natural products. The only other cases known at present are: di-bromo-tyrosine, obtained by Mörner (1913) from horny corals, and evidently formed in the same way as the di-iodo-compound; di-bromo-indigo, the classical Tyrian purple dye from the glands of the shellfish *Murex* or *Purpura* (Friedlander, 1909, 1922); certain aromatic chloro-compounds lately isolated from lichens (Nolan, 1934; Pfau, 1934); and other chloro-compounds which, as Raistrick has shown (1936), are formed by certain moulds growing in solutions of inorganic chloride.

No experiments seem to have been made in order to learn whether the addition of iodine compounds to sea water, or their removal, affects the growth of those marine organisms in which iodine is found organically combined. It is worth noticing, however, that the iodine compound is accumulated not in the fleshy cell-tissue of the sponge or the coral, but in the horny skeleton on which these living cells sit; and this skeleton, though mechanically useful to the cell colony, may almost be called an excretory product of that colony. It is for the animal physiologist to decide whether in these cases the skeletal protein is serving as a mere dump for di-iodo-tyrosine that has been discarded by the cells as useless, or whether, on the contrary, it acts as a reserve store upon which the cells can draw for part of some vital process. This question, unsettled though it is, is not without significance in the light of the biochemistry of animals higher up in the evolutionary scale.

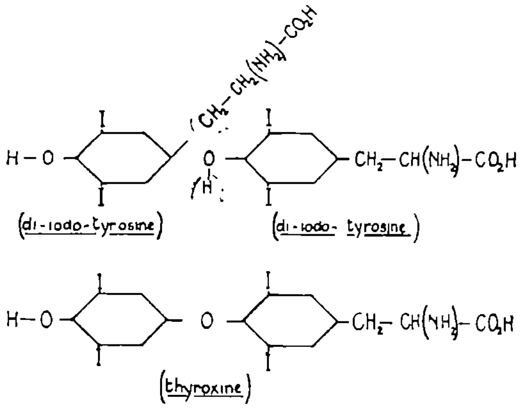
Sponges and corals are lowly creatures, with small differentiation of tissues and no co-ordination of parts, and they existed even in Cambrian times, long before forms of land life were evolved. Making, then, a very wide biological jump to the vertebrates, including man, we again find the faculty for the organic fixation of iodine, and it is localized now in the thyroid gland. That it here determines the metamorphosis of amphibian larvæ, such as tadpoles and axolotls, was first shown in 1912; and the well-established correlation of inadequate traces of iodine in food with irregularity in the function of the gland, and consequently with the disturbances of basal metabolism which cause goitre, imperfect growth, myxœdema, or cretinism, was given a rational basis first by Kendall's isolation (1915) of the thyroid hormone as a crystalline organic iodine compound which he called thyroxine, and then by the brilliant work of C. R. Harington and his associates (1926 *et seq.*), to whom we owe our knowledge of what thyroxine really is.



THYROXINE

It appears that the iodine atoms in this molecule are essential to the physiological potency of the substance; and a teleologist might well find in this hormone molecule the sole *raison d'être* of the element iodine.

Harington has shown that thyroid iodine is present partly as thyroxine but also as di-iodo-tyrosine, both amino-acids being chemical components of the complex protein thyroglobulin. The direct physiological activity of the di-iodo-tyrosine appears, so far as published evidence goes, to be relatively slight; but there cannot be much doubt that it is the precursor of thyroxine in the chemical synthesis for which the thyroid gland is responsible. The conversion into thyroxine, indicated in a purely formal way by



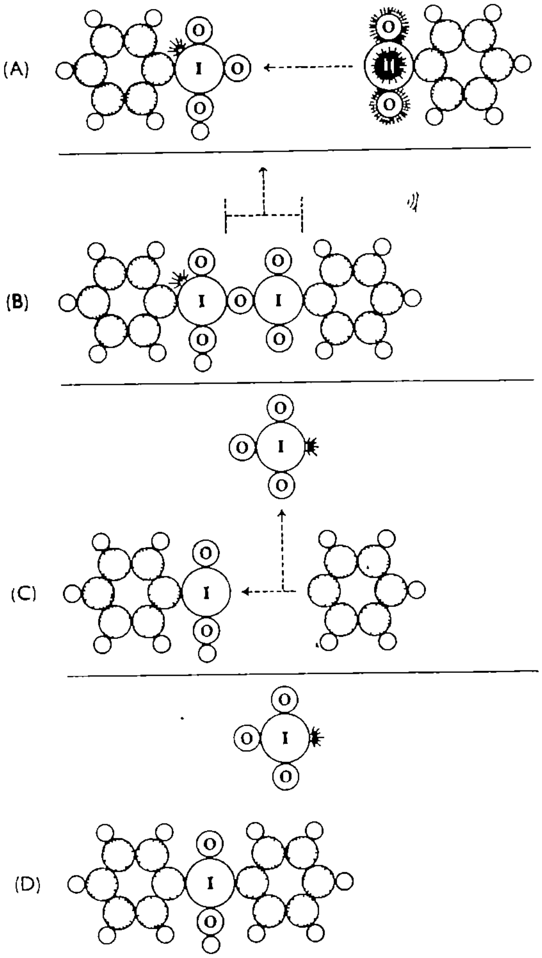
has not been accomplished in the laboratory (the pioneering synthesis of thyroxine by Harington and Barger necessarily used materials and methods not natural to living tissues), but it would involve steps of a kind not unknown in other branches of protein chemistry.

To sum up this part of our subject: the opportunity for the natural fixation of inorganic iodine into an organic form has in all ages been extremely slight; not because the process is intrinsically difficult (for it is not), but because the supply of inorganic iodine has always been extremely scanty. Accordingly, iodine is not one of those elements which, like sulphur or phosphorus, became normal ingredients of common proteins. Living things had next to no iodine to draw upon, so most of them managed and evolved without it. But very early in the history of multicellular animals in the sea—if we may make an inference from those simple forms which have survived into this age—the organic fixation and accumulation of iodine was accomplished by some of them, and what they did with it was to make it into di-iodo-tyrosine. This same faculty of making di-iodo-tyrosine, we find, has been preserved, or at any rate repeated, by the vertebrate animals, localized in their thyroid glands. Besides that faculty, we have put our finger upon one further chemical step, which has apparently accompanied the evolution of the vertebrates, is characteristic of them, and is indispensable to their being: namely, the final conversion of di-iodo-tyrosine into thyroxine.

That iodine is a biochemical element is a fact which lends importance to its organic chemistry in general; and in what follows, one part of this will be discussed, namely, that in which organic iodine is multivalent. In this field, some is not new but is perhaps undeveloped, while the rest is new; and to illustrate it, we shall confine ourselves here to a few connected examples drawn from work done at Durham (*J. Chem. Soc.*, 1669; 1935. 1718; 1937. NATURE, 139, 150; 1937). Throughout, the chemist has to bear in mind that iodine is not merely the heaviest halogen, but—especially when multivalent—is also the terminal member of its series in the Periodic System, and its behaviour is to be regarded accordingly.

Victor Meyer and Wachter's discovery of iodosobenzoic acid (1892) prompted Willgerodt to study iodobenzene dichloride, which he had isolated seven years before, and so to discover iodosobenzene and, ultimately, many other aromatic iodoso-compounds. Besides behaving as bases towards acids, these derivatives of tervalent iodine exhibit self-oxidation-reduction, as do nearly all inorganic compounds in which a halogen atom is in an intermediate state of valency; so iodosobenzene spontaneously turns into iodo- and iodoxybenzene, which latter compound has reactions of general chemical interest.

Iodoxybenzene, $C_6H_5IO_2$, is not only formally analogous to nitrobenzene, $C_6H_5NO_2$, but also by its chemical behaviour shows the internal electrical polarity which is known, on a variety of evidence, to exist in nitrobenzene. The respective donor atoms iodine and nitrogen are positive, the acceptor oxygen atoms are negative. Hence an iodoxy-compound is attacked either by negatively charged ions or parts of other molecules, which its positive iodine attracts, or else by positively charged ions or groups, which its negative oxygen atoms attract. In nitrobenzene, the small donor nitrogen atom is screened by the phenyl and by the two oxygen atoms, and is therefore not exposed to negatively charged reagents as is the large iodine; but its negative oxygen atoms are open. Thus, both compounds form salts with strong acids, by the co-ordinating (with resonance) of a proton with their oxygen atoms; for example, the crystalline hydrogen-sulphates:



Drawings of four successive stages of a model showing the expulsion of the iodate ion. The diagram illustrates the general nature of the other models also. The backgrounds were black. Positive ions were marked by the emission of a bright red light from the group of atoms; negative ions by that of a bright blue light (indicated by a small conventional 'explosion' sign). Polarities within molecules were shown by a red glow over the disk of a positive (donor) atom and a blue glow over the disk of a negative (acceptor) atom, as suggested in the drawing of the molecule of iodoxybenzene on the right in the first stage.

$[C_6H_5IO_2{\cdot}H]^+ [HSO_4]^-$	$[C_6H_5NO_2{\cdot}H]^+ [HSO_4]^-$
Iodoxybenzene hydrogen sulphate.	Nitrobenzene hydrogen sulphate.
(Cryst., mp. 127°)	(Cryst., mp. 12°)

Iodoxybenzene dissolves in alkali, owing to the attachment of a negative hydroxyl ion to the positive iodine, yielding the unstable solute, the *phenyl-iodoxylate* of the alkali metal:

$$\begin{array}{ccccc} C_6H_5IO_2 & + & Na^+(OH)^- & \longrightarrow & Na^+[C_6H_5\,IO_3H]^- \\ \text{Iodoxy-benzene} & + & \text{Sodium hydroxide} & = & \text{Sodium phenyl-iodoxylate} \end{array}$$

Nitrobenzene, for the reason explained above, does not combine with alkali; but the arylphosphonic and arsonic acids are probably analogous to the iodoxylates.

When the solution of an alkaline iodoxylate is boiled, its complex negative ion extrudes the group IO_3 which, as the iodate ion, carries off the ionic charge, leaving behind benzene:

$$C_6H_5IO_3H' \longrightarrow IO_3' + C_6H_6.$$

This elimination of the iodate ion is characteristic of such substances, especially in alkali. Thus, in a cold iodoxylate solution, the complex ion spontaneously co-operates with dissolved iodoxybenzene to do so, and the residues couple to form *diphenyliodyl hydroxide* (or its alkali salt), with the structure of which one may compare the diaryl phosphinic and arsinic acids:

$$PhIO_2 + PhIO_3H' \longrightarrow IO_3' + Ph_2IO.OH.$$

Again, the same dominant tendency is seen in the formation of iodonium compounds by Victor Meyer and Hartmann's second method, where iodoso- and iodoxy-compound react together in an alkaline medium:

$$RIO_2 + RIO \longrightarrow IO_3' + R_2I\cdot.$$

The converse of these processes, that is, the return of iodine from inorganic iodate into the organically combined state, proves easy to realize in the laboratory, under conditions of high acidity, organic derivatives of multivalent iodine being formed.

It will be understood that in these examples of reactions (all of which, in the discourse of which this is a condensation, were illustrated by working scale-models showing the atomic and electrical exchanges), the detailed intermediate mechanisms have here been slightly simplified, especially as regards the organic parts of the groups concerned. In them, however, the primary point is rather the formation and existence of hitherto unknown types of iodine compounds. These lead to a new field of chemical inquiry, and help to show, as do the biochemical facts reviewed, that we must think of iodine as an element which, like nitrogen or arsenic, is not inorganic alone, but is emphatically an organic element also.

Scientific Research in India

From a Correspondent

THE activities of the scientific delegation in India were by no means confined to the proceedings of the Congress in Calcutta and to sightseeing. Every opportunity was taken by individual members or groups of members to inform themselves of the progress of science in the various institutions which occasion could be made to visit. The notes which follow cannot be exhaustive, as they are based upon information only from members of the party who have just returned to England in the S.S. *Strathaird*; a substantial number of the delegates are not yet home.

The discovery of the pre-Aryan civilization of the Indus basin has stimulated studies in Indian archæology, and the delegation was profoundly impressed by the care bestowed upon the famous frescoes and sculptures in the rock-hewn temples at Ajanta and Ellora, while excavation is in progress elsewhere in the dominions of H.E.H. the Nizam of Hyderabad. The museums at Delhi, Bombay, Sarnath (near Benares), Calcutta and Madras all possess notable treasures, and that at Calcutta especially needs much greater space for its adequate exposition in order to guide future excavation. Turning to work within the scope of present-day anthropology, the Brahmachariya Sangha founded by the late Maharajah of Kazimbazar illustrates a type of Indian organization designed to help especially aboriginal peoples to overcome handicaps due to lack of knowledge of Hindu or Dravidian languages and to general backwardness. The aborigines around Ranchi on the Chota Nagpur plateau are being taught on the basis of a modernist interpretation of the Vedas, and schools, clinics and legal aid come within the province of this organization.

Elsewhere, the great medical institutions naturally attracted attention. At the famous Haffkine Institute in Bombay special note was taken of the work in progress towards a theory as to outbreaks of plague after periods of immunity; it was learned incidentally that mice are found more suitable than rats for plague experimentation. The work on rabies was also remarked; and it was observed that in Bombay malaria has been reduced to almost negligible proportions by covering in all open water tanks with fine-meshed wire netting or with glass. The School of Tropical Diseases at Calcutta is worked in connexion with the hospital, where there are beds for keeping cases under prolonged study and treatment. The All India Institute of Hygiene and Public Health possesses fine premises, but there appears as yet to be a shortage of expert workers ; and it may be remarked here that a more extensive supply of current medical and scientific journals, English and foreign, is apparently needed in medical libraries. It was satisfactory to note the increasing number of women's hospitals, staffed by women, especially in such a land as India, where so many women are debarred from medical aid unless rendered by their own sex. Women doctors are increasing in number, but an adequate supply of good nurses is as yet far from assured. Medical psychology was found to be fairly well established in Calcutta, and an excellent general and educational psychology is rapidly gathering strength in Mysore. The value of industrial psychology is well recognized ; the material aspects of the science appear to outweigh the purely philosophical.

Research in agriculture, obviously of outstanding importance for India, aroused much interest. For example, at the Imperial Agricultural Research Institute in New Delhi, the results were exhibited of crossing the sugar-cane with a species of bamboo which grows to a height of 60 feet, and also with sorghum and Indian corn. This work forms a part of breeding experiments carried out in order to discover the origin of cultivated sugar-canes and to improve them by hybridization. In the chemical department of the Institute valuable work is in progress on the utilization of atmospheric nitrogen in soils. The visit to Dehra Dun gave the delegates opportunity to see something of the important work of the Forest Research Institute, in which departments are concerned not only with the problems of forestry itself but also with timber testing and preservation and the uses of wood-pulp, resins and other products. The Punjab Agricultural College and Research Institute afforded an opportunity for observing the progress of valuable economic research in various departments, which has already added much to the agricultural wealth of the province. At the University of Agra the dissemination of cereal rust fungi has been under investigation for seven years, and the foci of infection have been traced to hill-tracts where rusts remain during summer in the uredo-stage. The good work of the cotton research and textile research laboratories is well known, and in consequence the opportunity of seeing some of the results at Bombay was welcomed. Plant virus work on tobacco leaf curl and on mosaic of sugar-cane was found to be in progress at more than one centre, but none was encountered on potato virus diseases, though preparations are being made at New Delhi for a general assault on these problems by genetic methods. In connexion with animal husbandry, one of the delegates comments in the highest terms upon the work of the Indian veterinary colleges and the cattle and other breeding establishments which he was enabled to visit. In the notes of another delegate reference is made to a secondary school at Bikram, a village south of Patna, which possesses a demonstration farm partly worked by pupils in the agricultural class ; the principle appears capable of wider application.

Delegates were fortunate in being able to take part in the hundred and fiftieth anniversary of the foundation of the Calcutta Botanic Gardens, which have been directed by so distinguished a succession of botanists and have played so important a part in the development of systematic botany. The small aquarium at Madras, the extension of which is contemplated, was much admired for the interest of some of its special exhibits, for example, the sea-snakes. Some adverse comment was directed against the attendants, whose artificial stimulation of the exhibits for the entertainment of visitors was deprecated. The zoological garden at Mysore was particularly noteworthy for the care bestowed on its lay-out and upkeep and for the fine and happy condition of the inmates. It was noticed that the enclosure of the giraffes by a small ditch and a single rail about eight feet above ground seemed entirely adequate.

It is well known that the Geodetic Survey has its headquarters for mapping and fieldwork at Dehra Dun ; but reference is due here to the latitude variation station at Agra which, it is hoped, will prove to be more free from causes of systematic errors than the station previously at Dehra Dun, which suffered from poor conditions for observation owing to its nearness to the Himalayas.

It is not the object of this report to comment further upon the work of the research departments and institutions so long associated with the Governments of India ; nor can it be attempted to review all, or even any large fraction, of the work of the various universities visited by the delegation. But special reference has been made by one of the delegates to the important applications of science to industry under investigation in the chemical laboratory at the University of Lahore, which are directed primarily to the utilization of waste products. Thus, cottons are improved in appearance by treatment with colloidal solutions of certain silk-like cotton wastes, resins are recovered from oil residues, soaps are made stable in colour and perfume, waste molasses is made into tiles and insulating materials, broken rice grains of little or no value are changed into colloidal solutions and used for making synthetic rice grains, oils are purified so as to burn without smoking. Researches of a fundamental character are being made into the magnetic properties of atoms and molecules with the object of revealing the nature of chemical bonds and the control of chemical reactions. At the Tata Institute at Bangalore the experiments in the physics section on backward internal scattering of light in liquids and the effect of supersonic waves on refraction show a combination of high experimental skill and first-class apparatus. A demonstration of the structure of lustrous shells was beautiful and impressive.

Among other notes, one of the delegates was struck with the initiative shown in making apparatus, which otherwise would have been hard to come by in India, at the Central Meteorological Station for altitude observations in Agra. Another comments upon the fine work of the Hydrodynamic Research Station at Poona, where, beneath the great irrigation dam, large-scale experiments are possible and have resulted in numerous and various records covering the work of years and published by the Government of India, but yet to be incorporated, as they should be, in text-books on hydraulics.

Such are a few examples—and it must be emphasized that they are only a few among many —of the widespread and practical interest in the advancement of science and its applications encountered by the delegation in India. If the delegation, through the contacts which its members have made, has succeeded on one hand in aiding that advancement in any manner, and should succeed, on the other hand, in broadening understanding at home of the achievements of scientific workers in India, it will have discharged its most important functions for the benefit of science in both countries.

The Aurora of January 25-26

THE auroral display on the night of January 25–26 was remarkable not only for it's brilliance but also for the wide area over which it was observed. Some time must elapse before it is possible to collect complete information, but it seems certain, from the newspaper reports already published, that it was seen over practically the whole of Europe, and as far south as Gibraltar and Sicily. *The Times* of January 27 states also that vivid auroral displays were seen over a large part of Canada on the nights of January 24–25 and 25–26.

Accounts of the phenomenon as observed in the British Isles differ considerably in points of detail. It is proposed to give here a few extracts from the most precise reports received either by NATURE or by the Meteorological Office. An account of the appearances observed at Harpenden, Herts, by Dr. B. A. Keen was given in last week's issue. Dr. Keen observed the display from 6.45 until after midnight. Three periods of brilliant display were noted, around 7.45, 8.30 and 9.45. The main features noted were red glows in the north-west and north-east, with a low green arc between during the early stages, green and white rays traversing a bright red glow in the north-north-east about 7.45, and rapidly fluctuating green streamers between north-west and north-east about 9.45.

At Kew Observatory, detailed observations were made between 6.50 and 9.10. These observations show good general agreement with those made by Dr. Keen, except that a green coloration of the arcs and rays is not mentioned. Strong groups of coloured rays were observed after 7.35, and at 7.51 these were spreading out from north-north-east to west-north-west reaching elevations of 5° to 10° above Polaris. At 7.57 the glow extended slightly beyond the zenith. A few minutes later, at 8.07, the display faded completely and no aurora was visible for several minutes. The later stages as observed at Kew were distinctly less brilliant, though there were some further appearances of arcs, patches and rays.

Mr. Charles Leaf sends details of observations made near Cambridge from 1.15 on January 26. He writes as follows :

"As seen at 1.15 G.M.T. there was a bright greenish glow behind banded cirrus cloud right across the northern horizon, while just to the north-west of the zenith there were two parallel bands of delicate pinkish light. Short groups of rays frequently developed in these bands. The rays were paler than the bands themselves, and gave the impression that they were white rays showing through the bands. The pink coloration gradually spread across the zenith towards the south-east where it appeared as a darker red patch, due to the background not being illuminated. At the same time there appeared a few faint luminous marks to the north-east, again quite close to the zenith. By 1.35 all that remained was a much fainter glow to the north and north-west, and this persisted until 2.30, when I went to bed."

A letter received in the Meteorological Office from Mr. J. M. Brierley, of Rodwell, South Petherton, Somerset, describes the phenomena as seen on a motor-car journey from Honiton to Ilminster. Here a rosy glow was observed in the north-north-west as early as 6.0 o'clock. By 6.30 the glow had increased greatly in size and brilliance, and numerous pale green streamers were observed. Until 8.05 the main features were a general display of rose-coloured light above a greenish arch extending almost from west to east, and reaching almost to the zenith. A period of maximum brilliance occurred at 8.05; the greenish arch was then at an elevation of about 45°, and above this was a rose-coloured arch nearly 90° broad. Numerous bright streamers appeared along the whole greenish arch and converged to a point between Aldeboran and the Pleiades. The green arch persisted until 11 p.m., after which the display was terminated by cloud.

Mr. R. Moss, Wellington College, Berks, has sent us a copy of a detailed record of observations made by two pupils, M. Majendie and J. H. Gordon, at the College, between 6 p.m. and 11.30 p.m. The period of maximum activity and brilliance was noted to have occurred between 7.45 and 8.0 o'clock and a second very active period between 8.30 and 8.45. Observations of the characters and extensions of different parts of the display were made every few minutes, and notes were written down at once, so that the record has far greater value than the general accounts of the display usually regarded as sufficient. A copy of the notes has been sent to the auroral branch of the British Astronomical Association, and Mr. Moss will be pleased to supply further information concerning the observations to anyone especially interested in them.

In a leading article in *The Times* of January 27, reference was made to the belief, going back to the time of Tacitus, that the aurora gives forth sounds. It is of interest to record that an observer at Catcott, Bridgwater, Somerset, the Rev. Harold Buckton, states that he seemed to hear now and again faint clicks resembling the noises made by the sparking of an electric machine. He is positive that these sounds were not caused extraneously, and he was not in fact aware of the possibility of sounds in association with the aurora, until he saw the matter referred to in *The Times*. The modern view is that sound could not reach the earth's surface from an electrical discharge occurring at heights of sixty miles or more, but we include the observation in these notes for what it is worth.

The subject was referred to by Prof. A. S. Eve in a discourse delivered at the Royal Institution on February 7, 1936, and published in a supplement of NATURE of May 16, 1936. Prof. Eve's view is that the aurora can make little or no noise, and that what is heard is of the nature of local brush discharge such as is frequently associated with electrical disturbances. An interesting letter upon the subject appeared in our issue of December 2, 1933, from F. T. Davies and B. W. Currie, of the Canadian Meteorological Office, Toronto.

SOLAR AND TERRESTRIAL RELATIONSHIPS

The great aurora and magnetic storm of January 25 last was a spectacular reminder of a solar-terrestrial relationship, the evidence for which has been slowly accumulated for nearly a hundred years. Although the connexion between magnetic storms and the aurora borealis (or australis) is not a simple one, yet there is in general a close association between the two phenomena. The observation of disturbances in the earth's magnetic field is a fairly straightforward matter, requiring, of course, a specially prepared magnetic observatory, but being independent of the weather. On the other hand, data of the aurora are disturbed by cloudy weather and the periodic occurrence of bright moonlight. As defined at Greenwich, a small magnetic storm is a disturbance in which the range in magnetic declination equals or exceeds $\frac{1}{2}°$ or that in horizontal force or vertical force equals or exceeds 150γ; a great storm is one having double these ranges as minimum (see NATURE of January 29, p. 192).

The evidence for a solar connexion with magnetic storms and associated auroras may be briefly summarized as follows: (1) a general accordance between the frequency curves of sunspots (or some other suitable criterion of solar activity) in the well-known eleven-year cycle and similar curves of magnetic storms. (2) An observed tendency for the lesser magnetic storms to recur at intervals of about twenty-seven days, which is the time taken for the sun (more particularly the mean latitude of the sunspot zones, one north and the other south of the sun's equator) to rotate once on its axis with respect to the earth moving in its orbit around the sun. Auroras likewise show this same recurrence tendency in a period of twenty-seven days. (3) A statistical relationship existing between the occurrence of individual sunspots of great size and the occurrence of great magnetic storms and associated auroral displays. Specific cases of joint coincidences between great sunspots, great magnetic storms, and unusual auroral displays witnessed in the south of England include those of March 22–23, 1920; August 9–10, 1917; November 17, 1882; August 28 and September 2, 1859, the last being associated with the unique observation, made by Carrington and Hodgson, of a transitory bright spot on the sun seen in integrated light with an ordinary telescope. At the commencement of a great magnetic storm, the associated sunspot is found on the average about one day past the sun's central meridian. This asymmetry with respect to the central meridian is thought to be indicative of the time of travel required for the solar agency to travel from the sun to the earth. An informative feature, often shown by great magnetic storms, is their abrupt commencement at the same time (U T.), so far as can be determined at widely separated magnetic observatories.

Apart from these special disturbances in the earth's magnetic field, illustrated by the recent aurora and magnetic storm, mention should be made of the high degree of accordance between curves of some solar index (say, smoothed mean daily areas of sunspots for each month) and curves similarly prepared which give the mean daily ranges of the earth's magnetic elements, *D*, *H* and *V*, after the seasonal inequality has been eliminated. No other known terrestrial phenomenon gives such detailed accordance with the observed periodic curve of solar activity.

To revert to the coincidences shown statistically by individual sunspots of first magnitude and great magnetic storms, it should be noted that as we proceed to the lesser sunspots and lesser magnetic storms, the relationship becomes less and less evident, and one concludes that the solar disturbances primarily related to the magnetic storms and associated auroras do not always produce a visible marking on the sun such as a sunspot. This point is clearly brought out in "time-pattern" diagrams prepared by J. Bartels to show synchronous or nearly synchronous solar activity and magnetic activity on the earth. The occurrence of the recent aurora is also an anomaly. Between January 12 and 24 a very large sunspot crossed the sun's disk. Magnetic storms were recorded in Great Britain commencing on January 16 and 22, and there were reported auroras in Canada. On January 25, when the great auroral display was seen, the big sunspot had been carried out of view by the sun's rotation. A spectroscopic examination of the sun's disk naturally suggests itself, but so far no distinctive phenomena have been reported which could reasonably be associated with the aurora and magnetic storm.

Characteristic features of the aurora itself have been investigated by studying (1) typical forms, (2) geographical distribution (annual and diurnal frequencies), (3) height above the earth's surface, (4) the characteristic spectrum. A useful collection of auroral photographs enabling the observer to identify typical forms is given in a "Photographic Atlas of Auroral Forms" published in 1930 by the International Geodetic and Geophysical Union. As is well known, the zone of maximum auroral frequency roughly circles the earth's magnetic poles in magnetic latitude 67° (the position of the north magnetic pole being in geographical longitude 96° W. and latitude 70½° N., and that of the south magnetic pole in longitude 151½° E., and latitude 71½° S.). Thus for places in the same geographical latitude, Canada is, for instance, more favourably placed for observing polar auroral phenomena than is Great Britain.

The association of magnetic disturbance with the aurora was first remarked by Halley in 1716; but as already noted, the association is not a simple one; auroras have been observed in the absence of marked magnetic disturbance and vice versa. Near the auroral zone itself, the frequency data of auroras fail to show a marked peak corresponding with solar maximum such as is given by the frequency curves of magnetic storms and auroras recorded in lower magnetic latitudes. It has been suggested by Vegard that the generally increased magnetic disturbance near sunspot maximum is instrumental in conveying auroras from the auroral zone to lower latitudes, thus reducing the frequency in the auroral zone itself. This suggestion finds corroboration in the results of a comparison made, by A. Röstad, between the position of auroral displays observed in Trondhjem, Oslo and in Holland and the intensity of the simultaneous magnetic storms recorded at Potsdam. Theoretical and practical investigations by Birkeland and Størmer have shown that if the earth encounters a beam of electrified particles, then the particles will be deflected by the earth's general magnetic field into two zones (to be identified with the auroral zones) one in the northern and the other in the southern hemisphere. The nature of these streams of particles has been the subject of several more recent investigations by Størmer, Chapman, Lindemann, Milne, Vegard, and others. Although the precise nature of the streams is undetermined, it would seem that they must consist of electrified particles of considerable energy so as to penetrate the earth's atmosphere to the lower observed limit of the aurora (about 70 km.). It will be noted that the deflected corpuscles are able to come down on the night side of the earth, the diurnal distribution of the aurora showing a pronounced maximum near midnight, reckoned with respect to the earth's magnetic axis.

The determination of the height of auroras has in recent years been made systematically by measuring the angular displacement of distinctive features of a particular aurora against the background of bright stars, as recorded on two simultaneous photographs taken at opposite ends of a long base line. Eventually it should be possible to decide whether the aurora ever comes down to very low levels as is sometimes reported.

The average height of the lower limit is about 106 km.; there is greater scatter for the upper limit, which shows some dependence upon type and distribution of light intensity along the streamers. The near coincidence in height between the average lower level of the aurora and that of the *E*-layer explored by radio-echo observations would appear to be other than fortuitous.

The spectrum of the aurora long presented great difficulty, and although important advances have been made, knowledge of the origin of the spectrum is by no means complete. In 1925, the well-known prominent auroral green line at 5577 A. (discovered by Angström in 1866) was proved by McLennan and Shrum in their laboratory in Toronto to be due to oxygen in a metastable state. The great intensity of this line is explained by Vegard as being due to oxygen excited to emit this radiation by means of collisions of the second kind with activated nitrogen. Besides the prominent green line, there are two lines in the red, at 6300 A. and 6365 A., both of which are thought to be due to oxygen. In addition, the visual spectrum is characterized by the negative band spectrum of nitrogen. A phenomenon of great interest, studied in particular by Lord Rayleigh, is the light of the night sky, the spectrum of which shows the same green radiation at 5577 A. as does the aurora, although the negative band spectrum of nitrogen is missing. Babcock accurately derived the wavelength as 5577·35 ±0·01 A. It has been suggested by Rayleigh (*Proc. Roy. Soc.*, A., **106**, 135) that the light from the non-polar aurora (as represented by the night sky luminescence found generally distributed over the world) is of a phosphorescent nature, the luminosity being excited by the sun during the daytime and carried round by the earth's rotation. It is important to note the distinction between the non-polar aurora and the polar aurora as exemplified by the recent display.

In conclusion, mention may briefly be made of the work of solar observers in trying to identify the precise phenomenon on the sun responsible for the occurrence of magnetic storms and their associated auroras. Replicas of Dr. Hale's spectrohelioscope, perfected by him in 1926, have been systematically used by a number of observatories in searching for and recording bright chromospheric eruptions which might, it was thought, be related to perturbations in the earth's magnetic field. Although no definite progress can be claimed in obtaining observational evidence of corpuscular streams (the search for which had been urged by Chapman), a new relation has been brought to light in which the solar agency appears to be radiation in the ultra-violet. There is now little doubt that sudden bright chromospheric eruptions (usually near sunspots) visible in $H\alpha$ with the spectrohelioscope or on Ca^+ spectroheliograms produce an immediate (that is, within about the time taken for light to reach the earth from the sun) disturbance in the ionosphere over the sunlit hemisphere, apparently just below the *E*-layer. At the same time, relatively small magnetic perturbations may occur, the effect of which is recorded within a limited distance from the place where the sun is in the zenith at the time of the solar eruption. These small disturbances in the earth's magnetic field are, however, clearly to be distinguished from the magnetic storms and auroras considered above, which are essentially high lattitude phenomena.

Obituary Notices

Prof. W. H. Pickering

PROF. W. H. PICKERING died on January 21 at his home at Mandeville, Jamaica, at the age of seventy-nine years, after several months of failing health. He was a younger brother of E. C. Pickering, the director of the Harvard College Observatory from 1876 until 1920.

Born at Boston in 1858, Pickering graduated at the Massachusetts Institute of Technology in 1879, and became a lecturer there, and at the same time was an assistant professor at the Harvard College Observatory. His first astronomical observations were at the eclipse of 1878, where he observed the radial polarization of the corona. For a time he was in charge of the Harvard College Observatory Station at Arequipa. Vol. 33 of the *Harvard College Annals* contains his researches on the determination of photographic stellar magnitudes, the Great Nebula in Orion and visual observations of the moon and planets.

In 1900 Pickering established the Harvard College Observatory at Mandeville, and while there published a lunar atlas from photographs taken with a 12-inch lens of focal-length 135 ft. The disk of the moon is divided into sixteen parts, and each part photographed under five different illuminations. In 1898 he discovered by photography a small satellite of Saturn at a distance of 8 million miles from the planet and revolving round it in a year and a half. This satellite, to which he gave the name Phœbe, is remarkable in that it revolves in a direction contrary to the other eight satellites, a peculiarity which was later found in three faint satellites of Jupiter.

At Mandeville, Pickering continued his visual observations of the moon and planets. He observed Mars under good climatic conditions and was satisfied of the existence of the "Canals" and drew the more important ones in agreement with Lowell. He regarded them as belts of vegetation of widths up to 150 miles along assumed water courses. In 1921 he challenged the view taken by astronomers that the moon was dead and that no changes took place on its surface in a paper contributed to the Royal Astronomical Society on "Seasonal Changes occurring in certain Lunar Craters". These he attributed to patches of snow which disappeared gradually and reformed. These changes have not been confirmed, and must be attributed to differences of definition.

Pickering, Percival Lowell and George Forbes all made calculations to discover an extra-Neptunian planet. Pickering used the slight deviations of the orbit of Uranus, Lowell and Forbes the slight deviation of the orbit of Neptune (and in the case of Forbes the existence of a so-called family of Neptunian comets), as data for the existence of this body. The position of the planet was found by both Pickering and Lowell from these wholly insufficient data, and strangely enough a planet was found by Tombaugh at the Lowell Observatory on January 21, 1930. Judging from its brightness, the mass of the planet is too small to exercise any appreciable perturbation on Uranus or Neptune.

Prof. Pickering married Anne Atwood, daughter of Mr. Isaac Butts of Boston. They visited England a number of times and made many friends. Prof. Pickering spoke several times at the Royal Astronomical Society, of which he was elected an associate in 1910. He has also addressed the British Astronomical Association, as he was greatly in sympathy with amateur observers. F. W. D.

WE regret to announce the death of Sir James Crichton-Browne, F.R.S., a pioneer in the treatment of mental disease, which occurred on January 31, aged ninety-seven years.

News and Views

Mr. W. M. H. Greaves

THE King has approved, on the recommendation of the Secretary of State for Scotland, the appointment of Mr. W. M. H. Greaves, chief assistant of the Royal Observatory, Greenwich, to be astronomer royal for Scotland and professor of astronomy in the University of Edinburgh, in succession to Prof. R. A. Sampson, who retired recently. Mr. Greaves entered St. John's College, Cambridge, in 1917. He obtained a first class with distinction in Part II of the Mathematical Tripos and was awarded the Tyson Medal for astronomy. He obtained a Smith's Prize in 1921 for an essay on the movement of asteroids of the Trojan group, was awarded an Isaac Newton Studentship and in 1922 was elected a fellow of his College. Mr. Greaves was appointed chief assistant at the Royal Observatory, Greenwich, in 1924. The most important work undertaken by Mr. Greaves at Greenwich has been the development of methods for the determination of the colour temperatures of stars. The observations are divided into two parts: the determination of the relative gradients of the spectral energy curves and the fixing of the zero point of the temperature scale. The determination of the zero point is a long and intricate investigation, requiring reference to a terrestrial source; it has been undertaken twice with concordant results. The mean colour temperature for stars of spectral type $A0$ was found to be 18,000° K.; this value is appreciably higher than had previously been accepted but has since been confirmed by other investigators. Mr. Greaves has also been in charge of the magnetic work at Greenwich and has made some valuable investigations of the relationships between sunspots and magnetic storms. Mr. Greaves was secretary to Section A (Mathematics and Physical Science) of the British Association from 1924 until 1931, and has been secretary of the Royal Astronomical Society since 1932.

Accident to Dr. W. W. Vaughan

MOST of the members of the British Association delegation to the jubilee meeting of the Indian Science Congress Association have now returned, and one of them has kindly told us the circumstances of Dr. W. W. Vaughan's lamentable accident at Agra. It appears that Dr. Vaughan, with Mrs. Vaughan and other members of the delegation, had gone to the Taj Mahal before moonrise on the night of the party's arrival at Agra. In the darkness, he missed his footing on the upper of two terraces between which there is a fall of several feet, without any parapet. He fell on to the lower terrace, and his leg was broken above the knee. Help was obtained from other members of the delegation, and also, very fortunately, from an Indian friend of one of them, who, as a resident in Agra, knew what to do. But there was a weary wait for the sufferer before an ambulance could be got, during which he retained both consciousness and, by all accounts, the bravest bearing. The Thomason Hospital at Agra received him with every attention. It is now known that the leg, which had not been healing satisfactorily, was amputated on Monday, January 24; a private message on the following Thursday spoke of the patient's condition as "improving", and a press bulletin on January 31 appeared equally favourable.

International Economic Collaboration

THE able report by M. Van Zeeland on his mission of inquiry to various countries, directed to "the possibility of obtaining a general reduction of quotas and of other obstacles to international trade", was published in the press on January 28. His proposals in the main are very much in line with views that have been repeatedly expressed in NATURE, and they should receive serious consideration by all Governments. His immediate object is to bring together representatives of the principal economic Powers—in particular, Great Britain, the United States, France, Germany, and Italy—in the hope that they may succeed in working out an agreed plan of international economic collaboration. That there is ground for this hope is clear from the fact that everywhere he went M. Van Zeeland tells us that he met with a most sympathetic reception. The report he has so carefully prepared should provide an excellent basis for discussion. It is well balanced, stating frankly the difficulties which have to be faced without being too caustically critical of the narrow nationalistic aims recently pursued by nearly all countries.

AMONG the more fundamental problems for which a solution must be found, two in particular have received a good deal of advertisement, different countries advocating claims and counter-claims in regard to them, namely, those which relate to raw materials and colonies. It is highly important that such problems should be approached, as M. Van Zeeland urges in his report, "in a spirit of complete objectivity". That is a sound principle which every man of science will be ready to endorse. As to colonies, the most promising line of attack seems to be, again quoting the words of the report, "to seek for the means of generalizing the system of the open door which obtains in the Conventional Basin of the Congo, a system the general result of which it is impossible to criticize". So long as colonial Powers are in a position to exercise monopoly rights in the areas they control, dissatisfaction is bound to remain in the minds of those ruling the nations that are shut out, and such dissatisfaction is the potential seed of war.

Niagara Falls Bridge Disaster

THE well-known Niagara Falls View Bridge across the Niagara River, just below the falls, a steel-framed structure in a single span of about 1,200 feet, weighing some 2,600 tons and erected in 1898 at a cost of £60,000, collapsed during the afternoon of January 27, under the pressure exerted by an enormous mass of pack ice which had accumulated at the foot of the Falls. By reason of the intense cold of the preceding weeks, the ice had piled itself in huge blocks as it was swept over the Falls, to a height not much less than the deck level of the bridge, which was 165 feet above the river, and the danger had been clearly recognized for some time previously, so that when, despite the efforts made to save the bridge with heavy timber fenders, the final collapse took place, the sight was witnessed by a crowd estimated at ten thousand. The broken bridge now rests in a tangle of twisted steelwork upon the surface of the ice, which continues to gather and fills the gorge for a distance of two or three miles. There is another bridge for rail and road traffic about a mile and a half downstream, and this will have to be utilized for pedestrians until the fallen bridge is replaced. The drift of ice towards Lake Ontario is causing concern lest damage should be done to the generating station and plant of the Ontario Hydro-electric Commission, which is a short distance below the Falls. As it is, there is serious interference with the supply of electricity due to the fracture of mains.

Decibels and Phons

A CORRESPONDENT has raised the question of the use of the decibel as a unit for expressing sound intensity. Since his difficulties are shared by others, it seemed worth while to place them before an authority on the subject, who has been good enough to deal with them. He points out that it is not always realized that the decibel is a unit for specifying changes in intensity, power, or energy, and not a direct measure of the absolute value of these quantities. Decibels are not additive, since they measure changes on a logarithmic scale; so that it is the ratio of two sound intensities which determines their difference in decibels. Two similar sounds of intensities I and I_0 are said to differ in intensity by n decibels when $n = 10 \log_{10} I/I_0$. Hence a 10-fold increase in the intensity of a sound is a 10 decibel change, a 100-fold increase a 20 decibel change, and a 1000-fold increase a 30 decibel change. A decibel corresponds to an increase of intensity or energy in a ratio of approximately 5/4, two decibels to a ratio of $(5/4)^2$, three to a ratio of $(5/4)^3 = 2$, . . . and so on. Thus doubling the intensity of a sound, as when two similar voices sing the same note, corresponds to a change of 3 decibels. When a sound is said to have an intensity of so many decibels, it is implied that the intensity is being compared with some intensity which has been selected as a zero level. An international conference held in Paris last July adopted an intensity corresponding to an acoustical pressure of 0·0002 dyne per sq. cm. as the reference zero, this being near the threshold of hearing for sounds with frequencies in the neighbourhood of 1000 cycles per second.

IT will be seen that the decibel is a purely physical unit and is independent of the characteristics of the ear, which assesses loudness and not intensity. Moreover, two sounds of the same intensity but of different quality will not necessarily appear to be equally loud. For comparing the loudness of sounds, a scale of phons has been set up, based upon the fact that individuals find it possible to judge whether sounds of differing quality produce a sensation of equal loudness. Any sound or noise is matched under specified conditions against a pure reference tone with a frequency of 1000 cycles per second. If the intensity of the reference tone in decibels above the zero level is n, the reference tone and the sound or noise are said to have an equivalent loudness of n phons. For sounds of medium frequency and moderate loudness, a phon happens to correspond roughly to the smallest difference of loudness which can be detected by alternate listening under ordinary conditions.

Educational Science at Cambridge

THE recommendations of the Special Syndicate at the University of Cambridge on the position of the

University Training College for Schoolmasters are of far-reaching importance and, if carried into effect, may have great influence on the development of educational methods. The Syndicate recommends the creation of a professorship of education and the establishment of a Department of Education in the University. The last Royal Commission on the University recommended that such a professorship should be founded, and the Syndicate advances cogent reasons why it is particularly opportune for the chair to be founded at the present time. The systematic study of educational problems, especially in so far as psychology bears on these, has advanced in no uncertain manner during recent years, and it is vitally important for the University to be intimately concerned with these developments; only thereby can it exercise due weight in the educational progress of the nation. To obtain a person of sufficient initiative, experience and prestige, the Syndicate considers that the head of the Department of Education should have the status of professor, as is the case in certain other universities.

£750,000 Claim against the University of Oxford

IN Congregation at Oxford on February 1 the Vice-Chancellor announced that the claim of the company which has been suing the University for £750,000, following the conviction of B. J. Owen, formerly director of the Institute for Research in Agricultural Engineering, had been settled by a payment by the University of £70,000. This ends satisfactorily, it may be said, a trouble that has been threatening the University off and on during the past seven years. It began in 1926, when the director of the Institute for Research in Agricultural Engineering sold to the plaintiff company patents relating to the extraction of sugar from beet which were stated to be novel and excellent but which proved to be worthless. The company believed that the director was acting throughout as agent of the University and that the representations he made in that capacity resulted in the loss by the company of much of its capital. The necessity for this large payment is, of course, a serious blow to the University, but the money required will not be diverted from any of the funds for which appeals have been made in recent months.

The British Film Institute

THE British Film Institute has recently published its fourth annual report (1937). It is an interesting record of rapid development and growing usefulness. It is clear that the exploratory phase in the use of the film in education has passed and that the time has come to put into effect the lessons learnt. But it is disappointing to learn that a census recently carried out by the Institute showed that only 916 projectors are available in the educational institutions of Great Britain. This is fewer than one tenth of the number in use in the United States, Germany, France, Italy, etc. Both the Board of Education and the local education authorities are concerned at this slow progress, and are doing their best to encourage teachers to make more use of visual material. The Board of Education is now willing to pay 50 per cent of the cost of any projectors installed. Among the numerous publications sponsored by the Institute in 1937, one is of special interest to teachers of science—the report prepared by the Science Panel. This contained, besides advice on technique of use, etc., a list of 455 science teaching films. Two thirds of these are concerned with biology—a subject well suited to visual presentation. It is unfortunate that so few films on physics and chemistry are available.

THE British Film Institute records that it is watching with close attention the work being done by the new cinematograph group of the British Standards Institution. This group is devising simple methods of testing the effective light output of projectors and is framing regulations for the use of non-flam films. The National Film Library, which now contains 268 films, is growing very slowly—shortage of funds is a great handicap. Recently the Library received a valuable gift from the Paisley Philosophical Society: a collection of films exhibited in 1901, which had been put away and apparently forgotten. These films are still in good condition though they need refixing and rewashing. It is interesting to note that the use of films in education is growing rapidly in other parts of the Empire: Canada has set up a National Film Society, the Minister of Education of South Africa has founded a Film Division, in East Africa a film library is to be set up, at Achimota College (Gold Coast) a library has been started. In all these cases, the co-operation of the Film Institute has been secured.

London School of Hygiene and Tropical Medicine

IN the report on the work of the London School of Hygiene and Tropical Medicine for the year 1936–37, the Board of Management notes that Mr. Neville Chamberlain has accepted the chairmanship of the Court of Governors vacant through the death of Sir Austen Chamberlain. The Dean of the School, Prof. W. Jameson, reviews the teaching and research work of the various departments. A course on mental deficiency, designed to enable medical practitioners to secure recognition by the Board of Education as certifying officers under the Mental Deficiency Acts so far as elementary school children are concerned, was held in the School for the first time in February, and proved an unqualified success, all available places being filled. Dr. Hamilton Fairley and Mr. R. J. Bromfield spent six weeks in Macedonia studying blackwater fever, and confirmed the presence of a new pigment, 'pseudo-methæmoglobin', in the blood in that disease. In the Department of Entomology investigations have been pursued into the production of satisfactory anti-larval oils for the destruction of mosquito larvæ in malaria control, and on the biology of the bed-bug. Sir Malcolm Watson contributes the report of the Ross Institute of Tropical Medicine, now incorporated in the School. He directs attention to the importance of agriculture in the tropics and of teaching health officers practising there the principles of farming. Workers abroad are largely concerned with the prevention of malaria, and in Northern Rhodesia they had been able to reduce the mortality from this disease among the European workers in the copper mines from 22 to 9, and among the natives from 31 to 5, per 1,000.

Meteorological Service for Indian Air Routes

"METEOROLOGICAL ORGANISATION FOR AIRMEN, 1937", is the title of a pamphlet compiled under the direction of Dr. C. W. B. Normand, Director-General of Observatories, India Meteorological Department, for the benefit of airmen flying anywhere between the Persian Gulf and Burma (Delhi: Manager of Publications. 2*s.* 3*d.*). It describes the organization maintained by the India Meteorological Department on behalf of aviation, the nature of the information about current weather that is obtainable from that organization, and all that an airman requires to obtain that part of the information which he may require on any flight. Full information in regard to the latter must include the addresses and telephone numbers of officers responsible under the Director-General for particular parts of the whole area dealt with, their office hours, and the times at which they complete synoptic weather charts, if the airman is to make the most of the information available. It may be noted, however, that on the trans-India air route between Karachi and Victoria Point, Burma, the issue of different kinds of meteorological message by wireless to all the main aerodromes has been organized on a routine basis and the latest information can be obtained from weather notice boards at such aerodromes; alternatively, it can be obtained by the airman by wireless while he is in flight. All these points are systematically treated in a series of tables that occupy most of the pamphlet, and among these tables are the very important ones that explain the different codes which make it possible to condense much information about actual and expected weather into telegrams or wireless messages. There is a key map showing the positions of the various types of meteorological station, and the boundaries of the different forecast areas and provinces. The organization embraces the whole of Baluchistan and Burma as well as India.

Royal Scottish Society of Arts

THE Royal Scottish Society of Arts is, like its prototype the Royal Society of Arts, one of the few unspecialized learned societies. It draws together men engaged in the pursuit of applied science and art of the most diverse kinds. In a prospectus just issued, this peculiarity is emphasized, and it will doubtless be accounted to the Society for righteousness by those who set a high value on general culture. The principal objects of the founders were "to stimulate and reward genius and mechanical industry and to afford a ready and useful medium of intercourse among men of all ranks who were engaged either in the pursuit of Science or in the various practical departments of the Arts and Manufactures". During the winter session there are fortnightly meetings at which papers are read, and a course of special lectures on a subject of general interest is given by a selected specialist. Prizes are offered for inventions and communications. The Council desires to suggest, especially to prospective student members (for whom the annual subscription is only 5*s.* up to the age of twenty-three years) that attendance at the ordinary meetings and participation in discussions provides an extremely easy and really valuable means of extending their general and technical education. Evidently a complete survey of adult education would not ignore the opportunities offered by this Society.

Modern Sylviculture

IN an article entitled "Revue de Sylviculture", published originally in the *Revue generale des Sciences pures et appliquees* (48, No. 7, April), Prof. H. Perrin deals with the practice of modern sylviculture more especially from the French point of view. He points out that in former times the forest was regarded solely as a source of supply of timber and smaller materials, on the supposition that such supplies would continue inexhaustible. Latterly, he says, there has been a swing-back, in some quarters, to this point of view. He pleads for a return to, or a continuance of faith in, the sylvicultural principles laid down by the old masters of the science or art, of whom the last century provided some of the best known. Perrin deals with the various aspects of, and factors influencing, sylvicultural practice, and details in a general manner French methods. A close acquaintance with the forest is not easy to acquire, owing to the fact that the methods of investigation common to all the biological sciences are difficult of application in the forest; long years of observation must be passed during which generations of men succeed each other; and only continuity and persistence will result in that sylvicultural knowledge and practice which is the antithesis of the 'get rich quick' theory as applied to forest management, which has made its appearance of late years in places.

The R.H.S. Lily Year-Book

CONTRIBUTIONS from the point of view of the practical gardener predominate in the Royal Horticultural Society's Lily Year-Book for 1937 (from the Society's Office, Vincent Square, Westminster, S.W.1, 5*s.* paper; 6*s.* cloth; pp. 153. Oct. 1937). Information upon the choice of lilies for all situations in the garden can be found in it, and the increasing popularity of *Nomocharis* and fritillary is reflected by several articles on these genera. Dr. W. B. Turrill contributes a useful taxonomic study on fritillaries, giving detailed descriptions of anatomy. A report of discussions upon the propagation of lilies from scales provides much practical information. Two papers, by Dr. Fred Stoker and F. C. Stern, compare lilies which will grow on lime-free and lime soil respectively. No sharp distinction can be drawn between the lily flora of these two horticultural habitats, and the absence of more scientific experiments leaves a doubt as to whether lime or some other influence is really the controlling factor. Mr. L.

Ogilvie describes experiments upon the depth of planting, and the effects of high and low temperatures, on lily bulbs. One cannot escape the conclusion, however, on considering the contents of the present volume, that it deals with less fundamental questions than previous issues.

Leeds College of Technology

ON the occasion of the distribution of prizes and certificates by Sir William Bragg on December 7, the principal of the Leeds College of Technology presented a report on the work of the last session, emphasizing the value to the local industries of the thoroughly up-to-date technical instruction given in the College to more than three thousand of their personnel. The total number of students was 3,862, of whom 3,320 attended evening classes only and 375 attended part-time day and evening classes. Although education authorities are often inclined to disparage evening classes on the ground that after a hard day's work people cannot be expected to be fit for serious study, they are nevertheless a very valuable part of the country's educational resources. As the principal points out, they are, moreover, capable of exerting a definitely beneficial effect on character: "To attend evening classes regularly after the day's work, for several sessions, each of which includes an English winter, is an indication of grit and perseverance in addition to intellectual ability". It is noteworthy that 379 students were released by employers to attend part-time day classes, generally in addition to evening classes.

Vocational Guidance

A 'VOCATIONAL GUIDANCE' pamphlet has been issued by the University College of the South-West of England, Exeter, for the use of parents and others. It gives a list of the various college courses with particulars of their duration and the fees payable for them, a list of vocations (other than teaching) for which the courses offer suitable preparation, and a list of other vocations. The attention of parents is directed to the fact that in some cases the course of study is of one year's duration only and entails no long or expensive training. Accompanying the pamphlet is a leaflet directing attention to the increased demand for scientific investigators both for routine and research duties, to the importance for entry into commerce or industry of good qualifications in modern languages and economics, and to a new course for a diploma in public administration. This diploma will, it is anticipated, be a valuable qualification for higher posts in the national and local government services.

The Laxminarayan Technical Institute, Nagpur

THE foundation stone of the Laxminarayan Technological Institute was laid by His Excellency Sir Hyde Clarendon Gowan, Chancellor of the Nagpur University, at Nagpur on December 8, 1937. The Chancellor paid great tribute to the untiring efforts of the present Vice-Chancellor, Sir Hari Singh Gour, in acquiring the present site for the Institute, which will be surrounded by charming scenery. The construction of the Laxminarayan Technological Institute and its workshop is the result of a princely bequest, now amounting to more than £400,000, made by the late Rao Bahadur D. Laxminarayan in 1930 to the University of Nagpur for the teaching of applied science and chemistry. The University has decided to begin with the creation of a department of applied chemistry for teaching and research work in this subject. Dr. R. S. Thakur, who had been deputed for the last two years by the University of Nagpur to visit England and the continent of Europe for practical training in applied chemistry, with special reference to oil technology, has now been appointed as the organizing officer. It is expected that the Institute will be in active operation about July of next year.

Refrigeration Conference

A REFRIGERATION Conference will be held in London on July 12, in the rooms of the Royal Society. This Conference, which is convened by the British Association of Refrigeration, will take place immediately following a meeting at the same centre of the Technical Commissions of the International Institute of Refrigeration, an organization with headquarters in Paris. The subjects provisionally set down for discussion at the Conference, which will be open to all technicians interested in refrigeration, are: influence of low temperatures on enzymes, vitamins, etc.; limitations of 'gas storage'; air conditioning problems; an international unit of refrigeration; standard tables giving the properties of refrigerants. Further information can be obtained from the Hon. Secretary, British Association of Refrigeration, Empire House, St. Martin's-le-Grand, London, E.C.1.

Mathematical Colloquium at St. Andrews.

A MATHEMATICAL colloquium, similar to the very successful gatherings held in 1926, 1930 and 1934, will be held in St. Andrews on July 4–July 15, 1938, under the auspices of the Edinburgh Mathematical Society. Short courses of lectures will be given by prominent mathematicians, including Prof. E. T. Whittaker, Prof. G. D. Birkhoff, Dr. A. C. Aitken, on topics of pure and applied mathematics. On their way to the colloquium, members will have the opportunity of attending a meeting of the Royal Society of Edinburgh, celebrating the three hundredth anniversary of the birth of James Gregory, who held in succession the chairs of mathematics in the Universities of St. Andrews and Edinburgh. This meeting will be held in Edinburgh on July 4. Further particulars of membership of the colloquium can be obtained from the Hon. Secretary, Edinburgh Mathematical Society, 16 Chambers Street, Edinburgh 1.

The Night Sky in February

FULL moon occurs on February 14 at $17 \cdot 2^h$ and new moon on March 2 at $5 \cdot 7^h$ U.T. No occultation of stars brighter than magnitude $5\frac{1}{2}$ occurs this month.

The moon is in conjunction with Saturn on February 4 at 18^h and three hours later with Mars, the two conjunctions illustrating very well the moon's movement in its orbit around the earth. Mars was in conjunction with Saturn on February 2 at 20^h, and the former continues to move eastwards relative to the latter. Those observers interested in the phenomena of Saturn's satellites should consult p. 30 of the B.A.A. Handbook for the times of eclipses, occultations and transits. The apparent diameter of the minor axis of the ring system is slowly increasing up to a maximum of 8″ in August next. Uranus (6th magnitude) is not far from 29 Arietis, a star of similar magnitude. Neptune is in Leo, and at the end of February is about half-way between 89 Leonis and σ Leonis; the disk presented by the planet is 2½″ in diameter. The well-known eclipsing binary, Algol (β Persei), is becoming less favourably placed for observation. The change in brightness (in 5 hours the star loses two-thirds of its light and then returns to its original brightness in the following 5 hours) can be seen best about 1½ hours before and after the following epochs: February 6^d $23{\cdot}8^h$; 9^d $20{\cdot}6^h$; 12^d $17{\cdot}4^h$; 24^d $4{\cdot}7^h$, 27^d $1{\cdot}6^h$ and March 1^d $22{\cdot}4^h$. In view of the occurrence of magnetic storms commencing on January 16, 22 and 25 (the latter being associated with the great auroral display), it may be worth while watching the northern skies 27 days after each of these dates, especially on or about February 21, when the moon will be absent until after midnight. Analysis of data shows, however, that great magnetic disturbances recorded in this country are much less likely to recur after one synodic solar rotation than those of lesser intensity.

Announcements

THE King of the Belgians has conferred upon Prof. H. S. Taylor, professor of physical chemistry in Princeton University, the Cross of Commander of the Order of Leopold II in recognition of the services rendered by him to Belgium as occupant of the Francqui chair at Louvain in chemistry from January until June of last year.

PROF. A. B. WASICKY, professor of pharmacognosy in the Pharmaceutical Institute of the University of Vienna, was awarded the Hanbury Medal for 1937 of the Pharmaceutical Society of Great Britain and the medal will be presented to him on February 8, when he will deliver a lecture entitled "Modern Points of View and Methods in Pharmacognosy".

MISS JEAN BATTEN has been awarded the Gold Medal of the International Aeronautical Federation. The award was made for the greatest flying achievement of 1937. There were twenty-two nations represented at the Federation's conference, at which the Royal Aero Club represented Great Britain.

THE prize of £100, founded by Viscount Cecil of Chelwood, which is offered yearly for an essay on some subject connected with the maintenance of international peace, and is open to all students, without distinction of sex or nationality, of any university or university college in Great Britain or Northern Ireland, has been divided between Miss Ursula Wasserman of the University of London and Mr. D. D. Hindley-Smith of the University of Cambridge. The subject for the year 1937 was "The Causes of the Failure of the Disarmament Conference".

THE ARCHBISHOP OF YORK (Dr. William Temple) has accepted an invitation to act as president of the Society for the Protection of Science and Learning, formerly the Academic Assistance Council, in succession to the late Lord Rutherford.

PROF. N. V. SIDGWICK will deliver the distinguished visitor's address of the Chemical Society of Birkbeck College, on February 14, at 6 p.m. The title of Prof. Sidgwick's address is "Multiple Links". Admission is free, without ticket.

DR. NANNA SVARTZ-MALMBERG, who is well known for her work on intestinal bacteria and their influence on rheumatic diseases, has been appointed professor of medicine at the Stockholm Caroline Institute by the Swedish Government. This is the first time that a Swedish woman has been appointed professor.

A DISCUSSION on the Ministry of Health new model building by-laws will take place at the Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.1, on February 8 at 5.30 p.m.

AN international conference of teachers to discuss the actual problems of international relations to-day and to exchange ideas and experiences on the methods of teaching international relations and of promoting international friendship and understanding in the colleges and schools will be held in London on April 22–25. Further information can be obtained from the Secretary, Education Committee, League of Nations Union, 15 Grosvenor Crescent, London, S.W.1.

THE Department of Mines and Resources, Mines and Geology Branch, National Museum of Canada, has available a number of reports comprised in a series dealing with the Canadian Arctic Expedition, 1913–18. Many of the publications include half-tone illustrations and maps, and copies will be supplied without charge on application to F. C. C. Lynch, National Museum of Canada, Ottawa, from whom a list of the publications available can be obtained.

ERRATUM. In the letter entitled "Westward Extension of the Ranikot Sea" (NATURE, Jan. 29, p. 202) by Lieut.-Colonel L. M. Davies, the names of species appearing in lines 5 and 6 of paragraph 2 should read as follows: *Operculinoides* cf. *sindensis* (Davies), *Miscellanea stampi* (Davies), *M. miscella* (D'Arch. and Haime).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 250.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Light Scattering and Fluid Viscosity

ACCORDING to well-known hydrodynamical theory[1], plane waves of sound propagated through a viscous liquid suffer a diminution of amplitude in the ratio $1/e$ in traversing a number of wave-lengths given by the quantity $3C\lambda/8\pi^2\nu$, where C is the velocity of sound, λ is the wave-length of sound and ν is the kinematic viscosity. Taking $\lambda = 4358$ A., this number for various common liquids which are fairly mobile at room temperature ranges from about 3 in the case of butyl alcohol to about 30 in the case of carbon disulphide. For phenol at 25° C., the number is less than 1, and for glycerine, it is a small fraction of unity. A consideration of these numbers shows that the theories due to Einstein[2] and L. Brillouin[3], which regard the diffusion of light occurring in liquids as due to the reflection of light by regular and infinitely extended trains of sound-waves present in them, can only possess partial validity for ordinary liquids, and must break down completely in the case of very viscous ones. In an earlier note in NATURE[4], we reported studies of the Fabry-Perot patterns of scattered light with a series of liquids, which showed clearly that the Doppler-shifted components in the spectrum of scattered light fell off in intensity relatively to the undisplaced components, with increasing viscosity of the liquid.

We have now to report some further results which illustrate in a striking way the part played by fluid viscosity in the diffusion of light by liquids. As mentioned in our previous note, the light scattered by liquid phenol at ordinary temperatures gives a Fabry-Perot pattern which is scarcely distinguishable from that of the incident light. When, however, the temperature of the liquid is raised, the viscosity falls off rapidly, and the number $3C\lambda/8\pi^2\nu$ assumes a value which is many times greater than at room temperature. Simultaneously, as can be seen from Fig. 1, the character of the Fabry-Perot pattern alters, and the Doppler-shifted components come increasingly into evidence; at 70° C. they are just as prominent as in ordinary inviscid liquids. The influence of temperature revealed by these studies for the case of the very viscous phenol is to be clearly distinguished from the broadening of the Doppler components with rise of temperature reported by us in an earlier note[5] for the case of carbon tetrachloride.

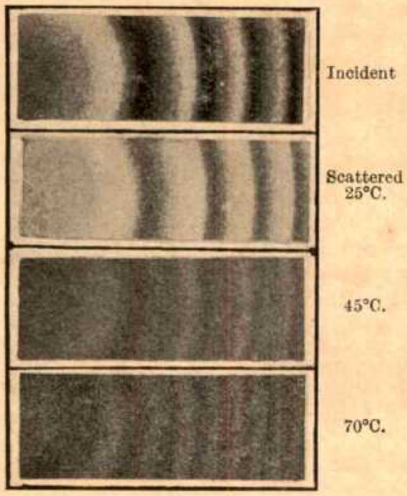


Fig. 1.
INFLUENCE OF TEMPERATURE ON THE SCATTERING BY PHENOL.

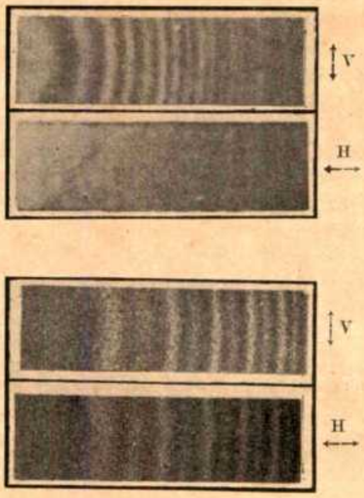


Fig. 2.
STATE OF POLARIZATION; ABOVE, TOLUENE; BELOW, PHENOL.

The four patterns reproduced in Fig. 2 show the remarkable difference in the state of polarization of the Fabry-Perot patterns of transversely scattered light for an inviscid liquid such as toluene and a viscous one such as phenol at room temperature. In the former case, only a continuous radiation is to be observed in the horizontal component; in other words, both the displaced and the undisplaced components in the pattern are sensibly completely polarized with the vibrations vertical. In the case of phenol, however, the undisplaced radiation is evidently partially polarized, as it appears both in the vertical and the horizontal vibrations ; a partial polarization of the continuous radiation is also noticeable.

C. V. RAMAN.
B. V. RAGHAVENDRA RAO.

Department of Physics,
Indian Institute of Science,
Bangalore.
Dec. 29.

[1] Lamb, "Hydrodynamics", fifth edition, p. 613.

[2] Einstein, A., *Ann. Phys.*, **33**, 1275 (1910).

[3] Brillouin, L., *Ann. Phys.*, **17**, 88 (1922).

[4] NATURE, **139**, 585 (April 3, 1937).

[5] NATURE, **135**, 761 (May 4, 1935).

New Phenomena Connected with Heat Flow in Helium II

SINCE publishing the preliminary measurements on thermal conduction in liquid helium II[1] which showed a variation of conductivity with temperature gradient, further data have been collected concerning the phenomenon.

It was noted that the conductivity appeared to increase as the bore of the conduction capillary decreased. It was then found that at very low temperatures (1·08° K.) small heat flows produced a rise in the level of the liquid in the closed bulb at the heated end of the capillary, instead of the fall caused by increased vapour pressure which was observed for higher heat flows. The apparatus was modified (Fig. 1) so that the top of the bulb at the hot end of the capillary was open to the vapour above the surface of the liquid helium bath. There was thus no possibility of a difference in vapour pressure between the liquid at either end of the capillary. As in the previous cases, heat was introduced electrically by means of a coil inside the bulb. On heating, the level of the liquid again rose in the bulb. The rise in level increased with increasing heat flow, and for constant heat flow increased with decreasing temperature. This effect opposes the effect of increased vapour pressure in the closed bulb, and thus will probably explain the apparent non-linear variation of heat flow with temperature gradient. More complete data on this phenomenon will be published later by one of us (J. F. A.).

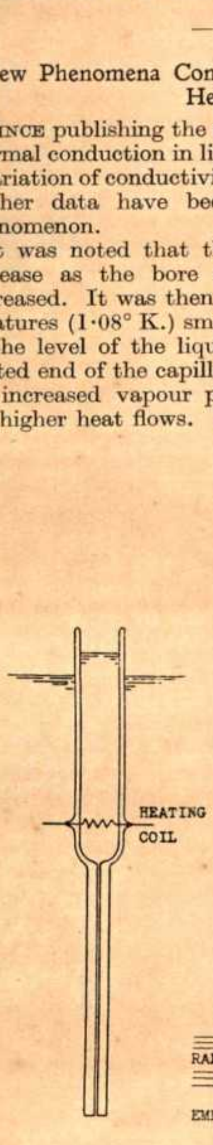


Fig. 1.

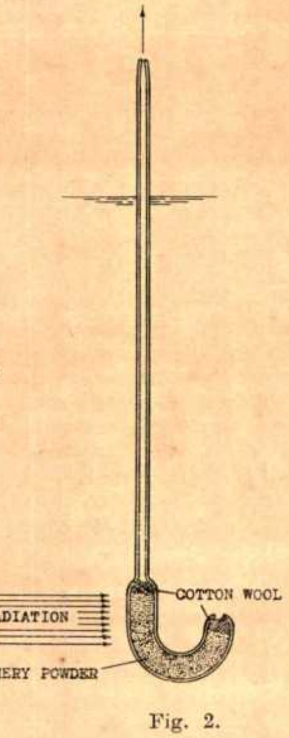


Fig. 2.

A more striking manifestation of the above effect was observed by one of us (J. F. A.) in collaboration with A. D. Misener. Observations were being made on the flow of liquid helium II through a tube packed with fine emery powder (Fig. 2). The top of the tube was allowed to project several centimetres above the level of the liquid helium bath, and an electric pocket torch was flashed on the lower part of the tube containing the powder. A steady stream of liquid helium was observed to flow out of the top of the tube as long as the powder was irradiated.

The principle is the same as that for the thermal conductivity apparatus, in which heat is introduced electrically and flows through a capillary. Here the capillary is replaced by the minute interstices in the powder, and the heat input is obtained by means of the absorption of radiation by the powder particles. The apparatus forms, in effect, a very simple and efficient helium pump. The height of the jet becomes greater for lower bath temperatures and for powder particles of smaller size. A photograph of the liquid helium pump is shown in Fig. 3. The stream rises approximately 4 cm. above the jet, the top of the stream striking the side wall of the flask. The illumination for the photograph consisted of a 60-watt bulb, which also provided the radiant thermal energy for operating the helium pump. The maximum height of jet produced was 16 cm.

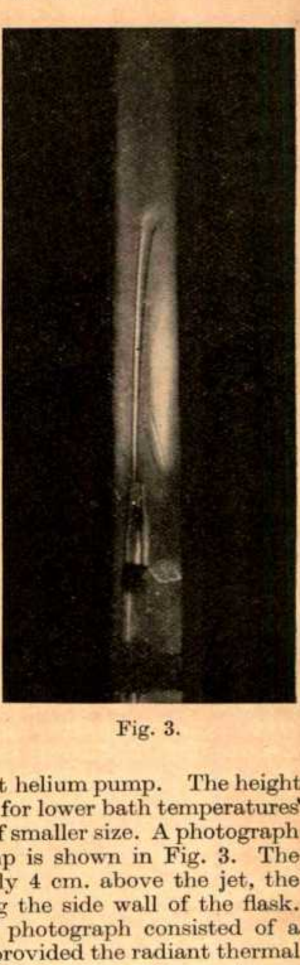


Fig. 3.

The significance of these results may perhaps be understood in the following manner. The observed specific heat of helium II shows that some co-operative phenomenon is concerned. According to Fröhlich[2], this is a disordering process analogous to that occurring in β-brass. Helium II is exceptional, however, in that almost the whole of the thermal energy at the λ-point is energy of disorder. We are led, therefore, to consider heat conduction as a flow of disorder rather than as a flow of vibrational energy. According to a suggestion of London's[3], the ordered state forms a diamond lattice which may be regarded as a body-centred cubic lattice in which only half the lattice points are occupied. According to Fröhlich, the disorder arises when some atoms fill the unoccupied sites of this underlying body-centred structure. Such 'wrong' atoms would be able to jump from one possible site to the next. This model, admittedly naïve, contains an interesting feature, namely, that as the flow of disorder is weakened by collisions with the walls of the containing tube, momentum in the direction of flow is lost. This should be contrasted with conduction by vibrational waves which do not carry momentum. The reaction due to loss of momentum gives rise to a pressure in the opposite direction to the heat flow.

This process of conduction by flow of disorder has been considered in rather more detail by one of us (H. J., to appear elsewhere), and a second process by which a flow of disorder can be dissipated, namely, by interactions with vibrational waves, has been discussed. This latter process will not, of course, result in a 'back pressure'. This pressure will therefore be greater the greater the part played by the walls in the heat resistance. Lessening the bore of the tube in which heat flows, or filling with powder, increases, therefore, for a given heat flow, the magnitude of the back pressure.

J. F. Allen.
H. Jones.

Royal Society Mond Laboratory,
Cambridge.

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[1] Allen, Peierls, and Uddin, Nature, **140**, 62 (1937).

[2] Fröhlich, H., *Physica*, **4**, 639 (1937).

[3] London, F., *Proc. Roy. Soc.*, A, **153**, 576 (1936).

Memories of Rutherford in Manchester

When I look back on the five years which I spent with Rutherford as a young physicist in Manchester, many delightful impressions spring to my mind. I see his quiet research room at the top of the physics building, under the roof, where his radium was kept, and in which so much well-known work on the emanation was carried out. But I also see the gloomy cellar in which he had fitted up his delicate apparatus for the study of the α-rays. Rutherford loved this room. One went down two steps and then heard from the darkness Rutherford's voice, reminding one that a hot-pipe crossed the room at head-level, and that one had to step over two water-pipes. Then, finally, in the feeble light, one saw the great man himself seated at his apparatus, and straightway he would recount in his own inimitable way the progress of his experiments, and point out the difficulties that had to be overcome.

There was also a cheerful room upstairs, in which we all met for a cup of tea in the late afternoon. It was perhaps Rutherford's greatest gift to his young pupils and collaborators that he attended with such regularity this pleasant break in the daily routine. Here he would discuss in his lively manner old and new problems in physics, or help us in our experimental difficulties and give us renewed confidence, and here, to the delight of all present, he would so often relate details of his latest successes and discoveries. He might even take us along to his research laboratory and demonstrate to us something that he had himself seen for the first time that very day.

Rutherford always gave most willingly from his rich treasure-house of knowledge, at the same time never thinking of himself. I will mention one instance of this, which is still fresh in my memory. A young physicist who had just arrived in the laboratory commenced work on his research, and before long he was confronted by difficulties. Rutherford suggested to him a new line of attack, which would lead him in a simple and certain manner to a successful termination of his work. But the young man had not quite rightly grasped the significance of Rutherford's suggestions. From that moment, however, what he had heard continued to work on his subconscious self, and he understood gradually the trend of the proposals Rutherford had laid before him. When he saw quite clearly his new plan of action he was delighted, and immediately told Rutherford about these ideas, which he was convinced were his own. But Rutherford only smiled, and congratulated him in words of friendly encouragement on his new plan of work.

I always like to recall another little episode, which occurred at the time when much work was being done in the laboratory with sources of radiation consisting of extremely thin glass tubes filled with emanation. It was necessary to exercise great care lest any of this emanation should escape, for it spread rapidly throughout the building, and by virtue of its activity made experimental work an impossibility for periods of many hours. In his typically drastic manner, Rutherford had threatened the severest penalties for offenders in this matter. One day I noticed that it had become impossible to use an electroscope in my room, where I had fitted up the first counting experiments for Rutherford, and before long other research workers emerged from the neighbouring rooms with the same sad story. We were not long in discovering that the emanation had come from Rutherford's own laboratory, where at that moment he was actively engaged with his experiments. As luck would have it, he came into my room shortly afterwards, and inquired how my work was proceeding. He would have been glad to hear of new developments, but I was brief and to the point. I told him that once again it was futile to attempt to do any work, for the whole building was full of emanation, all of which came from his room. Rutherford looked surprised, and replied: "Well, there you have further proof of the power inherent in this emanation." With this remark he left me; but he soon returned, suggesting that I must be somewhat upset, and that I needed a little fresh air. He took me forthwith in his car for a ride beyond the turmoil of the city, and he was soon discoursing on his own experiments and on all the problems that were yet to be solved. Nothing was so refreshing nor so inspiring as to spend an hour in this way, alone with Rutherford. In spite of the minor provocation, I would be loth to part with the memory of such a day, spent in fellowship with a master-mind.

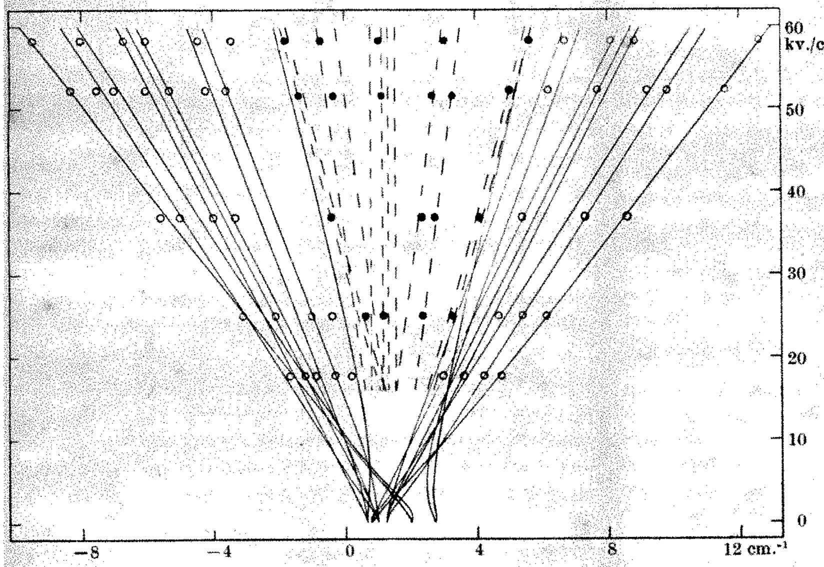
H. Geiger.

Physikalisches Institut,
Techn. Hochschule,
Berlin.
Dec. 21.

Relativistic Stark Effect of Ionized Helium

The problem of the relativistic Stark effect of hydrogen has been investigated mainly theoretically, the experimental investigation being hampered by great difficulties. These being less pronounced for the lines of ionized helium than for the hydrogen lines, I attacked the problem in question using the He^+ line λ 4686 A. This needed a stigmatic spectral apparatus of high resolving power coupled with great brilliancy. A suitable large autocollimation glass spectrograph with two compound prisms was available, the total base-length of the flint prisms being 30 cm., and the focal length 150 cm. The dispersion in this region is about 2·5 A. per mm. As light source, I used a Lo Surdo tube as modified by Ryde.

Using the standard theory of the relativistic Stark effect of hydrogen, as worked out by Schlapp[1], I have calculated for the above line the displacements and relative intensities of the fine-structure lines for electric fields ranging from 0 to 100,000 v. per cm. The accompanying diagram is intended to give an idea of the theoretical displacements, the extensive numerical data being reserved for a detailed publication. Only those lines have been plotted the calculated intensities of which make them likely to appear on the plates. The theory shows that, in strong fields, most of the Stark components consist of several fine-structure lines the mutual distances of which, apart from the second order effect, do not vary with the field. In weak and intermediate fields, that is, before the groups of fine-structure lines that constitute the ordinary Stark components have become separated, say, below 40,000 v. per cm., the theory draws a rather complicated picture that differs greatly from the symmetrical appearance of the ordinary hydrogen pattern.



STARK EFFECT OF THE HE+ LINE, λ 4686A. FULL LINES CORRESPOND TO p-COMPONENTS, BROKEN LINES TO s-COMPONENTS.

It has been possible to observe a number of fine-structure lines, or groups of such lines overlapping each other, in different fields ranging from 0 to 100,000 v. per cm. If the field is not very weak, the measurements are in good agreement with theory, as will be seen from the diagram, where some experimental values above 18,000 v. per cm. have been plotted. In weak fields the position is not quite clear, and corresponding measurements will be published later.

B. KULLENBERG.

Physical Institute,
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Dec. 17.

[1] *Roy. Soc. Proc.*, A, **119**, 313 (1928). For further literature, see Kullenberg, B., *Z. Phys.*, **102**, 423 (1936).

Bode's Law and Saturn's Satellites

THOUGH no satisfactory physical explanation has yet been found for Bode's law of the approximately regular progression of the mean distances of the planets from the sun, the law holds good for all the planets except Mercury and Neptune and should not, therefore, be regarded as merely a coincidental truth. If the distance of Mercury itself from the sun is left out of consideration, and Mercury's orbit is taken as the starting-point, then, representing the distance from Mercury's orbit to that of Venus by the number 3, the distance of the other planetary orbits from that of Mercury's are roughly in the geometrical progression 6, 12, 24, etc.

This general relationship seems to apply also to the orbits of satellites if distances are measured from that of the first satellite to those of the others. In the table below, the intervals between the orbits of the satellites of Saturn, as derived from the values given in Prof. R. H Baker's "Astronomy", and as given by a geometric series, are compared; and it will be seen from this that there is good reason for the suggestion of the existence of an undiscovered satellite of the planet between the orbits of Iapetus and Phoebe.

I realize, of course, that the measured distances of Titan and Hyperion from Mimas do not correspond with the distances represented in the geometrical series, but I suggest that this may be due to difficulties in determining the actual distances of these satellites from Saturn on account of the relatively high eccentricity of their orbits. With Titan, the major axis at right angles to a terrestrial observer gives an exaggerated maximum elongation upon which the distance would be based; and with Hyperion, the minor axis at right angles gives a relatively smaller maximum elongation. The result is thus to reduce the difference between the two orbits in both directions.

Mean distances between the orbits of	Observed distances in miles	Distances based on geometrical progression
Mimas and Enceladus	32,700	32,700
,, ,, Tethys	67,700	65,400
,, ,, Dione	118,700	130,800
,, ,, Rhea	211,700	261,600
,, ,, Titan	643,700	523,200
,, ,, Hyperion	804,700	1,046,400
,, ,, Iapetus	2,094,700	2,092,800
,, ,, missing satellite	——	4,185,600
,, ,, Phoebe	7,918,700	8,371,200

However this may be, there is a gap of nearly six million miles between the orbits of Iapetus and Phoebe, and the general order of the progression of the other orbits seems to afford evidence of the existence of a new satellite about two million miles from the orbit of Iapetus and four million miles nearer Saturn than Phoebe. It is just possible that the faint satellite of Saturn, of which Prof. W. H. Pickering reported the discovery in 1905, but which has not since been observed, is the missing body.

J. MILLER.

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Jan. 17.

Methods of Estimating Mental Factors

MR. M. S. BARTLETT has proposed[1] formulæ for the estimation of mental factors as alternatives to formulæ I have given[2]. My formulæ were arrived at by the ordinary regression method. Bartlett's estimates and the regression estimates attain different ends, and it is agreed that each method is correct in the right place. The regression estimates minimize the squares of the discrepancies between the estimates and the true values, summed over the population of persons. Bartlett's estimates minimize the squares of a man's *specific* factors, summed over the tests. If the scores expressed in matrix notation as linear functions of the true factors are

$$Z = MF = M_0F_0 + M_1F_1$$

the two sets of estimates, for the common factors only, are

$$\hat{F}_0 = M_0'(MM')^{-1}Z = M_0'R^{-1}Z \text{ (regression estimates)}$$
$$\check{F}_0 = (M_0'M_1^{-2}M_0)^{-1}M_0'M_1^{-2}Z \quad \text{(Bartlett's estimates).}$$

The regression method has the quality that if factors estimated by it are inserted in the specification equation which defines a vocation in terms of factors, the result is the same as a direct regression estimate of vocational ability from the tests.

If estimates, by either method, of all the factors including specifics are inserted into the specifications MF of the test scores, they reproduce the latter exactly. If, however, only the common factors are estimated and used, Bartlett's reproduce the scores better than the regression estimates do. In such a situation, however, the regression method would again *estimate* the original scores from the estimated common factors, and it is the object of this note to point out that if this is done, the results are identical with those produced by Bartlett's method.

If we estimate the quantities Z from the $\hat{F}_0$ only, by the ordinary methods of regression, we get, bearing in mind that the $\hat{F}_0$ are neither normalized nor uncorrelated,

$$\hat{\hat{Z}} = M_0(M_0'R^{-1}M_0)^{-1}M_0'R^{-1}Z = SZ \text{ say.}$$

Whether we simply insert Bartlett's estimates in M_0F_0, or make a regression estimate of the scores from the $\check{F}_0$, we reach the result

$$\check{Z} = M_0(M_0'M_1^{-2}M_0)^{-1}M_0'M_1^{-2}Z = EZ \text{ say,}$$

and we see that the matrices S and E are identical if we use the relations

$$R = M_0M_0' + M_1^2$$

and

$$(M_0'R^{-1}M_0)^{-1} = I + (M_0'M_1^{-2}M_0)^{-1}.$$

GODFREY H. THOMSON.

University,
Edinburgh.
Jan. 12.

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[1] *Brit. J. Psych.*, **28**, 99 (1937).

[2] *(American) J. Educ. Psych.*, **27**, 41 (1936).

Blood Group Inheritance

THE unusual blood group proportions among the Soussoux in French Guinea, found by J. S. de Goldfiem[1] and quoted by R. Elson Dew[2], are inexplicable as a stable distribution on the accepted triple allelomorph theory of blood group inheritance. They are, however, quite consistent with the quadruple allelomorph theory proposed by us[3], if it be assumed that the fourth allelomorph, the AB gene, while rare in most human populations, is the predominant one among the Soussoux. The hypothesis could be tested as follows.

Denoting the four allelomorphic genes R, A, B, D (that is, ab, Ab, aB, AB in our previous notation), let their frequencies be γ, α, β, δ; and let the frequencies of the blood groups O, A, B, AB be r, p, q, s. Then for a stable distribution,

$$\gamma^2 = r,\ \alpha^2 + 2\alpha\gamma = p,\ \beta^2 + 2\beta\gamma = q,$$
$$\delta^2 + 2\alpha\delta + 2\beta\delta + 2\gamma\delta + 2\alpha\beta = s.$$

Hence $\alpha = \sqrt{p+r} - \sqrt{r},\ \beta = \sqrt{q+r} - \sqrt{r},$

$$\gamma = \sqrt{r},\ \delta = 1 - \sqrt{p+r} - \sqrt{q+r} + \sqrt{r}.$$

(For the triple allelomorph theory, there is the additional equation $\delta = 0$.) The data in question are

$$r = 0{\cdot}01,\ p = 0{\cdot}01,\ q = 0{\cdot}09,\ s = 0{\cdot}89,$$

whence $\gamma = 0{\cdot}100,\ \alpha = 0{\cdot}041,\ \beta = 0{\cdot}216,\ \delta = 0{\cdot}642.$

The gene distribution would therefore be

10 per cent R + 4 per cent A + 22 per cent B + 64 per cent D.

Calculation on this basis gives the following results for the offspring of two parents, one being of group AB (in other cases the usual theory applies).

$AB \times AB = 0{\cdot}75\ (AB) + 0{\cdot}025\ (A + 3AB) + 0{\cdot}20\ (B + 3AB) + 0{\cdot}02\ (O + 3AB) + 0{\cdot}005\ [\mathrm{A} + B + 2AB]$,

$A \times AB = 0{\cdot}52\ (AB) + 0{\cdot}26\ (B + 3AB) + 0{\cdot}12\ (O + A + 2AB) + 0{\cdot}085\ [A + AB] + 0{\cdot}015\ [2A + B + AB]$,

$B \times AB = 0{\cdot}49\ (AB) + 0{\cdot}03\ (A + 3AB) + 0{\cdot}07\ (O + B + 2AB) + 0{\cdot}40\ [B + AB] + 0{\cdot}01\ [A + 2B + AB]$,

$O \times AB = 0{\cdot}46\ (AB) + 0{\cdot}06\ (A + AB) + 0{\cdot}31\ (B + AB) + 0{\cdot}15\ (O + AB) + 0{\cdot}02\ [A + B]$.

The notation means that in 75 per cent of families with parents $AB \times AB$ the offspring will be all AB, in 2½ per cent they will be A and AB, expected in the ratio 1 : 3, and so on. On the usual theory, only the family types in square brackets should occur.

It will be seen that the majority of offspring of $O \times AB$ will be either O or AB, that is, anomalies on the usual theory; and a few such anomalies appear in the other three cases. The fourth allelomorph was in fact suggested in order to account for just such anomalies in ordinary populations. Other suggestions which have been made to account for them are *mutation* by various investigators, *crossing-over* by Bauer[4], *trisomy* by Haldane[5]. An examination of blood group pedigrees among the Soussoux would perhaps settle the matter.

J. FFOULKES EDWARDS.

Northumberland House,
Green Lanes, London N.4.

I. M. H. ETHERINGTON.

Mathematical Institute,
University of Edinburgh.
Jan. 8.

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[1] *C.R. Soc. Biol.*, **123**, 391 (1936).

[2] NATURE, **140**, 1066 (Dec. 18, 1937).

[3] NATURE, **136**, 297 (Aug. 24, 1935); 646 (Oct. 19, 1935).

[4] *Klin. Wochenschr.*, **7**, 1588 (1928).

[5] NATURE, **136**, 432 (Sept. 14, 1935).

Cell Size in Millipedes

THE idea of the constancy of cell size for a particular tissue in different individuals of an animal species has long held sway in zoological literature. This concept has frequently been extended to cover nearly related species[1]. I wish to thank Dr. J. R. Baker, of Oxford, for suggesting this investigation into a case which proved to be at variance with the generally accepted view.

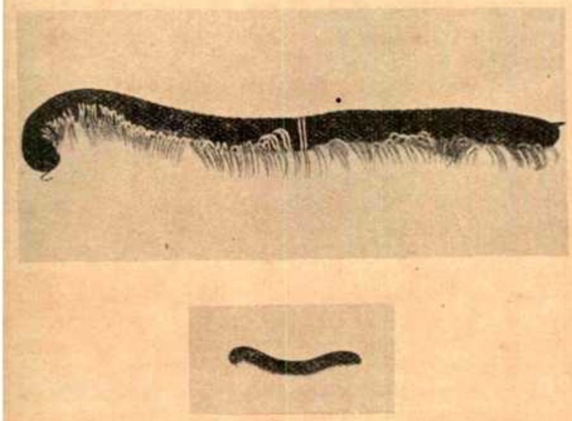

Fig. 1.

ABOVE, *Spirostreptus stenorhynchus*; BELOW, *Cylindroiulus londinensis*. BOTH ABOUT TWO THIRDS NATURAL SIZE.

Spirostreptus stenorhynchus is a very large millipede from Ceylon (Fig. 1). A specimen examined was 13·8 cm. long. The fore-gut (of stomodæal origin) of this animal was fixed in Flemming's fluid with reduced acetic acid content, and transverse sections cut at 5μ. Fat was removed from the sections by immersion in turpentine, and they were afterwards stained in iron hæmatoxylin. These sections were very kindly lent me by Dr. Baker. *Cylindroiulus londinensis*, a British millipede, of average length 2·7 cm., was treated in exactly the same way. It should be noted that these two animals are quite closely related species, both being formerly included in the genus *Iulus*. Flemming's fluid was used since it gives a reasonably good fixation of the nucleus without causing excessive shrinkage in the cytoplasm.

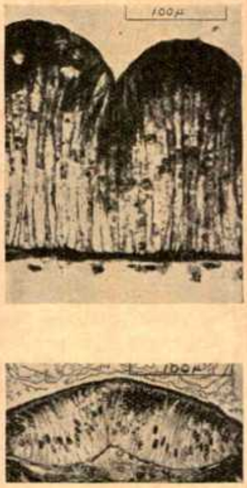

Fig. 2.

FORE-GUT CELLS OF *Spirostreptus* (ABOVE) AND *Cylindroiulus* (BELOW).

In the Ceylon millipede, fifty of the epithelial cells of the fore-gut (see Fig. 2) had an average length of 189 μ, and an average width of 7·8 μ. Corresponding dimensions of the cells of the British millipede were 54 μ and 3·9 μ respectively. It will therefore be seen that the cells of the Ceylon millipede are about fourteen times as large by volume as those of the British millipede. This really enormous difference in cell size (not, however, comparable with the difference in body volume) may perhaps be typical of single-layered epithelia, where symmetry relations according to the size of the lumen would demand larger cells in the larger species.

It may be pointed out, moreover, that W. F. Abercrombie[2] and W. Trager[3], working independently on the larva of the flesh-fly, *Lucilia sericata*, found that the entire growth of the larva from the first instar "is accounted for by increase in size of cells".

The photographs were taken at the John Innes Horticultural Institute by kind permission of Sir Daniel Hall.

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[1] See Painter, T. S., *J. Exp. Zoo.*, **50** (1928); also Berrill, N. J. *Phil. Trans.*, B, **225** (1935).

[2] *J. Morph.*, **59** (1936).

[3] *J. Exp. Zoo.*, **71** (1935).

Œstrogenic Activity of Certain Synthetic Compounds

IN earlier communications[1,2] two of us have described the œstrogenic activity of certain derivatives of diphenylethane, and in particular it was shown that the introduction of an ethylene linkage between the α and β carbon-atoms of such compounds greatly increased the potency. A number of stilbene derivatives were found to possess a marked activity. Following up this observation, the activity of *p*-hydroxypropylbenzene was next investigated and compared with that of *p*-hydroxypropenylbenzene (anol). The œstrogenic activity of some specimens of anol was found to be of a very high order, but further research indicated that this remarkable potency was probably due to the presence of a more complex substance produced as a by-product during the demethylation of anethole[3]. Recently, the activity of di-anol has been described[4].

In the meantime an investigation had been initiated at Oxford, the object of which was to prepare possible œstrogenic agents bearing a close structural resemblance to œstrone (or œstradiol) but which should be capable of ready synthesis.

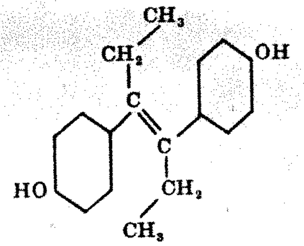
Substance	Dose (mgm.)	Per cent Positive
4-Hydroxy acetophenone	100	Nil
4-Hydroxy propiophenone	10	100
4-Hydroxy butyrophenone	100	100
4 : 4′ : α : β-Tetra hydroxy-α : β-dimethyl-diphenyl ethane	100	100
4 : 4′ : α : β-Tetra hydroxy-α : β-diethyl-diphenyl ethane	0·1	100
	0·01	80
4 : 4′ : α : β-Tetra hydroxy-α : β-di-*n*-propyl diphenyl ethane	10	100
4 : 4′-Dihydroxy-α : β-diethyl diphenyl ethane	10	100
Trans-4 : 10-dihydroxy-1 : 2 : 7 : 8 : 13 : 14 :-hexahydro chrysene..	1	100
4 : 4′ Dihydroxy-α : β-diethyl stilbene in sesame oil	0·0005	100
	0·0004	100
	0·00035	60
,, in water	0·0005	100
	0·0003	80
,, in oil, orally	0·001	80
Diacetate of ,, in oil	0·001	100

In certain directions, especially in the diphenylethane and stilbene groups, we found it convenient to join forces in order to avoid duplication of work.

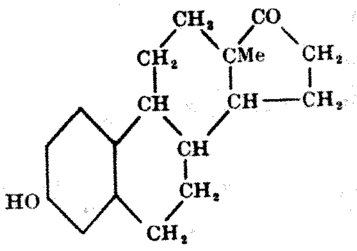
In the preceding table will be found a description of the activity of certain substituted derivatives of 4 : 4′-dihydroxydiphenyl ethane and 4 : 4′-dihydroxystilbene.

It will be noted that by far the most potent substance is 4 : 4′-dihydroxy-αβ-diethylstilbene. This was fully active in ovariectomized rats in a dosage between 0·3 and 0·4 gamma. Comparative tests show it to be between two and three times as potent as œstrone under similar conditions[5]. As can be seen from the table, it is active when dissolved in oil or in aqueous alcohol, or in aqueous solution as the sodium salt. The acetate is also fully active.

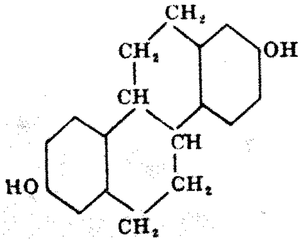
If the formula of this compound, $C_{18}H_{20}O_2$, (I), be written as shown below, the structural resemblance to œstrone, $C_{18}H_{22}O_2$, (II) can be appreciated. It can be seen that it is a possible dimeride of anol.



I



II



III

It is interesting, however, to note that as much as 1 mgm. of dihydroxyhexahydrochrysene (III) is required to produce œstrus in the ovariectomized rat, so that no advantage was gained by the inclusion of the full chrysene structure. The substance had, in fact, an activity of the same order as that of the related 4 : 4′-dihydroxy-αβ-diethyldiphenylethane.

Investigations are in progress upon the pharmacology and biological properties of 4 : 4′-dihydroxy-αβ-diethylstilbene and a series of its acyl derivatives. Other substituents are being introduced at the α and β carbon atoms and the behaviour of the resulting compounds will be reported later.

In view of the fact that 4 : 4′-dihydroxystilbene is the mother substance of a series of œstrogenic agents, we suggest that it may be termed *stilbœstrol*.

The following notes on the preparation of new substances are appended and more detailed publication will follow in another place.

4 : 4′-αβ-*Tetrahydroxy*-αβ-*diethyldiphenylethane* and its *dipropyl analogue* are the pinacols derived from 4-hydroxypropiophenone and 4-hydroxybutyrophenone respectively. The ketones were reduced by means of aluminium amalgam in moist ethereal solution. Crystallized from alcohol, the diethyl compound had m.p. 204–206° ; *diacetate*, m.p. 199–200° ; the dipropyl compound had m.p. 186–187°, *diacetate*, m.p. 199°.

Trans-4 : 10-*dihydroxy*-1 : 2 : 7 : 8 : 13 : 14-*hexahydrochrysene* (III) crystallized from ethyl acetate, m.p. 263–264°, was obtained by the action of a boiling mixture of hydriodic acid (*d* 1·9) and acetic acid on its dimethyl ether[6].

α-*Ethyldeoxyanisoin*, obtained by the action of alcohol sodium ethoxide and ethyl iodide on deoxyanisoin, is a colourless oil, b.p. 192–193° at 0·65 mm. By reaction with ethyl magnesium bromide it affords 3 : 4-*dianisylhexan*-3-*ol*, colourless plates from alcohol, m.p. 115–117°, and this in its turn yields 4 : 4′-*dimethoxy*-αβ-*diethylstilbene* on dehydration in various ways, for example, by the action of acids, acetic anhydride or phosphorus tribromide. The dimethoxydiethylstilbene crystallizes from light petroleum or alcohol, m.p. 123–124°.

The demethylation by many of the usual methods could not be effected. Thus the action of boiling hydriodic acid furnished 4 : 4′-*dihydroxy*-αβ-*diethyldiphenylethane*, a viscous oil, b.p. 189–190° at 0·8 mm. Aluminium chloride reacts with the stilbene so as to form fission products, phenol and a substituted phenol. Demethylation was found to be best effected by the action of alcoholic potassium hydroxide in a sealed tube at 205° and in this way 4 : 4′-*dihydroxy*-αβ-*diethylstilbene* (diethylstilbœstrol) was obtained colourless plates, m.p. 167–168° from aqueous alcohol ; *diacetate*, prisms, m.p. 123–124°. *Dimethylstilbœstrol*, similarly prepared, has m.p. 193–194° after crystallization from ethylene chloride.

The substances, the names of which are italicized above, have all been submitted to elementary analysis and the results are in agreement with theoretica anticipations.

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[1] Dodds and Lawson, NATURE, **139**, 627 (1937).

[2] Dodds, Fitzgerald and Lawson, NATURE, **140**, 772 (1937).

[3] Dodds and Lawson, NATURE, **139**, 1068 (1937).

[4] Campbell, Dodds and Lawson, NATURE, **141**, 78 (1938).

[5] Allan, Dickens and Dodds, *J. Physiol.*, **68**, 348 (1930).

[6] Ramage and Robinson, *J. Chem. Soc.*, 610 (1933).

Mechanism of Propagation of Electronic Excitatio Energy, and Photosynthesis in Plants

THE main objection to the concept of a 'photo synthetic unit' in the assimilation process of gree plants has been that the light quanta absorbe primarily would not sustain the numerous transfer from one chlorophyll molecule to another[1]. Recently however, a simple mechanism has been suggested whereby electronic excitation energy could be propagated without loss in a complex of dye molecule

Below, a more complete picture is derived from considerations on the quenching of fluorescence of dyes in solution[3].

In this process an electron of the light absorbing (fluorescent) molecule (D) on being transferred to a higher level (thus constituting the excited form D^*) leaves an empty electronic level behind. If this excited molecule collides with another molecule or ion [acceptor (Acc.)] which possesses an electron, bound with an energy corresponding to this unoccupied level, this electron is transferred to the excited dye, the fluorescence of which is thereby quenched. The molecules in collision constituting a single system, the electron transfer process must be regarded as a quantum mechanical resonance between the states (D^* Acc.) and ($D.^-$ Acc.$^+$) according to the non-adiabatic process[4]

$$D^* + \text{Acc.} \rightleftarrows D^- + \text{Acc.}^+$$

reduced dye (semiquinone).

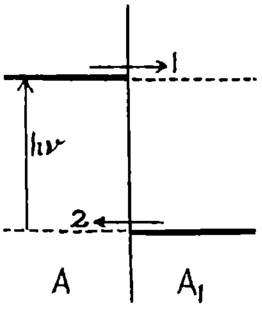
It has been emphasized recently[2] that the double refraction and the probable dichroism of the chloroplasts suggests a regular (crystallic) arrangement of the chlorophyll molecules (Prof. H. Zocher, Prague, has recently been able to prove that the double refraction and dichroism of the chloroplast is partially due to the chlorophyll molecules themselves: private communication) and also strong mutual interaction between the π-electron clouds of the conjugated bond system. A type of such an interaction has been demonstrated in the interesting experiments of Scheibe[5] and Jelley[6] on aggregates of various cyanine dyes. My recent observations that the leucobases of various dyes, for example, methylene blue, Lauth's violet, exert a particularly powerful quenching effect on the fluorescence of the respective dyes show that electronic resonance transfer can easily take place between the excited dye and its leucobase according to

$$D^* + DH^- \rightleftarrows D^- + DH, \ (D^- + H^+ \rightleftarrows DH)$$

(semiquinone)

If a light quantum is absorbed by an electron of one of the dye molecules in the complex, then on account of the strong coupling forces this electron can travel through the lattice. It then represents an excess electron in each molecule through which it passes, thus converting it into a negative ion for a very short time. But at the same time it leaves a positive charge in the originating molecule, and this positive charge can also travel by the transfer of an electron from a neighbouring molecule.

The diagram represents schematically the propagation of electronic excitation energy. Molecule A absorbs the light quantum ($h\nu$). The excited electron is transferred to a neighbouring molecule A_1 ($\rightarrow$1). The electron deficiency in A is made good by another transfer into its lower level (2 $\leftarrow$). As a result the excitation energy is transferred from A to A_1, and the repetition of these processes propagates the energy through the complex.



It is obvious that there exists a close analogy between the above process and the photo-conductivity and related phenomena in halide crystals, which have been extensively studied by R. W. Pohl and his co-workers[7]. It should therefore be possible to apply the experimental methods of Pohl, in a suitably modified form, to the above problem.

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[1] Franck, J., and Herzfeld, K. F., *J. Chem. Phys.*, **5**, 237 (1937).

[2] Weiss, J., NATURE, **137**, 997 (1936); *J. Gen. Physiol.*, **20**, 501, (1937).

[3] Weiss, J., NATURE, **136**, 794 (1935) Weiss, J., and Fishgold, H. *Z. phys. Chem*, B, **32**, 135 (1936). Weiss, J., *Trans. Faraday Soc.*, **32**, 1331 (1936).

[4] cf. London, F., *Z. Phys.*, **74**, 143 (1932).

[5] Scheibe, G, Kandler, L., and Ecker, H., *Naturwiss.*, **25**, 75 (1937); **25**, 474 (1937); Scheibe, G., *Naturwiss.*, **25**, 795 (1937).

[6] Jelley, E. E., NATURE, **138**, 1009 (1936); **139**, 631 (1937).

[7] cf. the latest articles from Prof. Pohl's Institute in Gottingen: Pohl, R. W., *Kolloid Z.*, **71**, 257 (1935); Hilsch, R., *Z. angew. Chem.*, **49**, 69 (1936).

Spontaneous Isomerization of Lycopene

DURING some experiments with benzene extracts of various fruits, it was observed that the calcium hydroxide chromatogram frequently, but not in every case, shows a rather brownish orange layer below the lycopene zone. Subsequent experiments have proved that this behaviour of carefully purified lycopene depends on the time which elapses between the dissolution and the adsorption analysis. A fresh solution forms a uniform chromatogram, but if the liquid has been kept at 20° for 1–2 days, the new polyene ("neo-lycopene") is observed; it then forms a very distinctly separated zone in the chromatogram developed with benzene and light petroleum (3 : 1). The pigment content of this layer reached 3 per cent of the total lycopene in experiments of 24 hours duration; the absorption maxima are 511, 479·5, 450 mμ in benzene and 498·5, 468, 440 mμ in petroleum ether. When the benzene solution is kept at room temperature, neo-lycopene is partly transformed into lycopene (or into a very similar dye which cannot be separated from lycopene in the column).

Gillam and his co-workers[1] have published important and highly interesting observations on the isomerization of carotene, which change, according to their data, takes place in the adsorbent itself, during the chromatographic process. In the case of lycopene, we claim that the chromophor spontaneously undergoes a partial rearrangement in certain solvents, where the ordinary lycopene tends to reach an equilibrium with at least one new compound. The progress of this isomerization is a function of the time, and it has nothing to do with a possible subsequent adsorption. The Tswett column only furnishes a suitable method for showing an effect already present in the solution. The isomerization may also be recognized by spectroscopic and colorimetric readings, independently of the chromatographic technique.

As a close study of the change is disturbed by a gradually increasing tendency to autoxidation and bleaching, the observation that the equilibrium between lycopene and neo-lycopene can be reached far more rapidly at an increased temperature was welcome. Examples: (*a*) A solution of 2·6 mgm. of chromatographically homogeneous lycopene in 25 ml. benzene was boiled under reflux for 20 min., during which time the colorimetric value fell to 2·15 mgm. 'lycopene'; the final chromatogram consisted of two main zones, the relative colorimetric strengths of which were 100 lycopene to 62 neo-lycopene. Autoxidation did not occur. (*b*) In a similar experiment performed with a pure solution of neo-lycopene, an increase in the colour value was observed during the heating period from 2 mgm. to 2·35 mgm. 'lycopene', and a chromatogram nearly identical with the foregoing was obtained, namely 100 lycopene to 68·5 neo-lycopene. (The presence of a small quantity of iodine does not alter these proportions considerably.)

At present work is in progress in this laboratory to investigate the stability of other carotenoids under the above conditions, including the isomerization of capsanthine, recently described by Zechmeister and Cholnoky[2]. Further, preliminary experiments show that chromatographically homogeneous β-carotene yields in the calcium hydroxide column a second layer (with α-carotene spectrum), if the freshly prepared solution in light petroleum has been previously kept at 70° for 30 min.; however, the spontaneous change of dissolved lycopene suggests that the stability of the conjugated system of natural carotenoids may be far less than is generally accepted.

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[1] Gillam and El Ridi, NATURE, 136, 914 (1935); *Biochem. J.*, 30, 1785 (1936); Gillam, El Ridi and Kon, *Biochem. J.*, 31, 1606 (1937).

[2] Zechmeister and Cholnoky, *Liebigs Ann.*, 530, 291 (1937).

Points from Foregoing Letters

Sir C. V. Raman and B. V. Raghavendra Rao submit Fabry-Perot patterns of light scattered by phenol, showing that, with increasing temperature, Doppler-shifted components come increasingly into evidence. In a non-viscous liquid like toluene, both the displaced and undisplaced components are almost completely polarized with the vibrations vertical. In the more viscous phenol the undisplaced vibration is only partially polarized, appearing both in the vertical and horizontal vibrations. The authors consider that the theory which regards the diffusion of light in liquids as due to the reflection of light by regular and infinitely extended trains of sound-waves present in them, must break down in the case of very viscous liquids.

J. F. Allen and H. Jones report experiments which show that associated with a flow of heat in helium II there is a pressure operative in the reverse direction to the heat flow. Under suitable conditions this pressure is great enough to allow the arrangement to be used as a convenient form of helium pump. A possible explanation of the effect, by regarding heat flow as a flow of disorder, is suggested.

By means of a stigmatic spectral apparatus of high resolving power and brilliancy, Dr. B. Kullenberg has determined the relativistic Stark effect, using the line 4686 A. of ionized helium, and submits a diagram showing how the values found experimentally fit the curves theoretically deduced. He finds that if the field is sufficiently strong (above 18,000 volts./cm.) the measurements are in good agreement with the theory.

A table showing the observed mean distances between the orbits of the known satellites of Saturn is given by J. Miller, who points out that they form a rough geometrical progression—a relation which also exists between the relative distances of the planetary orbits (taking the orbit of Mercury as zero line). From his table, Miller infers the existence of a missing satellite of Saturn, between the known satellites Iapetus and Phœbe, at a mean distance of about four million miles from the orbit of the innermost satellite, Mimas.

Prof. G. H. Thomson discusses the sphere of applicability of his 'regression method' of estimating mental factors and of the alternative formulæ proposed by M. S. Bartlett. If only the common factors, excluding specifics, are estimated and used, then Bartlett's formulæ reproduce the scores better than the regression estimates do, but in such a case the regression method would again estimate the original scores from the estimated common factors and would thus give results identical with those obtained by Bartlett's method.

The blood group proportions of the Soussoux of French Guinea appear to be inconsistent with the accepted theory of blood group inheritance. Dr. J. F. Edwards and Dr. I. M. H. Etherington point out that this could be explained if the inheritance depends on four (instead of three) allelomorphic genes. This view of blood group inheritance was previously proposed on other grounds.

H. G. Callan submits photographs showing the relative size of the Ceylon millipede, *Spirostreptus stenorhynchus* and of the English species, *Cylindroiulus londinensis*, and also photomicrographs showing the relative size of the epithelial cells from the fore-gut. The cells of the Ceylon millipede are about fourteen times as large, by volume, as those of the British species.

A table giving the œstrogenic activity of several compounds bearing a close structural resemblance to the sex hormone œstrone, but capable of being readily synthesized, is submitted by Prof. E. C. Dodds, L. Goldberg, W. Lawson and Prof. R. Robinson, together with brief notes indicating the method of preparation of new compounds. The most potent substance is 4 : 4′-dihydroxy-αβ-diethylstilbene, being between two and three times more active than œstrone. The authors propose the name stilbœstrol for the substance 4 : 4′-dihydroxystilbene, which is the mother substance of a series of œstrogenic agents.

From considerations on the quenching of fluorescence of dyes in solution, Dr. J. Weiss suggests a mechanism for the propagation of electronic excitation energy in a complex of molecules. The author considers that the mechanism might be applicable to the process of assimilation by green plants, the energy of the absorbed light quanta passing from one chlorophyll molecule to another, through the transference of an electron which can travel through the lattice.

Lycopene, a natural colouring matter belonging to the carotenoid series, when adsorbed on calcium hydroxide in a Tswett column, shows sometimes an additional brown band. This, L. Zechmeister and P. Tuzson suggest, is due to isomerization taking place when the solution (in benzene or light petroleum) is kept for a few days. Heating renders the isomerization more rapid, an equilibrium being apparently reached.

Research Items

Cave Paintings of Eastern Spain

PROF. H. OBERMAIER, in a review of the palæolithic art of eastern Spain (*L'Anthropologie*, 47, 5–6), reconsiders in the light of recent discovery the evidence bearing on its date, which once generally accepted as Pleistocene and Upper Palæolithic, has recently been assigned by certain archæologists to the Mesolithic period. Prof. Obermaier here argues for the Pleistocene dating. The caves with paintings are found in all the Mediterranean provinces extending southwards from Lerida through Tarragona, Teruel, Castellon, Cuenca, Albaceta, Murcia and Jaen. Though mostly maritime, some caves are situated at some distance from the sea in the mountainous interior. Albarracin (Teruel), for example, is 130 kilometres inland. The resemblance with the Franco-Cantabrian cave art of northern Spain, admittedly Pleistocene, is considerable, the most important difference being the prominence of the human form in eastern Spain, rare or absent in the north, and throwing a remarkable light on costume, weapons, etc., as well as on mode of life, warfare, and even belief. Apart from this resemblance, the argument for the age of the eastern paintings must depend upon the character of the animals which are depicted, The fauna of northern Spain is poorer than that of the cave art of France; reindeer, rhinoceros and mammoth are absent. In central, southern and eastern Spain, northern species do not appear at all, while the southern fauna had already disappeared. What remains are the species of general distribution, ibex, deer, horse, Bovidæ, boar, lynx, rabbit. The animal figures of the east are very much reduced in size, but for the most part are clearly to be distinguished, though some on this account are ambiguous in form. Nor were the painters always meticulously careful in detail; nevertheless it has been possible to identify a number of species with certainty, while other identifications are probable. None is domesticated, and all belong to a palæolithic fauna. Two further arguments are adduced: first the resemblance to the *art mobilier* of the cavern of Parpallo, Valencia, from proto-Solutrean and Solutrean levels, and secondly the relation of its schematic forms to the Azilian art in a line of descent in schematization.

Vitamin B_6 and Flavin Phosphoric Acid

A SHORT article in NATURE on December 18, 1937, p. 1070, summarized the present position with regard to the vitamin B_2 complex. It was there mentioned that 'vitamin B_2' is now regarded as a complex of three distinct factors—namely, (1) the pellagra-preventing (P.P.) factor, which cures pellagra in man, monkeys or pigs, and the so-called black-tongue of dogs; (2) lactoflavin (known as 'riboflavin' in the United States), which is needed for the growth and well-being of rats, and probably of many other species; and (3) vitamin B_6 (the so-called 'rat acrodynia', or 'rat pellagra' factor) which prevents certain characteristic skin lesions in rats. Work on the chemical characterization of these three constituents of the 'B_2 complex' has made rapid progress of late. Lactoflavin was already synthesized in the laboratory a year or more ago. In the issue of NATURE referred to, mention was made of the identification of the pellagra-preventing vitamin (or pro-vitamin) with nicotinic acid. The matter is now taken a step further by the recent announcement in the current issue of *Pflüg. Arch. ges. Physiol.*, by Karrer, Laszt and Verzár that vitamin B_6 deficiency in rats is cured by 'flavin phosphoric acid'. The close chemical relationship thus suggested between two constituents of the vitamin B_2 complex, vitamin B_6 and lactoflavin, raises many interesting points which will no doubt be the object of further study.

Pennatulacea of the John Murray Expedition

IN a recent report, Prof. Hickson describes several interesting forms although none is actually new to science (The John Murray Expedition 1933–34. Scientific Reports, 4, No. 5. The Pennatulacea, by Prof. Sydney J. Hickson, 1937). Numbers of certain species, hitherto only known from a single specimen, are present, providing material for the study of growth and variation, and in one case (*Umbellula huxleyi*) it is possible to prove that several previously described species are only growth stages or varieties of one widely distributed species. *Umbellula huxleyi*, like many others from the deep sea, is now shown to have a very wide geographical distribution, extending perhaps as far east in the Pacific Ocean as Hawaii. The remarkable *Chunella gracillima*, regarded previously as very rare, was found in great numbers in the Pemba Channel, where it was first discovered by the *Valdivia* Expedition. This was associated in both collections with *Funiculina quadrangularis*. The only other locality in which *Chunella gracillima* has been found is in the Bali Sea in the Malay Archipelago, where it is also associated with the only specimen of *Funiculina* obtained during the voyage of the *Siboga*. The sexual condition of all species wherever possible is noted.

Crabs from Singapore

No. 13 of the *Bulletin of the Raffles Museum*, Singapore, Straits Settlements (Aug. 1937), contains many papers of interest, two of which deal with the Brachyura: "Notes on a Collection of Swimming Crabs (Portunidæ) from Singapore" by Chià-Jui Shen, and "On the Crabs of the Family Ocypodidæ in the Collection of the Raffles Museum" by M. W. F. Tweedie, curator of the Museum. There are many swimming crabs in this region, but all belong to the sub-family Lupinæ, the groups Lupocycloida and Podophthalmoida each being represented by one species and the group Lupoida by twenty-six. It is shown that the Portunidæ are more abundantly represented in the warmer regions than in the cooler. This paper is illustrated by excellent figures of many of the species, and two new species of *Neptunus* are described. The material for the second paper was collected for the most part mainly in mangrove swamps around Singapore Island and on the east and west coasts of the Malay Peninsula. A key is given of the species (19 and one sub-species) of *Ilyoplax* and their geographical distribution, and there is one new species described. The new genus, *Pseudogelasimus*, closely related to *Ilyoplax*, is proposed for a single male specimen with peculiarly long eyes and associated broadening of the carapace and very unequal chelæ. A large number of other species belonging to other genera are described.

Genitalia of Orthopteroid Insects

No. 5 of vol. 96 of the Smithsonian Miscellaneous Collections (1937) is devoted to a comprehensive account of the male genitalia of orthopteroid insects, written by Mr. R. E. Snodgrass of the U.S. Bureau of Entomology. The author points out that the external genitalia in these insects are primarily phallic organs. Accessory parts or periphallic (clasping) organs are but little developed and when present they are, for the most part, secondary formations having no apparent relationship in the different groups. The true appendages of the ninth segment are, however, retained in many families as a pair of small styli which are carried on the hind margin of the 9th sternum. It is only in the Grylloblattidæ that these styli retain their bases or coxopodites (coxites): in all other families these basal elements are fused with the sternum. The median penis of Ephemeroptera and some Dermaptera is a different structure from that of the Orthoptera because it is clearly a product of the union of two separate penes, each containing an outlet duct. The median penis of Orthoptera, and probably of most pterygote insects, is not produced by the union of two primary organs, each containing part of a primitive lateral duct. The external and internal genitalia, and their homologies, are discussed in great detail in all the Orthopteroid orders and related groups. Mr. Snodgrass's account is accompanied by numerous original figures notable for their clarity and detail. At the end of the memoir there is a very full bibliography of the literature on the subjects concerned.

Photosynthesis of Coffee Leaves under Natural Conditions

F. J. NUTMAN has recently described a method of studying the carbon dioxide absorption by individual leaves under field conditions (*Ann. Bot.*, N.S., **50**, July 1937), and by the use of this method supplies evidence that these leaves assimilate more vigorously in shade than in full sunlight under tropical conditions in the northern province of Tanganyika Territory. The reasons for this behaviour are discussed; it is concluded that stomatal closure in direct sunlight is the most probable explanation and experimental evidence in support of this conclusion is promised in a subsequent communication. These conclusions have some general importance as Nutman has previously shown that the cause of a serious die-back disease of coffee in East Africa may be found in a shortage of carbohydrates.

'Brown Oak' Disease

MR. K. T. ST. G. CARTWRIGHT has investigated the cause of a brown rot of oak and sweet chestnut (*Trans. Brit. Mycol. Soc.*, **21**, Pts. 1 and 2, 68, Oct. 1937). The common beef-steak fungus, *Fistulina hepatica*, is responsible, and though it may cause little loss of strength in the early stages, a severe attack makes the wood very brittle. The decay does not continue in converted timber, and 'brown oak' is actually easier for the carpenter's work than normal wood. Growth of the fungus is most rapid at 25°–27° C., and the paper suggests that it may obtain its sugar from the breakdown of tannin; the brown material may be a degradation product of lignin and hemicelluloses. Full descriptions of the organism as it appears in wood and upon culture media are given, and two coloured plates aid in realistic portrayal.

Mounds of Arctic America

ALL travellers on the low coastal plain of northern Alaska between Point Barrow and the Mackenzie delta have noted the curious, isolated, more or less conical mounds that diversify the otherwise featureless plain. The Eskimos call such a mound a *pingo*. In a paper in the *Geographical Review* of January 1938, Mr. A. E. Porsild discusses the origin of these and other earth mounds in north-western America and Greenland. He agrees with E. de K. Leffingwell that the Alaskan mounds may be formed by hydraulic pressure. This type is old and shows no sign of recent movement. The freezing of the surface layers over previous unfrozen strata produced conditions favourable to artesian wells. Where downward freezing checked the subterranean seaward flow of water, hydraulic pressure forced upwards the surface layers. A second type of mound, common in the Mackenzie delta, is found in level country or near the border of a lake or former lake basin. This type ranges from a few feet to more than two hundred feet in height and averages 40–75 ft. They often show a median rupture sometimes enlarged to a 'crater' and a well-defined stratification conforming to the slope of the surface. Mr. Porsild suggests that these mounds are formed by local upheaval, due to expansion following downward freezing of a body of water enclosed between bed rock and frozen surface soil. The position of this type of mound supports the theory. When sedimentation fills a lake, freezing of the surface is sure to occur first, thus producing the necessary conditions for the subsequent elevation of the mound. Many of the mounds are in an advanced stage of destruction due to subaerial erosion: some contain small lakes.

Earthquakes of the Channel Islands

SEVEN years ago, Mr. A. E. Mourant issued a valuable catalogue of the earthquakes of the Channel Islands from 842 until 1931 (Société Jessiaise, 50 pp.). To this, he has recently added a supplement (*Trans. Soc. Guern.*, 12, 523–540; 1937) containing accounts of nineteen additional earthquakes from 1640 until 1935, the majority of which originated in centres near the Channel Islands. Of these centres, the one most frequently in action (especially in 1804, 1843 and 1926) is the Jersey focus, situated off the Cotentin coast opposite Jersey. Another important focus, connected with strong earthquakes in 1799 and 1843, lies beneath or near Guernsey. Mr. Mourant notices the interesting point that the occurrence of an earthquake in the Channel Islands tends to be associated with the approach of a depression after an interval of fine weather.

Trade and Counter-trade Winds

MANY interesting facts about the trade and counter-trade winds are revealed in a detailed analysis of eleven years of observations with pilot balloons at Kingston, Jamaica, that is given by S. Proud in Professional Note No. 78 of the Meteorological Office. The natural wind structure above the locally controlled surface wind consists of a layer of trade winds (which blow mainly from east and south-east) several kilometres thick, surmounted by a more shallow transitional layer of veering wind that leads to the counter-trade, which last is an extension southwards and upwards into the tropics of the westerlies of temperate latitudes. The gradient of temperature between the poles and the equator in the stratosphere, which is the reverse of that at the earth's surface, is such as to weaken and ultimately to reverse the westerlies at great heights above the tropopause. Such reversals were found on three occasions, one during the remarkable ascent to 26 km. (87,000 feet) of October 6, 1928, which showed south-easterly winds from 20 to 26 km. Apart from day to day variations in the wind structure, which are considerable, there is the well-marked annual oscillation from south to north and back again of the northern boundary of the trade winds at the surface in accordance with the varying declination of the sun but with a lag of about two months, which tends to cause a similar variation in the height at which the counter-trade is reached, this being much less in and around March than in September. The completeness of the reversal is, however, much greater from November until May than in other months. It is shown that the few occasions when the trade wind was absent at all heights were mostly when the main polar front was in the neighbourhood or when a hurricane was developing, generally to the north of Jamaica.

Photochemical Union of Hydrogen and Chlorine

A. J. Allmand, H. C. Craggs and G. V. V. Squire (*J. Chem. Soc.*, 1869; 1937) have carried out investigations on the above subject. In reactions at low pressures in the absence of oxygen the effect of light intensity (I) on the velocity was found to be proportional to I^n, where n varied over the range $0{\cdot}05 - 1$, the latter figure being found at low chlorine pressures, the values becoming lower as the light intensity and chlorine pressure were increased. At sufficiently high pressures, there was an intensity range in which $n = 0{\cdot}5$. The rate of reaction and quantum yield passed through a maximum as the chlorine pressure was increased. Intensive drying of a low-pressure mixture was not found to inhibit the reaction in light, the addition of small quantities of water vapour to the dried gases actually retarding the reaction somewhat. The results are explained by assuming the existence of the radical Cl_3. Reaction chains are terminated by disappearance of Cl and Cl_3 both on the walls and, without triple collisions, in the gas phase.

Solubilities of Citric and Tartaric Acids

SINCE the information on the solubilities of citric and tartaric acids in water was very incomplete, these properties have been reinvestigated by L. H. Dalman (*J. Amer. Chem. Soc.*, 59, 2547; 1937) who gives values from 0° to 100° for both acids. The solubility curve for tartaric acid is a straight line representing solutions in equilibrium with anhydrous tartaric acid, this line being represented by the equation $s = 51{\cdot}8573 + 0{\cdot}2643\,t$, where s is solubility in per cent by weight and t is temperature. The solubility curve for citric acid consists of two straight lines which intersect at 35·8°; below this temperature, citric acid monohydrate exists, whilst above it, anhydrous citric acid is the stable phase. The solubility curve for the monohydrate is represented by the equation $s = 48{\cdot}9559 + 0{\cdot}5231\,t$, and that for the anhydrous acid by $s = 57{\cdot}8564 + 0{\cdot}2616\,t$.

Improvements in Cinema Sound Reproduction

THE improvements in the quality of the sound reproduction in the cinemas of Great Britain has greatly increased since its inception ten years ago. In the chairman's address to the Radio Section of the Institution of Electrical Engineers given on November 3, these developments are broadly traced out and an indication is given of the trends of further research. The average human ear, it was stated, can appreciate sounds having frequencies lying between 16 and 20,000 cycles per second. The early equipments of 1928–30 had a frequency range lying between 100 to 4,000 C.P.S. and a power range of 30 'decibels'. At 1,000 C.P.S. a power range of 130 decibels can be appreciated lying between the threshold of audibility and maximum audibility. The difficulties of maintaining a recording power range of 30 decibels on the film led to serious alterations in the character of the recorded sound. Distortion was also introduced by the film propelling mechanism, which consisted of a gear-wheel and sprocket-tooth. A harsh and throaty reproduction was thus produced. The volume range of the film is expressed as the ratio of the amplitude of the maximum signal that can be recorded on the track to the amplitude of the background noise from the film itself. If the background level is 30 decibels below the maximum signal it is inaudible. The elimination of ground noise was the aim of the earlier inventors, and this led to considerable improvements. The extension of the frequency range of the amplifiers has been from 100–4,000 to 50–8,000. The loud speaker range has been extended to 30–8,000 and the harmonic distortion has been greatly reduced. The amplifiers and loudspeakers are now in an advanced state of development. Cinema acoustics are becoming better understood, but it is not yet possible to predict with confidence the overall characteristics of a well-tried equipment when installed in a new auditorium.

Comparison of Right Ascensions

W. W. H. GREAVES has recently issued a paper "A Comparison between the Right Ascensions of the Second Greenwich Catalogue of Stars for 1925·0 and of the FK3" (*Mon. Not. Roy. Astro. Soc.*, 98, 1, Nov. 1937). The systematic differences in right ascension between the Second Greenwich Catalogue for 1925·0 and the *Dritter Fundamentalkatalog des Berliner Astronomischen Jahrbuchs* (usually referred to as "FK3"), have been determined, and this complete systematic difference $\Delta\alpha$ is given by $\Delta\alpha = \Delta\alpha_a + \Delta\alpha_\delta$, the terms on the right-hand side being taken from tables. It has been found that the $\Delta\alpha_a$ values include periodic terms which involve the tangent of the declination, and it is suggested that this may be attributed to a periodic error in the determination of the azimuth of the Airy transit circle. In the previous Greenwich Catalogue, a similar effect was noticed, but opposite in phase. This change appears to be associated with a change in the system of determining azimuth. For the first catalogue, the azimuths were based on the observations of nine stars situated within 4° of the north pole, but when the second catalogue was commenced in 1922, the azimuth list was extended down to declination + 45°, and at present comprises 79 stars. This appears to have introduced a noticeable change in the periodic azimuthal term, but it is admitted that the precise instrumental origin of the change is obscure. It is suggested that a diurnal oscillation in azimuth with a seasonal change in its amplitude might be a possible contributory cause.

A Simplification of Maxwell's Equations in Conformity with the Flux-cutting Principle

By Dr. C. V. Drysdale, C.B., O.B.E.

DURING the last thirty years, the question as to whether electromagnetic induction is caused by the change or by the cutting of magnetic flux has been debated at intervals. Faraday's rotating disk experiment and the later experiments of Blondel[1] and of Messrs. Cramp and Norgrove[2], as well as Prof. H. A. Wilson's experiments with moving dielectrics[3], all appear definitely to favour the flux-cutting hypothesis; and Rowland's experiments with revolving electrostatically charged disks[4] indicated that a magnetic force is similarly induced by the cutting of an electric field. There seems little doubt that Faraday himself believed that electromagnetic induction was produced by the cutting of his magnetic "lines".

The four fundamental equations of Maxwell for a non-conducting dielectric medium:

$$\text{(i) } 4\pi D = \varepsilon E, \qquad \text{(iii) } -\operatorname{curl} E = \dot{B},$$
$$\text{(ii) } B = \mu H, \qquad \text{(iv) } \operatorname{curl} H = 4\pi\dot{D},$$

(where E and H are the electric and magnetic forces, D and B the corresponding displacement and induction; and ε and μ the dielectric constant and permeability of the medium, respectively) were avowedly intended to put Faraday's concepts into mathematical form; but the two latter equations are obviously based on the change of flux principle, as they give the line integrals of the electric or magnetic forces around unit area due to the rate of change of magnetic or electric flux through that area, and not the actual forces themselves. These two equations are not only difficult to comprehend and to visualize physically, but also they are difficult of application owing to the complex differential equations to which they give rise; and, if the flux-cutting principle is the true one, they are not completely fundamental.

It is easy to show that a simple transformation of the Maxwellian equations divests them of all complexity and harmonizes them with the flux-cutting principle. For if we write $j\frac{\partial}{\partial x}$ for curl, equation (iii) becomes

$$-j\frac{\partial E}{\partial x} = \frac{\partial B}{\partial t} = \frac{\partial B}{\partial x}\frac{dx}{dt} = V\frac{\partial B}{\partial x},$$

from which $E = jVB$, if $E = 0$ when $V = 0$. This is equivalent to the dynamo designer's formula E.M.F. = lVB for the electromotive force in a conductor of length l moving transversely with velocity V across a magnetic field B, since the electric force E is the electromotive force per unit length. The quadrantal versor $j = \sqrt{-1}$ simply implies that the electric force is perpendicular to the plane containing the motion and magnetic flux, and does not affect its magnitude.

Similar treatment of equation (iv) gives us $H = -j4\pi VD$, which is obviously proportional to the rate of cutting the electrostatic flux and is in accordance with the results of Rowland's experiments; and if we harmonize the electrostatic and magnetic units by writing J for $4\pi D$, which implies 4π electrostatic "lines" of induction per unit charge, in conformity with 4π magnetic lines per unit pole, Maxwell's equations become:

$$\text{(i) } J = \varepsilon E, \qquad \text{(iii) } E = jVB,$$
$$\text{(ii) } B = \mu H, \qquad \text{(iv) } H = -jVJ,$$

for an isotropic dielectric medium moving with velocity V, or:

$$\text{(ia) } J = \varepsilon E, \qquad \text{(iiia) } E = -jVB,$$
$$\text{(iia) } B = \mu H, \qquad \text{(iva) } H = jVJ,$$

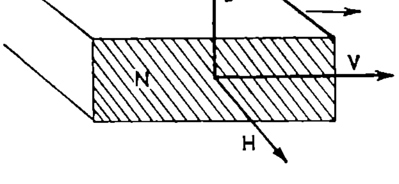
for a stationary isotropic dielectric and moving fields. The change of sign in the last two equations is equivalent to the change from the 'right hand' to the 'left hand' rule in changing from moving armature to moving field machines.

These equations are all of the same simple linear form, and are easily grasped, memorized and handled, since the last two may be summed up as:

Induced $\left\{\begin{matrix}\text{electric}\\ \text{magnetic}\end{matrix}\right\}$ force is equal to the rate of cutting $\left\{\begin{matrix}\text{magnetic}\\ \text{electric}\end{matrix}\right\}$ lines.

APPLICATIONS TO ELECTROMAGNETIC WAVE PROPAGATION

A few applications to the theory of electromagnetic wave propagation will serve to show their convenience. Combining (iia) and (iiia), we have $E = -j\mu VH$: and combining (ia) and (iva), $H = j\varepsilon VE$. If we suppose the north pole of a magnet moving transversely through an isotropic non-conducting medium with velocity V, as shown in the accompanying diagram, its magnetic force H will be directed horizontally forward, and according to the first of these combined equations, it will induce an electric force in the medium, $E = -j\mu VH$, directed vertically upwards. By the second combined equation, this electric force will in turn induce a magnetic force $H^1 = j\varepsilon VE = \varepsilon\mu V^2H$, since $j^2 = -1$, so that H^1 will be in the same direction as H, and will therefore tend to strengthen the magnet, just as a capacitance load on an alternator causes a rise of E.M.F. by strengthening its magnetic field. The transverse motion of the magnet therefore produces a forced electromagnetic disturbance or wave in the medium, and as the velocity of the magnet is increased the



magnetic and electric fields will increase, unless H is diminished to $H - H^1 = (1 - \varepsilon\mu V^2)H$, as an engineer reduces the excitation of an alternator to prevent the rise of voltage with a leading current. When $\varepsilon\mu V^2 = 1$, or $V = 1/\sqrt{\varepsilon\mu}$, therefore, H should be reduced to zero, or the magnet may be withdrawn, and the forced electromagnetic wave will persist as a free one in which E and H are maintained by their reciprocal inductive interactions, and it will travel forward unchanged with the velocity $V = 1/\sqrt{\varepsilon\mu}$, which is Maxwell's expression for the velocity of propagation of electromagnetic waves, including light. Since $E = -j\mu VH$, and $V = 1/\sqrt{\varepsilon\mu}$, $E = -j\sqrt{\mu/\varepsilon}\,.\,H$: so that as ε and μ are constants for all dielectric media, E and H must have a constant ratio and hence have the same wave-form and phase.

The formula $E = -jVB = -j\mu VH$, which represents the rate of cutting magnetic lines, is already familiar to scientific and technical students, but the corresponding formula $H = jVJ = j\varepsilon VE$, which represents the rate of cutting electric lines, is not; so that it may be well to show that it is in conformity with known elementary principles. A vertical electric force E in a dielectric medium produces an upward electrical displacement D such that $4\pi D = \varepsilon E$, so that if we consider the magnetic field H as stationary while the medium is flowing past it with velocity V in the opposite sense, the effect of this displacement will be that of two horizontal surfaces, an upper one charged with surface density $+D$, and a lower one charged with density $-D$, both moving with the medium from right to left. The upper surface will be equivalent to a current sheet of intensity VD per unit breadth flowing from right to left, and the lower to a similar current sheet flowing in the opposite sense since it is negatively charged; so that the total effect will be that of a current sheet or solenoid of intensity VD per unit length circulating round the region of electric displacement in a counter-clockwise direction, which must produce a magnetic force H in that region equal to $4\pi VD = \varepsilon VE$ and directed horizontally forward, and hence $H = -j\varepsilon VE = -jVJ$, the negative sign being due to our dealing in this case with a moving medium instead of moving fields. Since for a moving medium $E = jVB = j\mu VH = \varepsilon\mu V^2E$, E and H will be mutually maintained when the velocity of the medium $V = 1/\sqrt{\varepsilon\mu}$, so that if an electromagnetic disturbance is once started, it will persist unchanged in magnitude and position and will therefore be travelling with the velocity $1/\sqrt{\varepsilon\mu}$ relatively to the moving medium. This is analogous to Prof. P. G. Tait's well-known simple demonstration of the propagation of transverse waves along stretched cords or belts.

Crystalline Media. The above equations apply for all isotropic non-conducting dielectrics, but in crystalline media ε varies with the orientation of E, so that the direction of D or J is not in general identical with that of E or perpendicular to the plane of B and V; and as it is only the component of J perpendicular to V which is concerned in the cutting and the induction of H, we must write $H = jVJ \sin\theta$, or $[VJ]$, where θ is the angle between J and V, and the square brackets imply the vector product of V and J. Similarly we may write $E = -[VB]$, but since the permeability of dielectric media does not differ materially in any direction from that of space, B is simply μH and is always in the direction of H and perpendicular to V, so that we may write $E = -jVB$ or $-[VB]$ as we prefer. Hence the fundamental equations for all dielectric media are:

$J_1 = \varepsilon_1 E_1$ etc., $B = \mu H$, $E = -[VB]$, and $H = [VJ]$, which lead to the following six simple algebraical equations:

$$\begin{aligned}
E_1 &= V_3B_2 - V_2B_3 = \mu(V_3H_2 - V_2H_3)\\
E_2 &= V_1B_3 - V_3B_1 = \mu(V_1H_3 - V_3H_1)\\
E_3 &= V_2B_1 - V_1B_2 = \mu(V_2H_1 - V_1H_2)\\
H_1 &= V_2J_3 - V_3J_2 = \varepsilon_3V_2E_3 - \varepsilon_2V_3E_2\\
H_2 &= V_3J_1 - V_1J_3 = \varepsilon_1V_3E_1 - \varepsilon_3V_1E_3\\
H_3 &= V_1J_2 - V_2J_1 = \varepsilon_2V_1E_2 - \varepsilon_1V_2E_1
\end{aligned}$$

where the suffixes imply the components in the three axes of the crystal.

Combining these we have:

$$\begin{aligned}
\{1-\varepsilon_1\mu(V_2^2+V_3^2)\}\,E_1+\varepsilon_2\mu V_1V_2E_2+\varepsilon_3\mu V_1V_3E_3 &= 0\\
\{1-\varepsilon_2\mu(V_1^2+V_3^2)\}\,E_2+\varepsilon_3\mu V_2V_3E_3+\varepsilon_1\mu V_1V_2E_1 &= 0\\
\{1-\varepsilon_3\mu(V_1^2+V_2^2)\}\,E_3+\varepsilon_1\mu V_1V_3E_1+\varepsilon_2\mu V_2V_3E_2 &= 0
\end{aligned}$$

Hence if the propagation is along axis 1, $E = 0$, $(1 - \varepsilon_2\mu V_1^2)E_2 = 0$, and $(1 - \varepsilon_3\mu V_1^2)E_3 = 0$, which show that the components E_2 and E_3 travel with the velocities $1/\sqrt{\varepsilon_2\mu}$ and $1/\sqrt{\varepsilon_3\mu}$ respectively, so that they must be regarded as separate waves polarized in perpendicular planes. Similarly for propagation along axes 2 and 3, and hence the wave surface must have two sheets intersecting the three axes at radii a and b, a and c, and b and c respectively, where $a = 1/\sqrt{\varepsilon_1\mu}$, $b = 1/\sqrt{\varepsilon_2\mu}$, and $c = 1/\sqrt{\varepsilon_3\mu}$.

It should be noted that since the directions of J and E are not in general the same, the wave cannot be self-maintained unless E, J and V are coplanar, as if J is deviated out of the plane EV, $H = [VJ]$ must be perpendicular to the plane JV and the induced electric force $E_1 = -\mu[VH]$ will be in the plane JV instead of the plane EV and cannot be coincident with E for any value of V. But for any direction of E there will be a plane containing E and J, so that if V is in this plane and perpendicular to E, the induced electric force will be identical with E for a certain value of V, and hence a plane polarized beam can be transmitted in that plane. For E, J and V to be coplanar the scalar product $(EJV) = (\varepsilon_3 - \varepsilon_2)E_2E_3V_1 + (\varepsilon_1 - \varepsilon_3)E_1E_3V_2 + (\varepsilon_2 - \varepsilon_1)E_1E_2V_3$ must be zero, and it is easy to show that this condition can always be satisfied for two perpendicular planes. Hence for any direction of propagation the electric force will be resolved into two perpendicular components both of which will be self-maintaining or transmitted, but in general with different velocities, so that the medium will be doubly refracting and the two components will be plane polarized in perpendicular planes.

Semi-Conducting Dielectrics. In such media an electric force E produces a steady current of density $\dot{D} = \dot{J}/4\pi = gE$, where g is the conductivity, in addition to $J = \varepsilon E$, and hence $J = \varepsilon E + 4\pi g\underset{\cdot}{E}$, where $\underset{\cdot}{E} = \int E dt$. Hence for all isopic semi-conducting media:

$$J = \varepsilon E + 4\pi g\underset{\cdot}{E},\ B = \mu H,\ E = -jVB, \text{ and } H = jVJ,$$

and the induced electric force $E^1 = \mu V^2(\varepsilon E + 4\pi g\underset{\cdot}{E})$, which must balance the impressed electric force E for a self-maintained wave. But the power dissipated in the conductance causes an attenuation or reduction of E as the wave travels forward, and since the displacement of the dissociated ions depends on the previous variations of the electric force, we shall only obtain the steady periodic condition by differentiating twice with respect to time, and writing $\frac{d^2E^1}{dt^2} = \mu V^2(\varepsilon E + 4\pi gE)$. The variations on the right-hand side depend simply upon the changes of E with time, irrespective of the motion of the wave in space, but the induced electric force E^1 is caused by the cutting due to the motion and we must therefore write

$$\frac{dE^1}{dt} = \frac{\partial E^1}{\partial x}\frac{dx}{dt} = V\frac{\partial E^1}{\partial x}, \text{ and } \frac{d^2E^1}{dt^2} = V^2\frac{\partial^2E^1}{\partial t^2},$$

which gives us $\frac{\partial^2E}{\partial x^2} = \varepsilon\mu\frac{\partial^2E}{\partial t^2} + 4\pi g\mu\frac{\partial E}{\partial t}$ for a self-maintained wave.

This relation arises directly from the Maxwellian equations, but the above treatment is not only more simple but also gives a clear idea of the physical processes involved, and it directs attention to the question of the actual displacement of the dissociated ions which may give rise to transients.

Lorentz Theory of Moving Media. According to the ionic constitution of matter, the absolute dielectric constant of a medium is $\varepsilon_0 + \varepsilon_i$, where ε_0 is the absolute dielectric constant of space, and ε_i that due to the displacement of the ions, which is equal to $4\pi\Sigma\frac{Ne^2}{K-m\omega^2+jb\omega}$, where N is the number of ions of charge e, mass m, coupling constant k, and damping coefficient b per unit volume, for a sinusoidal disturbance for which ω is 2π times the frequency; and this in conjunction with the above equations leads to Drude's theory of dispersion. But if the medium is moving and carrying the ions along with it with a velocity v in the direction of propagation, an electromagnetic disturbance travelling with velocity V only travels with velocity $V - v$ relatively to the ions. The conditions are therefore similar to those in an induction motor in which the revolving field cuts the stationary stator bars with a velocity V and the revolving rotor bars with velocity $V - v$, the former being represented by the stationary ether between the ions, and the latter by the moving ions. If a magnetic field H is moving with velocity V through the medium, it will induce an electric force $E_0 = -j\mu VH$ acting on the stationary ether, and $E_i = -j\mu(V - v)H$ acting on the ions; and hence $J_0 = -j\varepsilon_0\mu VH$, and $J_i = -j\varepsilon_i\mu(V - v)H$. These electric inductions will in turn induce magnetic forces $H_0 = jVJ_0 = \varepsilon_0\mu V^2H$ in the ether and $H_i = \varepsilon_i\mu(V - v)^2H$ due to the ions, so that the total induced magnetic force will be $H^1 = H_0 + H_i = \mu\{\varepsilon_0V^2 + \varepsilon_i(V - v)^2\}H$, and the wave will be self-maintaining if $H^1 = H$, or $\varepsilon_0\mu\{V^2 + \frac{\varepsilon_i}{\varepsilon_0}(V - v)^2\} = 1$.

But $\frac{\varepsilon_0 + \varepsilon_i}{\varepsilon_0} = 1 + \frac{\varepsilon_i}{\varepsilon_0}$ is the ordinary relative or measured dielectric constant of the medium $\varepsilon = n^2$, where n is the refractive index of the medium for the frequency of the disturbance, and hence $\varepsilon_i/\varepsilon_0 = n^2 - 1$ and $V^2 + (n^2 - 1)(V - v)^2 = 1/(\varepsilon_0\mu) = c^2$, where c is the velocity of propagation in space.

To the first order of $v/V = nv/c$, this gives us:

$$V = \frac{c}{n} + \frac{n^2 - 1}{n^2}v,$$

if the source is moving with the medium, or

$$V = \frac{c}{n} + \left(\frac{n^2 - 1}{n^2} - \frac{\lambda}{n}\frac{\partial n}{\partial\lambda}\right)v$$

for a stationary source and moving medium.

These are Lorentz's relations for the propagation of electromagnetic waves through moving dispersive media, which have been confirmed by the moving-water experiments of Zeeman and give a theoretical basis for the Fresnel drag coefficient $(n^2 - 1)/n^2$.

The above applications will suffice to show that these simple equations lead to results which are in agreement with those derived from the Maxwellian equations, and their simplicity and fundamental correctness of principle may lead to useful extensions, especially as they focus attention on the physical interactions involved. For closed circuits of rigid conformation where we are concerned only with the total induced electromotive force, the ordinary rate-of-change or 'transformer' formula $E = -\partial N/\partial t$ is correct and more convenient, and even for deformable circuits I have shown[5] from energy considerations that the most convenient general formulæ for calculating the force or torque in such systems are $f = \frac{1}{2}i^2\frac{\partial L}{\partial x}$ or $T = \frac{1}{2}i^2\frac{\partial L}{\partial\theta}$, where f is the force, T the torque, and L the inductance of the circuit; but it seems to be proved beyond doubt that electric and magnetic forces can only be induced by the cutting of magnetic or electrostatic fields, so that even in closed circuits it appears that any change of flux must involve the actual cutting of magnetic or electrostatic "lines", although it may be difficult to visualize the process in many cases. The simplified Maxwellian equations, based on the flux-cutting or 'dynamo' principle, appear to be the fundamentally correct ones; and, as they are much more simple to handle and comprehend in dealing with radiation problems, it would seem that they should be adopted.

SUMMARY

Faraday's rotating disk experiment and the later experiments of Blondel, Cramp and Norgrove, and H. A. Wilson all indicate that magneto-electric induction is caused by the cutting of a magnetic field rather than by its rate of change; and Rowland's experiments with rotating electrostatically charged disks similarly indicate that a magnetic force is induced by the cutting of an electrostatic field. The fundamental Maxwellian equations are based on the change of flux principle, but it is here shown that a simple transformation of these equations brings them into harmony with the flux-cutting principle and reduces them to four simple algebraic or vector equations which enable radiation problems to be treated with great simplicity and easy grasp of the physical processes involved. Application of these equations to the propagation of electromagnetic waves in isotropic and crystalline dielectrics and in semi-conducting and moving media show that they lead to the same results as the Maxwellian equations.

Comptes rendus, 159, 674–679 (1914). *Electrician*, 75, 341 (1915).

[2] *J Inst. Elect Eng.*, 78, No. 472, 481 (April 1936).

[3] *Phil Trans Roy. Soc.*, A, 204, 121 (1905).

[4] *Phil Mag.*, (v), 27, No 169 (June 1889).

[5] *J. Sci. Instruments*, 9, 209–216 (1932). *J. Inst. Elect. Eng*, 72 365–384 (1933)

Food of the Herring*

TWO researches on food of adult herring have recently been published. It is interesting to compare the results, although Savage's work covers March–October only, chiefly May–August, and Jespersen's was continued throughout the year. The period covered is the same, from 1931 until 1934 and 1935. In 1931 the herring fishery at Bornholm was very poor in both number and size of fish and it was found that those feeding were remarkably few in number, a fact probably correlated with the scarcity of food, especially copepods. Off Shields and in the northern North Sea, however, the year 1931 was a rich feeding year, due almost entirely to the abundance of *Calanus*. Although *Calanus* is such an important herring food in many regions it is not present at Bornholm (the low salinity accounting for its absence), the chief copepods being *Pseudocalanus elongatus*, eaten during the first half of the year, and *Temora longicornis* and *Eurytemora hirundoides* (taken together), on the whole even more important, eaten throughout the year, but especially in the winter half.

Copepods form the main food of the herring in both districts. There is little feeding during the great East Anglian autumn fishery and in the Bornholm herrings it is lowest in August-October, in and just after the spawning season. In both districts it is highest in spring and early summer and the main food consists of copepods, but *Oikopleura* occupies an important position in some years as food in the North Sea and is not present at all in Bornholm. *Ammodytes*, however, was frequently eaten both at Bornholm and off Shields although absent from farther north. Whereas, however, it is eaten chiefly in winter and early spring at Bornholm it seems to be eaten indiscriminately at other times of year at Shields. In fact, there is a more marked difference in the seasonal food at Bornholm than in the North Sea with the exception of the all-important *Calanus*, the maximum of which is in all years in May.

In the Bornholm herring in spring the food is principally copepods and young fish, in summer principally copepods and cladocerans, in autumn copepods and in some degree cladocerans, in winter, besides copepods, chiefly larger crustaceans. In the North Sea the principal food, varying in different years, is *Calanus* in spring and summer, *Temora longicornis* in late summer, *Oikopleura* usually in spring and early summer, whilst other copepods, cladocerans and larger organisms, such as *Sagitta*, Crustacea and *Ammodytes* occur at different times, varying in different years. The curve shows a maximum of food, due to *Calanus*, in May, and a characteristic smaller secondary peak at the end of August and beginning of September due to decapod larvæ, *Oikopleura*, *Sagitta*, Schizopods, *Limacina* or Amphipods, *Temora* and, occasionally, *Calanus*.

Calanus was the principal item in the food of the Shields herring and the date and size of its maximum in the plankton appeared to have a close relation with the appearance and size of the shoals, an early maximum being associated with abundant herring and a late maximum with poor catches.

It is an interesting fact that the 1931 year-class of herring, that is to say those fish spawned after the rich feeding of that year, has been a very poor one since it entered the shoals as three-year-old fish in 1934; on the other hand, the fish spawned after the poor feeding of 1932 have proved to be a very rich year class.

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* Meddelelser fra Kommissionen for Danmarks Fiskeri og Havundersøgelser. Serie Plankton, Bind 3, Nr 2: The Food of the Herring in the Waters round Bornholm. By P. Jespersen. Pp. 40. (København: C. A. Reitzels Forlag, 1936.) 2.40 kr. Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol 15, No 5. The Food of the North Sea Herring, 1930-1934. By R. E. Savage. Pp 60. (London · H.M. Stationery Office, 1937) 3*s.* net.

Malnutrition and Maternal Mortality

SINCE 1934, the National Birthday Trust Fund has been engaged in an attempt to reduce the high maternal mortality rates which prevail in most of the 'special areas', and some interesting results have been obtained in the last two years. A general outline of the schemes which have been applied in Glamorgan, Monmouth and Durham and the results obtained are described by Lady Williams in *Public Health* (50, 231, and 51, 59; 1937).

The schemes involved additional medical facilities with or without a distribution of free foodstuffs to necessitous mothers. The additional food comprised one pint of milk daily (from the local authority) with Ovaltine and Marmite from the National Birthday Trust Fund, and either Brandox Essence of Beef or Dorsella dried milk. Analysis of the results shows that whereas increased medical facilities alone produced a definite reduction in the puerperal death-rate—to about one third– from 'other causes', the death-rate from 'sepsis' was less affected. On the other hand, in the groups receiving the extra food a remarkable reduction in the puerperal death-rate from 'sepsis' was observed.

In two and a half years, extra food was supplied to 10,384 expectant mothers: the puerperal death-rate per 1,000 total births was 1·63, being 0·09 from sepsis and 1·54 from other causes. Among 18,854 other cases in the same areas during this period, the puerperal death-rate has been 6·15, being 2·91 from sepsis and 3·24 from other causes. In the preceding seven years, the rate in these districts was 5·63. In the first six months of this year the stillbirth and neo-natal death-rate among the assisted mothers has been approximately half that among cases in the same areas that were not assisted with extra food.

The evidence adduced by Lady Williams suggests strongly that it is the extra food which is responsible for the reduction in the mortality rates: the constituent or constituents have yet to be determined. Since the beef essence and dried milk were not given in all areas, and yet in all areas, among mothers assisted with extra food, the reduction in the mortality rates was observed it appears that the good results must be attributed to the milk, Ovaltine or Marmite.

It is considered that the amount of extra food given was not sufficient, in all probability, to make the diet of the poorest group of mothers who were assisted, more than equal in *quantity* to that of the better-off groups, which did not receive the extra food and acted as controls to the first group. The additional medical facilities, where provided, were available to all groups without regard to income.

It appears, therefore, that the reduction in the maternal mortality rates must probably be due to the *quality* of the extra foods supplied, rather than their *quantity*. The administration of the schemes has now been handed over by the National Birthday Trust Fund to the Research Committee of the Joint Council of Midwifery, by whom further reports will be issued when the results are available.

University Events

CAMBRIDGE.—The Rockefeller Foundation is providing the University with up to £8,000 towards the support of research in the Department of Experimental Medicine over the five-year period, January 1, 1938–December 31, 1942. The funds will be used for the salaries of a pathologist and a psychiatrist, and for supplementing the amount which the radiologist receives from Addenbrooke's Hospital.

N. F. M. Henny, of St. John's College, has been appointed University demonstrator in mineralogy and petrology.

Dr. A. H. Evans has offered to the University his collection of birds' eggs, of which the Director of the Museum writes: "This collection is practically a complete series of the eggs of British birds, and Dr. Evans has spent much time over many years in perfecting it."

The Michael Perkins Prize is awarded to I. L. Mason, of Pembroke College, for his essay entitled "Hot-spring Animals and their Adaptation to Supernormal Temperatures".

M. C. Burkitt, of Trinity College, T. T. Paterson, of Trinity College, and Dr. E. J. Lindgren, of Newnham College, have been appointed delegates to the Second International Congress of Anthropological and Ethnological Sciences, to be held in Copenhagen on August 1–6.

The Board of Management of the Frank Edward Elmore Fund will shortly proceed to the award of a studentship for research in medicine. The studentships are open to male graduates of any university who were born in any country within the British Empire other than Scotland. The student appointed will work in the Department of Medicine in the University, under the direction of the regius professor of physic. The commencing salary will be £300 a year, and the appointment will be for two years in the first instance. Further information may be obtained from the Regius Professor of Physic, Department of Medicine, University of Cambridge, to whom applications should be sent not later than February 28, 1938.

LONDON.—The title of reader in entomology in the University has been conferred on Dr. O. W. Richards, in respect of his post held at the Imperial College—Royal College of Science.

The following doctorates have been conferred: D.Sc. (Economics) on S. J. Madge, an internal student, of the London School of Economics; D.Sc. in botany on F. T. Bennett, an external student; D.Sc. in physics on C. E. Wynn-Williams, an external student.

Science News a Century Ago

The Royal Astronomical Society

IN the report of the Council read at the anniversary meeting of the Royal Astronomical Society on February 9, 1838, it was stated that the printing of the observations made at the Cape of Good Hope by Henderson on the declination of the principal stars and those made by Maclear relative to the reappearance of Halley's comet after its perihelion passage, had been done at the expense of the Government, "an evidence of the encouragement which the Government was disposed to give to science when favourable opportunities presented themselves". The Government had also granted £500 towards the repetition of the Cavendish experiment for determining the density of the earth. A eulogium was passed on the conduct of the British Association for the appropriation of £1,000 towards the improvement and reduction of astronomical catalogues. The report also referred to the arrival of the astronomical and pendulum observations made by the late Lieut. Murphy, during the voyage under Colonel Chesney down the Euphrates, the reduction of which had been undertaken by Sheepshanks and Baily. In conclusion, the Council congratulated the meeting on the flourishing state of the Society and expressed a hope that the same activity and unity of action would continue to influence and pervade their future proceedings. The president at this time was Francis Baily.

Structure of Shells

ON February 9, 1838, John Edward Gray (1800–75) assistant zoological keeper at the British Museum, lectured at the Royal Institution on "The Development, Growth and Structure of Shells". In the course of his lecture he said that the most simple form of crystalline structure is shown in the *Pinnæ* and a few other shells, where the calcareous particles, as they are deposited on the inner surface of the shell, assume a prismatic crystalline form, the crystals being perpendicular to the surface of the shell and extending from surface to surface, except where they are interrupted by any temporary suspensions of the growth of the animal. The most common form of crystalline structure which is found in most univalve shells is far more complicated, and exhibits one of the most beautiful examples of the extremely simple means by which Nature provides for the protection of her creatures. If man, he said, had but observed the process pursued by Nature in the formation of these shells, she would have taught him hundreds of years ago to combine strength with buoyancy in the perfection of naval architecture, instead of leaving it to be a modern discovery. Shells of this structure are formed of three concentric coats closely adhering together.

Biot's Experiments on Tartaric Acid

"M. BIOT has been making some important experiments and observations concerning the effect produced in rays of polarized light by different solutions of tartaric acid, either purely aqueous or combined with other bodies, which combinations alter the rays. The object of these experiments is to establish the laws of each combination, and the learned professor is still devoting his attention to the subject, in the hope of completing the system." (*Athenæum*, Feb. 10, 1838.)

Societies and Academies

London

The Royal Society, January 27.

E. Glückauf and F. A. Paneth: Identification and measurement of helium formed in beryllium by gamma rays. While it has been known for some time that the beryllium nucleus, irradiated by γ-rays, emits neutrons, it could not be decided whether the nucleus is thereby transformed into a stable isotope of beryllium of mass eight, or into two helium atoms. By a micro-chemical method, helium was detected in beryllium after irradiation by the γ-rays of radon. In one of the experiments, the number of neutrons simultaneously emitted during the irradiation was determined by measuring the helium produced by these neutrons in methyl borate; a comparison of the two helium quantities showed that the main final product of the γ-irradiation of beryllium is helium and not the beryllium isotope.

J. W. J. Fay, E. Glückauf and F. A. Paneth: Occurrence of helium in beryls. Various specimens of old beryllium metal have been analysed for helium. As the method employed, in spite of its sensitivity, failed to detect any traces of helium, it must be concluded that the spontaneous production of helium in beryllium is less than $1 \cdot 3 \times 10^{-11}$ c.c. of helium per gram beryllium per year. From this figure it follows that the helium content of beryls cannot be explained as a consequence of the spontaneous disintegration of a beryllium isotope of mass eight. In recent years, the helium content of beryls has been attributed to the influence of γ-rays from radioactive minerals in the neighbourhood of the beryls, and to cosmic radiation. From the figures, however, of the preceding paper about the amount of helium produced in beryllium by γ-rays, it follows that the influence of the natural sources of γ-radiation is not nearly sufficient to explain the helium content of beryls. Since, therefore, beryllium does not produce adequate amounts of helium, either under the influence of external radiation or as a consequence of spontaneous disintegration, it seems that the helium content of beryl is not connected with its beryllium content but is due to some other chemical element.

Moscow

Academy of Sciences (*C.R.*, 17, No. 3, 1937).

V. Gantmakher and V. Šmuljan: The linear spaces having a feebly compact unitary sphere.

V. Antonov-Romanovskij: Quantitative data on the decrease of phosphorescence of Zn-phosphorus at different temperatures.

F. S. Baryšanskaja: Studies on fluorescence in a layer of a thickness comparable to the wave-length.

L. I. Beljajev: Colloidal formations and electrophoretic phenomena on metals.

L. V. Nikitin: The electro-chemical method of the study of mechanical deformation of metals.

M. A. Iljinskij and E. S. Pokrovskaja: The oxidation of anthracene and methylanthracene by chromic acid and by diluted nitric acid.

M. A. Iljinskij and P. B. Rošal: (1) Determination of carbazole by way of methylol-derivate. (2) Determination of phenanthrene.

J. V. Grečnyj: Composition and nature of organic substances from gas-bearing clays of the Melitopol territory.

O. S. Vialov: The palæogene of the Tadjik depression.

B. A. Rubin and E. V. Arcikhovskaja: Relation between oxidation and hydrolysis in a living cell.

F. V. Čirikov: Availability of soil phosphates for the plant.

R. Kh. Tureckaja: Influence of heteroauxin on root formation in perennial plants.

A. A. Isakova: (1) A study of the effect of microbial bacteriorhizal complexes on root formation in different plants. (2) Effect of bacteriorhizal complexes on the development of the sugar beet.

A. A. Mirzajan: Digestion stages in *Phlebotomus papatasii* Scop.

A. A. Voitkevič: Morphogenetic activity of different parts of the hypophysis. (8) The influence of the anterior lobes of the hypophysis on the thyroid and the formation of feathers in pigeons.

Vienna

Academy of Sciences, December 2.

Elisabeth M. Przibram: Spot method for the macroscopic analysis of very small quantities of liquid. The liquid to be tested is sucked up by a cotton thread. This is then dabbed on a paper which has been treated by a reagent and dried. Many tests can be made with the liquid in a single thread.

A. Stift: Transformation of dysplastically and heteroplastically transplanted hollow bones in amphibians (*Molge cristata* Laur., *Salamandra maculosa* L. and *Rana esculenta* L.).

A. Stock: Homœosis and speed of regeneration in *Dixippus morosus* Br. et Redt. and in other insects.

K. Tzonis: Electro-meta-narcosis of fish. The duration of the period of paralysis following the passage of a current through the fish is determined for different species.

E. Zeif: Role of the organs of sight and touch and of the blood stream in the colour changes of the tree frog (*Hyla arborea* L.).

K. Graff: Visual colour excesses of bright stars in the region of Cassiopeia.

E. Wegemann: Solubility of radium emanation in fats. Data are given for vacuum greases and for animal fats.

G. Heinrich: Occurrence of discontinuities in the flow of liquids in tubes. There is a discontinuity in the pressure gradient along the outflow pipe of a water-jet pump. This occurs where the jet suddenly expands to fill the whole width of the tube. The stability of the discontinuity is examined theoretically.

O. Pesta: Ponds in the Kelch Alp region at Kitzbühel in the Tyrol.

A. Zahorka and K. Weimann: Velocity of hydrolysis of vinyl ethyl ether.

E. Abel and F. Fabian: Kinetics of halogenate-halide reactions in heavy water.

December 9.

Hertha Pertz: Radioactivity of thermal spring waters.

W. Fleischmann and Susanne Kann: Test for thyreotropic hormone. The action of thyreotropic hormone on the thyroid gland of the guinea pig is made clearer by injecting colchicine.

K. Zalesky: A new sub-species of *Sorex araneus* L. from the Dutch island of Terschelling in the North Sea.

Forthcoming Events

Monday, February 7

SOCIETY OF ENGINEERS (in the rooms of the Geological Society, Burlington House, W.1), at 6.—H. Bentham: Presidential Address.

Wednesday, February 9

ROYAL SOCIETY OF ARTS, at 8.15.—J. Roberts: "The Search for Oil".

Thursday, February 10

ROYAL SOCIETY, at 4.30.—Sir Joseph Barcroft, F.R.S., and D. H. Barron: Film illustrating "The Development of Movement in the Fœtus of the Sheep."

Friday, February 11

ASSOCIATION OF APPLIED BIOLOGISTS (in the Metallurgical Theatre, Royal School of Mines, South Kensington, S.W.5), at 2.30.—Annual General Meeting.

Dr. J. Henderson Smith: "Some Recent Developments in Virus Research".

ROYAL INSTITUTION, at 9.—The Most Rev. William Temple: "Truth in Science, Poetry and Religion".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ENGINEER (grade II) in the Station Design and Installation Department of the B B C—The Engineering Establishment Officer, Broadcasting House, Portland Place, W.1 (February 7).

SCIENTIFIC OFFICER (ref. C.3—radio and line communication), JUNIOR SCIENTIFIC OFFICERS (ref. C.4—physics, electrical engineering or mathematics), ASSISTANT (grade 1, ref. C.5—physics or electrical engineering), ASSISTANT (grade II, ref. C.6—physics or electrical engineering), ASSISTANT (grade III, ref. 7—physics or engineering), at the Bawdsey Research Station, Woodbridge, Suffolk—The Superintendent, Bawdsey Research Station, Bawdsey Manor, Woodbridge, Suffolk (February 12).

ASSISTANT LECTURER IN CHEMISTRY (organic) in University College, Southampton—The Registrar (February 19).

UNIVERSITY READER IN EMBRYOLOGY in University College, London—The Academic Registrar, University of London, W.C.1 (March 4).

AGRICULTURAL CHEMIST in the Tea Scientific Department, Devarashola P.O., Nilgiris—The Secretary, South Indian Association in London, 29 Mincing Lane, E.C.3.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Thirty-fifth Annual Report, 1936–1937, of the Imperial Cancer Research Fund. Pp. 48. (London: Imperial Cancer Research Fund.) [61

Technical Publications of the International Tin Research and Development Council. Series A, No 67: Some Differences between the Structure of Electro-deposited and Hot-dipped Metal Coatings. By D. J. Macnaughtan. Pp. 16+6 plates. Free. Series A, No. 68: The Influence of the Difference of Orientation of Two Crystals on the Mechanical Effect of their Boundary. By Dr. Bruce Chalmers. Pp. 10. Free. Series A, No 69 The Colorimetric Determination of Tin by means of Toluene-3 4-dithiol ("Dithiol") By Dr. R. E D. Clark. Pp 6. Free. (London International Tin Research and Development Council.) [61

Eleventh Annual Report, 1st August 1936 to 30th September 1937 (Accounts for the Year ending 31st July, 1937) of ULAWS. Pp. 40+xvi+4 plates. (London: University of London Animal Welfare Society.) [61

Leeds University Department of Pathology and Bacteriology. Annual Report, by Prof Matthew J Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research, by Prof R. D. Passey. Pp. 14. (Leeds. The University.) [61

Eighth Annual Reports of the National Radium Trust and Radium Commission 1936–1937, including a Statistical Report. (Cmd 5612.) Pp. 80. (London. H.M. Stationery Office.) 1*s*. 3*d*. net. [61

Department of Scientific and Industrial Research. Forest Products Research Records, No 22 (Woodworking Series, No. 1): Circular Saws. By P. Harris. Pp 15+9 plates. (London H.M. Stationery Office.) 6*d*. net [61

Department of Scientific and Industrial Research: Food Investigation. Leaflet No 7. The Conditioning of Imported Plums and Pears. By Dr. J. Barker and C. R. Furlong. Pp. 9. (London: H.M. Stationery Office.) Free. [61

Other Countries

New Zealand Marine Department Fisheries Bulletin No 6: Natural Reproduction of Quinnat Salmon, Brown and Rainbow Trout in certain New Zealand Waters By Derisley F. Hobbs. Pp. 104. (Wellington: Government Printer.) [61

New Zealand. Eleventh Annual Report of the Department of Scientific and Industrial Research. Pp. 147 (Wellington: Government Printer.) [61

Indian Science Congress Association, Silver Jubilee Session, 1938. An Outline of the Field Sciences of India. Edited by Dr. Sunder Lal Hora. Pp. v+168+17 plates. (Calcutta: Indian Science Congress Association.) [61

Crohamhurst Observatory. Paper 7. The Climate of Australia during the Hypothetical Jovian Sunspot Cycles 1877–1901, together with the Monthly and Annual Rainfall Observations at selected Stations during the Period, and some Comments on the Evidences of Cyclical Reproduction of the Weather. By Inigo Jones. Pp. 128 (Brisbane: Government Printer.) [61

Department of Agriculture, Straits Settlements and Federated Malay States General Series, No. 28. The Practical Aspects of Copra Deterioration. By F. C. Cooke. Pp. iii+49+3 plates. (Kuala Lumpur: Department of Agriculture.) 50 cents [61

Indian Central Cotton Committee. Annual Report of the Director, Technological Laboratory, for the Year ending 31st May 1937. Pp. 38. (Bombay: Indian Central Cotton Committee.) 6 annas [61

Report on the Work of the Imperial Council of Agricultural Research in applying Science to Crop Production in India. By Sir John Russell. Pp v+235+18 plates. (Delhi Manager of Publications.) [61

Carnegie Institution of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. (Reprinted from Year Book No 36, for the Year 1936–1937.) Pp. ii+62 (Washington, D.C.: Carnegie Institution.) [61

Royal Agricultural Society, Egypt. Technical Section, Bulletin No. 33. Long Staple Cottons in Egypt, a Survey of the Present Position and a Proposal for the Future By Dr M. A. Fikry. Pp. 14. (Cairo: Royal Agricultural Society.) [61

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 157: Experimental Research on the Temper-hardening of the Silver-rich Ag-Al Alloys. By Shiro Ishida, Hideo Tajiri and Masao Karasawa Pp. 77–114. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 55 sen. [61

Commonwealth of Australia: Council for Scientific and Industrial Research Bulletin No. 84. The Basal (Standard) Metabolism of the Australian Merino Sheep, 2. By A. W. Pierce. Pp. 22. Bulletin No. 110: Radio Research Board Report No. 12. Pp. 46. Bulletin No. 111. Radio Research Board Report No. 13. Pp. 59 (Melbourne: Government Printer.) [61

Tide Tables for the Atlantic Coast of Canada for the Year 1938. including the River and Gulf of St. Lawrence, the Bay of Fundy, Northumberland and Cabot Straits, Hudson Bay, and Information on Currents; in addition Tide Tables for New York and Boston, U.S.A. Pp. 98. (Ottawa Department of Mines and Resources.) [61

Proceedings of the United States National Museum. Vol. 85, No. 3027: On some Onychophores from the West Indies and Central America. By Austin H Clark. Pp. 4. (Washington, D C.: Government Printing Office.) [61

Department of Science and Agriculture, Jamaica. Bulletin No. 9. Field Experiments on Sugar Cane in Jamaica, 1933–1936. Report by H. H. Croucher. Pp 13. Bulletin No. 10: Progress Report on Damage done in the Kingston and St Andrew Area by Termites which infest Buildings. Pp 11. Bulletin No. 12. Reprints of Miscellaneous Articles, 1936. Pp 31 (Jamaica Government Printing Office.) [61

U.S. Department of Agriculture Leaflet No. 144: Cockroaches and their Control By E A. Back. Pp. 6. 5 cents. Leaflet No. 147: House Ants. By E. A. Back. Pp. 8. 5 cents. (Washington, D.C. Government Printing Office.) [61

U.S. Department of the Interior: Office of Education. Bulletin 1937, No. 6. Bibliography of Research Studies in Education, 1935–1936. Prepared by Ruth A. Gray. Pp xiv+338. 30 cents. Pamphlet No. 80: Sources of Visual Aids and Equipment for Instructiona Use in Schools. Compiled by Cline M Koon. Pp. iii+44 10 cents (Washington, D.C.: Government Printing Office.) [61

Pennsylvania State College: School of Agriculture and Experiment Station Bulletin 339: The Digestibility of Rations by Cattle and Sheep. By Ernest B. Forbes, John W. Bratzler, Alex Black and Winfred W Braman. Pp 30. (State College, Pa.: Pennsylvania State College.) [61

Catalogues, etc.

B.D.H. Vaccines and Sera. Pp. 60. (London: The British Dru Houses, Ltd.)

Determination of Moisture. (Circular No. 332.) Pp. 2. (London A. Gallenkamp and Co, Ltd.)

Precision Gauge for Measuring Liquid in Tanks. (List No. G/28. Pp. 8. (London: Negretti and Zambra.)

Musik: Praktisch, historisch, theoretisch. Teil 1: A—Fétı (Antiquariats-Katalog Nr 51.) Pp. 112. (Leipzig Karl Max Poppe.

Old Science and Medicine (List 27) Pp. 38 (London: E. I Goldschmidt and Co, Ltd.)

Concentration Recorder Controller. (List No R/9.) Pp 8. (London Negretti and Zambra.)

Quartz Spectrograph and Visual Ultra-Violet Absorptiomete (FA 37) Pp. 8 Photographic Recording. (REG 37.) Pp. 4. (Delft P. J. Kipp en Zonen.)

Le Officine Galileo nell'Anno II dell'Impero, Anno XV E F MCMXXXVII. Pp. 124. (Firenze. Le Officine Galileo.)

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Social Imports of Invention

IN his presidential address to the British Association at Blackpool in 1936, Sir Josiah Stamp, discussing the impact of science upon society, stressed the need for a technique of social adjustment. The soundness of this plea has been emphasized in many subsequent discussions on the relations between science and society and has been confirmed by evidence afforded in such reports as those of the Commissioners for the Special Areas or the surveys of such areas; for example, that of South Wales conducted by the University College, Cardiff.

Despite growing recognition of the importance of some attempt to devise more systematic means of using technical discoveries and improvements and to foresee their direct and indirect effects, there has as yet appeared in Great Britain, however, no systematic study of the direct or indirect repercussions of the impact of invention upon society. The report on "Technological Trends and their Social Implications" (Washington: U.S. Government Printing Office. 1 dollar) which the United States National Resources Committee published in June of last year is accordingly the more welcome, and in issuing an admirable summary of this six hundred page report, Political and Economic Planning (Broadsheet No. 111) has again earned the thanks of all who are considering the problems which arise from the impact of science upon society.

The report in question was prepared by a special scientific sub-committee and represents a major attempt to forecast the limits of new inventions which may affect living and working conditions in the United States in the next ten to twenty-five years. It indicates some of the problems inevitably involved in the adoption and use of these inventions and emphasizes the importance of national efforts to bring about prompt adjustment to those changing situations with the least possible social suffering and loss, and sketches some of the lines of national policy required.

Much of the matter contained in the report is relevant to European as well as to American conditions, and the lack of attention which the report has received is a further indication of the absence of effective means for the exchange of information and the interpenetration of thought on problems of common concern to the two chief English-speaking democracies. PEP itself is indeed now attempting to improve such contact by exchanging publications with a number of leading American organizations concerned with planning and public affairs. The growing importance of close and effective relations between Great Britain and the United States demands the extension and encouragement of any means to that end.

The possibility of forecasting the impact of technical inventions on society has been widely discussed, and its many pitfalls have been emphasized repeatedly. The present report, however, while not overlooking these difficulties, distinctly emphasizes the practical possibility of such forecasting and of avoiding many of the most obstinate problems with which their indirect effects have confronted Governments. The impact of inventions never comes instantaneously without signals, and on an average is spread over a period of about thirty years. Moreover, there are three distinct aspects of prediction. It may be possible to forecast in which industries and processes invention is most likely to occur on a considerable scale, which industries are most likely to be affected economically by the impact and what repercussions are most likely elsewhere.

For the technician, the first of these aspects is the most interesting, but for the community, the third and to a lesser extent the second are of more direct and immediate concern. If, however, the work of inventors is to be followed from a broader social and economic point of view, so that opportunities for anticipating and meeting the subsequent repercussions are used, we must have administrators competent to recognize and take account of the scientific and technical factors involved. That this aspect of the impact of invention should be seriously considered is the more important because, as the report indicates, not only is the number of inventions made each year likely to increase rather than to diminish, but also in spite of the difficulty of predicting the effects of specific inventions, it is much easier to forecast the broad social impacts of invention as a whole, since clusters of inventions after all lead to the same social end. For example, the telephone, broadcasting and television all tend to break down individual isolation and privacy, while motor transport, railway electrification, telephones, radio, the cinema and the chain store have all tended to encourage a suburban type of development.

There is, indeed, little information that is new in the present report, but it establishes very clearly the principle that it is a function of Government to watch over and adjust the serious strains and friction which invention may set up in society, while its recommendations for a permanent mechanism for giving effect to this principle deserve study.

In modern industry itself, inventions to-day have four characteristic social tendencies: continuous processes, automatic operation, use of registering devices and use of controlling devices. All of them tend towards the displacement of labour or making a job more mechanical or monotonous, though quite often a few highly skilled or intelligent workers are required as a result in place of many unskilled or manual labourers. Thus, although one result of mechanical invention may be that the more arduous and unpleasant tasks to be performed by manual labour are considerably reduced in number or can be performed by far fewer operators under pleasanter or less exacting conditions, this advantage must be set against the possible effects on displaced workers if no fresh employment is found for them.

Once again, therefore, we are concerned with a net social effect or with the integration of the social consequences of the invention or discovery both direct and indirect. It is precisely such reasons as these which have given a new impetu to social science and research, and to the attemp to plan the utilization of national resources o scientific lines. Moreover, if, as Dr. Ogburn suggests, the lag between invention and its impact o the community makes invention a social barometer it is the more important that every effort shoul be made to read that barometer. It is highl probable, for example, that new developments i industry will threaten the existence of a numbe of skilled occupations, and unless the adoption o fresh methods is carefully adjusted to recruitin policy, and suitable schemes of compensation an retraining for the displaced workers are enforced much friction will result.

The argument for the extension of scientifi planning advanced by this report accordingly rest essentially on human considerations. Scientifi planning as suggested here, the application o scientific methods in an ever-widening field o social and economic problems, is not the handlin of human affairs in the cold dispassionate spher of reason and mechanical efficiency with disregar of human emotions and suffering. On the contrary it seeks to eliminate the selfish direction of industrial undertakings with regard merely to th financial advantage or mechanical efficiency of single enterprise, and to insist that account sha be taken not merely of the well-being of th employees of the concern itself but also of th welfare of the industry and the nation as a whole

The report opens up whole fields of research fo applied psychology, and if it says little or nothin about that aspect of invention which has perhap the first claims on the interest of scientific workers namely, the conditions most conducive to creativ thought and fecund research, its concrete proposals in themselves include some special studie of a few inventions likely to be widely used wit important social consequence. Among these ar the establishment of federal committees on technological unemployment, departmental science committees to investigate and report regularly on th progress and trends of science and invention an their possible social and economic effects, and review of the whole working of the patent laws with a view to adaptation to contemporary needs It is indeed to be hoped that scientific workers an others will be quick to grasp the significance o this report and the challenge it offers to constructive effort no less in Great Britain than i the other English-speaking democracy to which i was primarily addressed.

Procreative Beliefs of the Australian Aborigines

Coming into being among the Australian Aborigines:
a Study of the Procreative Beliefs of the Native Tribes of Australia. By Prof. M. F. Ashley-Montagu. Pp. xxxvi + 362 + 4 plates. (London: George Routledge and Sons, Ltd., 1937.) 21*s*. net.

IN 1899 Spencer and Gillen, writing about the Arunta tribe of Australia, declared that the natives possessed no knowledge whatsoever of the relationship between coitus and pregnancy, and in the early years of this century this gave rise to an extensive controversial literature. Prof. Ashley-Montagu takes up the subject again, and reprints and discusses in his book all the directly relevant records in ethnographical literature. His thesis is "that in Australia, practically universally, according to orthodox belief, pregnancy is regarded as causally unconnected with intercourse". The argument and its conclusion assume a distinction between 'orthodox' belief and what Prof. B. Malinowski in his foreword calls "random statements of irrelevant opinion", but no objective criterion is offered by which to distinguish these different kinds of beliefs. The argument is also vitiated by the fact that the author never makes clear what he means by "causally connected". Thus he accepts (p. 168) the statement of Miss McConnel (which is supported by a myth) that in a Queensland tribe sexual intercourse is regarded as a necessary condition of conception, and then writes, "the important point of course here is that these natives do not regard intercourse as the cause of conception but only as a condition thereof". Since for the modern scientific investigator coitus is a necessary but not a sufficient condition of pregnancy it is difficult to understand what is the nature of that "causal connection" of which the Australians are said to be ignorant. But the author is not consistent, since (on p. 237) he says that for the Australian native sexual intercourse "positively has no connection with childbirth".

There is good evidence from recent field-work that in a number of Australian tribes there is a recognition of some connexion between sexual intercourse and childbirth. Most of the work during the last ten years has been carried out in the northern part of the continent, since it is there that are to be found the tribes that have not been destroyed by white invasion. Prof. Ashley-Montagu, in order to maintain his thesis, treats these tribes as "aberrant" and writes: "there is every reason to believe that the beliefs of the tribes in this general region are not strictly indigenous, that there is some evidence that they are of foreign origin, and that for this reason they cannot be regarded as strictly aboriginal Australian beliefs" (p. 113). But he adduces nothing that can properly be regarded as evidence for this view.

Another weakness of the argument is that the author, as he himself notes, takes the Arunta of the Alice Springs district as typical of the whole of Australia. What is typical of Australian tribes taken together is not anything found in any one particular tribe, but those general characteristics which are common to all or to the great majority. The Arunta have their own special beliefs about childbirth which are not shared by the majority of Australian tribes, and to take these as typical of the continent is invalid.

The author assumes that in their beliefs, or rather in their 'orthodox' beliefs, the Australian natives are logical and consistent. ("In his own thought the savage is perfectly logical", p. 340.) When, therefore, he finds in the accounts given of the beliefs of any tribe, things that seem to him inconsistent, he falls back on the distinction between 'orthodox' and other beliefs, or else treats the inconsistencies as if they arose, not from the statements of the natives themselves, but from the way in which they are reported by the ethnographer.

There doubtless is a certain kind and degree of consistency among the Australian beliefs, but it is not of the kind that the author has in mind. Many Australian tribes hold a belief that a woman becomes pregnant because a "spirit-child", as the native term is often translated, has entered into her. Prof. Ashley-Montagu accepts this as the 'orthodox' belief, and seems to think that people who hold it cannot also recognize any connexion between pregnancy and coitus. If we had no more knowledge about the beliefs of Roman Catholics than we have about those of the Australian aborigines, we should, by following the author's methods, conclude that the orthodox belief that every child born into the world is the result of a special act of creation by God is incompatible with the belief that the child results from the fertilization of an ovum by a spermatozoon. But we do in this instance know that the two beliefs are held together and are made consistent by the distinction between soul and body.

The dangerous unsoundness of Prof. Ashley-Montagu's simplistic, almost naïve, treatment of the Australian problem may be illustrated by yet another instance from our own society. Anyone in modern Europe who believes that the human soul continues to exist after the death and dissolution of the body will be likely on certain occasions to deny that thought and feeling are dependent on physiological processes in the nervous system, yet will also on occasions recognize that it is through such physiological action that unconsciousness results from chloroform or a blow on the head. An inquiring anthropologist from another world using Prof. Ashley-Montagu's methods would conclude that in twentieth century England, according to orthodox belief, conscious thought is regarded as causally unconnected with the physiological functioning of the brain.

In Australian tribes the phenomena of pregnancy and childbirth are associated with a number of things, with menstruation and with menstrual blood and thereby with the moon, with the small whirlwinds that swirl across the country in hot weather, with rain as the primary source of fertility in Nature and with the rainbow-serpent in which the life-giving power of water is personified, with food, with dreams, with the totemic ancestors, with certain sacred spots (baby totem centres) at which members of the baby totem group perform ceremonies to produce a supply of babies in the tribe just as members of the kangaroo totem by similar ceremonies multiply the kangaroo. Many of these ideas are found associated together in a single tribe. They afford a means by which the Australian aborigines represent to themselves the place of childbirth in a complex order which is at one and the same time the social order and the natural order. In spite of the author's attempts to explain it away, there is clear evidence that in many tribes there is included in this set of ideas an association between childbirth and sexual intercourse. The anthropologist who knows his business is not disconcerted when he is told by the same informants that babies come from the moon, that pregnancy results from a woman eating food which makes her sick, that there would be no children if there was no copulation, and that to ensure a proper supply of babies it is necessary once a year to perform a ceremony at the baby totem centre. What is needed in a scientific treatment is an examination of what these associated ideas mean in the thinking and the behaviour of the natives themselves, not a discussion of them in terms of our own complex notion of efficient causation, which is a product of centuries of Aristotelian philosophy and of scientific and technological development. What consistencies and inconsistencies there are must also be studied in the minds of the natives themselves, not in terms of our own conceptions. To such a needed study the book under review makes no contribution of any value.

To his thesis that the Australian aborigines are ignorant of physiological paternity the author adds, in his thirteenth chapter, the thesis that they are also ignorant of "physiological maternity". What exactly he means by the latter thesis is even more obscure than what he means by the former. The writing throughout the book is awkward, and there are occasional faults of grammar. The map on p. 292 showing the distribution of subincision, taken from Basedow, is incorrect. There seem to be very few misprints; a line of type, seven from the bottom, has been dropped on page 260. The reviewer is unable to agree with the lavish, even extravagant, praise that is bestowed on the work by Prof. B. Malinowski in his foreword.

A. R. RADCLIFFE-BROWN.

The Newer Outlook on Animal Nutrition

Animal Nutrition
By Prof. Leonard A. Maynard. (McGraw-Hill Publications in the Agricultural Sciences.) Pp. xiv + 483. (New York and London: McGraw-Hill Book Co. Inc., 1937.) 24*s*.

AS the modern system of intensive production, calling for higher and higher milk yields or rapidity of growth, has developed, so not only have the demands of the animal for quantity of food increased, but also many new requirements as to the quality of the feed have been set up. Attention has therefore to be focused on special nutritive requirements previously unrecognized. It is especially in this respect that the book under notice extends the older works on animal nutrition.

Although the book is written primarily with application to farm animals, it does not deal with detailed feeding practices, as are already to be found in other books, but rather it seeks to show how the newer outlook on animal nutrition can assist these practices.

The subject is treated from the wide point of view of the comparative physiologist, both in obtaining general principles by a comparison of species and in the application of those principles to different species. This wider point of view is also seen in the chapters on growth, reproduction and lactation, in which the special nutritive requirements of these functions are considered in detail. Problems of intermediary metabolism and the means by which the nutriment in the body is regulated to the different organs are involved.

The inorganic elements and the vitamins required by the body are treated at length, particularly in relation to deficiency diseases and to questions of improved health and efficiency in different species of animals. Several sections are devoted to the technical side of running nutritional experiments, such as the determination of digestibility, nutritional balances and respiration calorimeters, while others deal with some of the physico-chemical bases of the life-processes, such as the absorption of radiation.

Interesting accounts of recent work on various points of practical interest at the present time include such problems as the storage of iron by the fœtus during pregnancy in its connexion with the study of anæmia, the nutriments required for egg production, the effects of the method of preservation of greenstuffs on their vitamin content, the relation of food fat to depot fat, the role of water in the body, and particularly the experiments quoted on the effect of improvements in the nutritional regime in causing better physical development in animals and man.

As the book throughout contains references to the literature, often from reports of agricultural experiment stations and other scattered sources, it should prove very useful to those engaged in nutritional work. Brief historical accounts of noted names in nutritional science are given in footnotes.
J. H.

Biological Positivism

The Axiomatic Method in Biology
By Dr. J. H. Woodger. With Appendices by Alfred Tarski and W. F. Floyd. Pp. x + 174. (Cambridge: At the University Press, 1937.) 12*s*. 6*d*. net.

DR. WOODGER'S book is an attempt to do for a part of biology what Whitehead and Russell, in "Principia Mathematica", did for mathematics. Starting from as small a number as possible of axioms and undefined terms, he proposes to deduce known biological generalizations, and to discover new ones by pure deduction. For this purpose he uses a special set of symbols, including many taken from Whitehead and Russell, and 125 new ones. Some of these, for example, **cell**, are undefined, whilst others, for example, **Ps**, meaning the relation of sexual parenthood, are defined in terms of cell lineages.

The author then arrives at a quasi-mathematics in which the fundamental operations are the division and fusion of cells, and the division of cell-parts, for example, genes. If any system conforms with his axioms, the theorems deduced will be true for it. Some of these theorems are applicable to taxonomy, some to embryology, but the majority to genetics. In this latter field, at any rate, Dr. Woodger's method is unsuited to deducing new results. Thus on p. 114 we are presented with an "unsolved problem", the solution of which can, however, be written down without difficulty by anyone familiar with Wright's mathematical methods.

This might not matter if the axioms used in deduction were biologically as well as logically correct. But they are not. Thus, on p. 70, **g** (for gamete) is defined as the class of cells which fuse in pairs to form a zygote (according to a restricted definition given earlier). Now a female cell which fuses with a male gamete may be a haploid (as in higher plants) or a diploid which only extrudes its second polar body after fertilization. Here an attempt to define gametes exclusively in terms of cell divisions and fusions leads to the loss of the fundamental distinction between diploid and haploid cells.

Again, on p. 92 in the definition of a "continuous component" of a cell series, it is apparently assumed that genes and chromosomes do not divide during the first meiotic division, which is therefore always reductional. This is known to be untrue. Hence not only is the whole subsequent genetical theory only proved for a non-existent class of organisms, but also any treatment of segregation in *Ascomycetes* becomes impossible.

It is perfectly true that both these mistakes occur in text-books of biology. But if Dr. Woodger's method is to be justified, it can only be on the ground of greater accuracy and rigour than are to be met with in current biological writing.

I believe that these errors arise from an attempt to be positivistic rather than materialistic. If we attempt, out of the inconceivable richness of biology, to concentrate on a few characters or processes which lend themselves readily to abstract description, we inevitably lose sight of biological realities. A classical example is the Linnæan system of flowering plants, logically perfect, but often at variance with the natural system based on community of descent.

In my own opinion, the attempt to fit the facts of life into any logistic scheme is likely, in the long run, to be a failure. But it will be a useful failure if it serves to show up false assumptions which we tacitly make. Some, such as the existence of female gametes, are relatively trivial. Others are much more deeply involved in our thought, and if they are false the results are much more serious.

Thus, Dr. Woodger assumes that a cell can be divided into momentary parts, that is to say that in theory, at least, we can specify the state of a cell at any instant with no limit to our accuracy. This is untrue for an atom, and, if it is correct that change is part of the very essence of life, it may turn out to be even more glaringly untrue of the cell.

Again, it is assumed that certain cell-parts, for example, genes, are individuals each with one and only one ancestor at any past date. This assumption has so far satisfied geneticists. But actually when two like genes come together in a homozygote at pachytene, and after a time which may be as long as forty-five years, finally separate, it is impossible to say which of the separating genes represents a given one of the synapsing genes. The uncertainty may be small, but is not necessarily negligible, and may prove very important.

Similarly, it is assumed that genes divide. This may be true. It is equally plausible that they reproduce by copying rather than by division.

The value of Dr. Woodger's book will be greatly enhanced if he clears it, so far as possible, both from definite myths, such as that of the female gamete, and from postulations of unobserved phenomena, such as gene division. If this is done, his method may prove valuable for morphologists for some generations to come, although until it takes cognizance of chemical facts it will be of little use to the biologist and none to the biochemist. But at present it falls between the two stools of positivistic description and materialistic explanation. I believe that the former ideal is in the long run unattainable. But the attempt to attain it has inspired such biologically valuable work as that of Karl Pearson.

In his preface Dr. Woodger emphasizes the tentative character of his book. If it proves possible to rewrite it in terms of observable phenomena only, without such postulates as gene divisions and momentary states of cells, it will be a valuable contribution to human thought. Until then, its main importance may be to lay bare erroneous assumptions rather than to serve as the basis of a further theoretical construction. J. B. S. HALDANE.

Synaptic Transmission

Autonomic Neuro-Effector Systems

By Prof. Walter B. Cannon and Prof. Arturo Rosenblueth. (Experimental Biology Series.) Pp. xiv + 229. (New York: The Macmillan Co., 1937.) 17*s.* net.

SEVERAL reviews have been written recently dealing with the chemical transmission of nervous impulses. A monograph has now been published which gives, for the first time, an authoritative exposition of the views of the Harvard School. The authors have both written many papers describing investigations of the properties of adrenergic nerves. They have shown that stimulation of these nerves causes the liberation of at least two different substances. The clear presentation of the evidence for this conclusion forms the most valuable and impressive feature of the book. No one could question the experimental results, but their interpretation is still in doubt. The theory that drugs combine with a special receptive substance in the motor organ provides the only reasonable explanation of the specificity of drug action, but Cannon and Rosenblueth's theory that this receptive substance is liberated with the drug into the blood stream seems unnecessarily complicated, and has met with opposition.

The book is argumentative. The authors reject Bacq's rather factious criticisms of their theory of sympathins *E* and *I*. They reject the theory advanced by Monnier and Bacq to account for the failure of 933*F* to antagonize the effect of adrenergic nerves in favour of that advanced by Dale and Gaddum to account for similar phenomena in connexion with atropine. They reject the theory which explains dose-effect curves in terms of individual variations of the sensitivity of muscle elements on the ground that it would be necessary to assume that the logarithm of the sensitivity of these elements was normally distributed. This is not the weak point of the theory in question, since the logarithms of biological quantities usually *are* normally distributed. They accept the theory which regards these curves as hyperbolæ, and interprets them in terms of mass action, but do not appear to realize that, on this theory, the ratio to one another of the potency of two solutions must be independent of the size of the doses used.

This book is, in fact, likely to lead to much discussion. J. H. G.

The Camford Visitation

By H. G. Wells. Pp. 76. (London: Methuen and Co., Ltd., 1937.) 2*s*.

MR. WELLS'S address as president of the Educational Science Section of the British Association last year dealt with certain aspects of education in the schools only. In his latest story, with its cover of dark and light blue, he deals with university education and its place in society. The story begins with an amusing sketch of a dyed-in-the-wool scholar, the master of Holy Innocents College, a preserver of culture, of true scholarship, born to appreciate without ever creating. His breakfast oration has got to the stage of denouncing "the dictatorship of the half-educated. . . . We are being endowed, Sir, and told what to know and teach, by the unholy wealth of ironmongers and the overblown profits of syndicated shop-keepers." Then enters the visitant as a voice, an unseen presence, asking: "Half-educated? Now how can you measure education and divide it into halves and quarters? What do you *mean* by education? . . ." For the rest of the story the visitant subjects human life, and in particular its treatment by the University of Camford, to a sympathetic but quite unsparing scrutiny. The general thesis is an appeal to the universities to play a part in "so heroic an ordering of knowledge, so valiant a beating out of opinions, such a refreshment of teaching and such an organization of brains as will constitute a real and living world university, head, eyes and purpose for Man".

In the development of the thesis many topics are reviewed or touched, with Wellsian incisiveness and ironic humour—the claim that the humanities are wisdom and that science is not, the pseudo-scientific explanations of psycho-analysis, the fashionable philosophy-cum-politics-cum-religion called dialectical materialism. "To see a novel proposition pass through a Marxist gathering is like watching a breeze across a field of ripe corn. It passes, and the serried minds return to their upstanding integrity." Mr. Wells is here as stimulating, provocative and entertaining as ever, but the visitant treats university science teaching more kindly than we should have expected.

Out of my Life and Work

By Auguste Forel. Translated by Bernard Miall. Pp. 352+8 plates. (London: George Allen and Unwin, Ltd., 1937.) 16*s*. net.

THIS volume of memoirs deals with a full and varied life. Prof. Forel became a psychiatrist by profession and simultaneously was one of the leading European myrmeologists. A narrow and isolated early upbringing led him to take refuge in Nature around him and, before he was eight years old, he had become interested in ant life. Forel was destined for medicine, and he seems to have prosecuted his studies in this subject side by side with those on ants. Failure to pass the examinations at Zurich led to his transference to Vienna. Here he graduated and secured his first post, which was under Prof. Gudden in Munich.

Forel had been working for some time at his "Ants of Switzerland" and in 1875 this treatise received the Thore Prize of the Paris Academy of Sciences. In 1879 he became assistant physician at the Burghölzli Asylum, overlooking Lake Zurich. Here he remained for nearly twenty years, becoming its director, and also professor in the University of Zurich. His energies were devoted to research, teaching and treatment in connexion with insanity. His earlier studies on the brains of normal individuals and of mental deficients were followed by his development and application of hypnotic suggestion as a method of treatment. He tells much of his life at Burghölzli, of its trials, misunderstandings and successes; of his travels to other lands in order to further his studies of ants; of his politics and of his efforts as an uncompromising opponent of alcoholism; and of his life in retirement and its retrospection. These memories are written in a frank, unpretentious style, and reflect their author's efforts in recording the events of his life in their proper perspective. The work of translation has been ably done by Mr. Bernard Miall.

The Chromosomes

By M. J. D. White. (Methuen's Monographs on Biological Subjects.) Pp. viii+128. (London: Methuen and Co., Ltd., 1937.) 3*s*. 6*d*. net.

THIS competent book of 128 pages provides a guide to recent discoveries in cytology. It describes the phenomena of mitosis and meiosis, considers chromosomes in relation to evolution and does not shrink from invading the realms of advanced cytological theory. The book contains a curious mixture of well-written, easily understood remarks on advanced work, combined with involved descriptions of more elementary material. This is probably due to the author's endeavour to cover as much of the ground as possible in a small book.

A glossary is provided, but the definitions are not always strictly specific. The book is to be recommended to those who require a summary of the modern theories and discoveries of cytology and will undertake further reading of authorities in the excellent bibliography. F. W. S.

Life and Death:

the Autobiography of a Surgeon. By Prof. Andrea Majocchi. Translated by H. J. Stenning. Pp. 343. (London: George Allen and Unwin, Ltd., 1937.) 10*s*. 6*d*. net.

THE author of this temperamental book, which is obviously intended as much for the layman as for the medical reader, is professor of surgery at Milan and consultant to the Ospedale Maggiore. In addition to a short history of this hospital, the work contains a vivid description of the author's practice in the Obstetrical Department, his visits to the surgical clinics of Switzerland, the United States, Paris and Berlin, his War service at the Front and especially the treatment of wounds of the abdomen, brain and spinal cord and the "roses and thorns" of a surgeon's career. Chapters are also devoted to the nursing profession as seen through Italian spectacles, and a satirical account of a medical congress.

Soil Conservation in Tropical Africa

By Dr. L. Dudley Stamp, director of the Land Utilisation Survey of Britain

THE attention which has recently been given to the widespread and serious nature of soil erosion in the African continent has perhaps insufficiently emphasized two aspects of the problem. One is that the serious and rapid erosion is of recent growth—not only in large measure consequent upon the control of the continent by Europeans but also actually in danger of being increased by the very measures designed to combat it. The other is that the African cultivator has already evolved over large areas a system of farming designed to combat soil erosion and maintain soil fertility, and that the essential need is to encourage and develop this system rather than to supersede it. A recent tour in Nigeria has convinced me that the African system may hold the key to the solution of some of the most urgent problems of soil erosion in America and elsewhere.

Prior to the European partition of tropical Africa, internecine strife and the incidence of disease, both epidemic and otherwise, resulted naturally in a limitation of population and of any serious pressure on the land in purely agricultural areas, and prevented overstocking both by man and by animals on grazing land. Nowadays, population density in parts of Southern Nigeria reaches more than five hundred to the square mile, whilst the number of cattle in Kenya increased from three to six million between 1920 and 1936.

In Southern Nigeria, a land of adequate rainfall (60 to 150 inches or more), naturally clothed with high forest but where certainly less than one per cent of virgin forest remains, the land is divided up between the village communities. Each village tract—in other lands one would say parish—is held communally and farmed on a well-marked system of rotation, each family returning in the appropriate year to farm its own special portion. The system is often, though wrongly, referred to as 'shifting cultivation', and has even by foresters been called after the system of temporary mountain clearings in Burma a 'Taung-ya' system, which it certainly is not. It is best described as 'bush-fallowing', a period of cultivation being followed by a long period of fallow, the only difference from the fallows of temperate lands being that the forest trees form the 'weeds' of the fallows. Seven to ten years (during which the trees grow to thirty feet in height) may be regarded as the normal period of fallow; it is when the pressure on the land is such that the fallow period has to be reduced perhaps even to as little as two years that the system breaks down. When the time comes, the fallow is cleared by burning—better if the burning is as early as possible after the rains so that the fires are not so fierce as to destroy the valued oil palms or completely to destroy the vitality of the stumps left in the ground.

Southern Nigeria is mainly tsetse infested: cattle are entirely absent over large areas and cultivation is entirely by hand—by the hoe. A family can cultivate two or three acres in this way and produce an adequate supply of the staple food—yams—together with limited quantities of cassava (manioc), corn (maize) and a supply of vegetables in the little garden plot (permanently cultivated) round the hut itself. Thus at any given time the village tract appears to be a series of tiny patches of cultivation in the midst of ragged, untidy second-growth forest of varied age. The patches themselves are a series of mounds or of yam hills (in which the yams or cassava are planted), a few stalks of maize or a few beans or gourds growing in the intervening hollows, and stumps of trees still remaining. Weeds are by no means absent, but the soil is protected. If some of the finer fractions are washed out, they are held up by the neighbouring tract of woodland. If Western ideals of ploughing, extensive clearing, weeding and single cropping were introduced, the soil would immediately be subject to serious erosion from which it is at the moment free. The Agricultural Department in Nigeria has rightly recognized this, and is concentrating its attention on the improvement of the present system by green manuring (by leguminous crops) to replace *part* of the fallow, early burning to prevent serious destruction by fire, and the improvement in quality and yield of the crops grown—especially those which may serve as additional cash crops (citrus, cocoa, oil palm, cotton, kola nuts, etc.) and supply the African with the money he needs for taxes, bicycles, travelling, clothing and the various demands coincident with an increased standard of living.

Northern Nigeria consists of large emirates in which the emir holds the land in trust for his people. The cultivators are his tenants, though often holding the land indirectly through the district headmen. The rainfall ranges from about 25 inches along the northern border to 60 inches in the south, and comes essentially in the wet

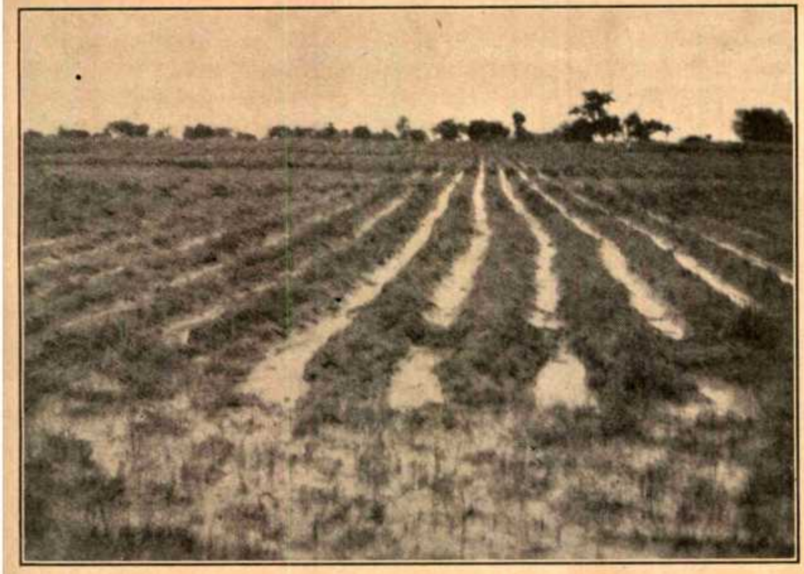

Fig. 1.

THE INTRODUCTION OF THE PLOUGH IS LIKELY TO CAUSE EROSION OF THIS TYPE (KANO, NORTHERN NIGERIA). AFTER A HEAVY RAINSTORM, EACH FURROW HAS BECOME AN EROSION CHANNEL CARRYING OFF THE LIGHTER, VALUABLE FRACTION OF THE SOIL.

season from April until October. It falls generally in a succession of storms, four inches in a single night being by no means unusual, and in consequence the predominantly light sandy soils are particularly liable to both sheet and gully erosion. In the dry season the country is parched and bare, and liable, at least in the north, to considerable wind erosion from the dust-laden Harmattan, though the film of fine dust which this wind from the Sahara deposits is not without its value to the soil. The population of the Northern Provinces is irregularly distributed —largely influenced by water supply, with the result that the Geological Survey is at present very actively engaged in well-siting and well-sinking. There is still a sharp distinction between the nomadic, or semi-nomadic cattle-rearing Fulani and the settled Hausa cultivators, though the latter are not blind to the value of manure and may even hire the large white-humped zebu cattle from the Fulani for the sake of their droppings.

The natural vegetation of the Northern Provinces is an open savannah forest with an undergrowth of grass, merging northwards into acacia scrub woodland. Uncontrolled grazing by cattle and the large northern goat results in an uneconomic use of the land, of which there would be ample for normal cultivation on the same basis as in the south. Hence it is, very rightly, the policy of the Agricultural Department to introduce and popularize by means of a series of demonstration farms a system of mixed farming, and to fuse the diverse interests in the land of the Fulani and Hausas. The results are gratifying. In 1928 three farmers tried the experiment; by the end of 1934 the number had increased to 298, but in the next year it had leapt to 621. The staple food crops of the north are the tall guinea corn (with stalks valued for roofing and light fencing), other millets (with a less valuable straw), together with some maize, cassava, and a few yams and, locally, rice. The staple cash crops are ground nuts and cotton. The traditional agricultural implement is the hoe, by which a family cultivates about three acres. The Agricultural Department has introduced a light plough throwing up a ridge on either side and which is to be drawn by the cattle now to be kept penned with millet straw bedding (making a manure with binding qualities on the light soils).

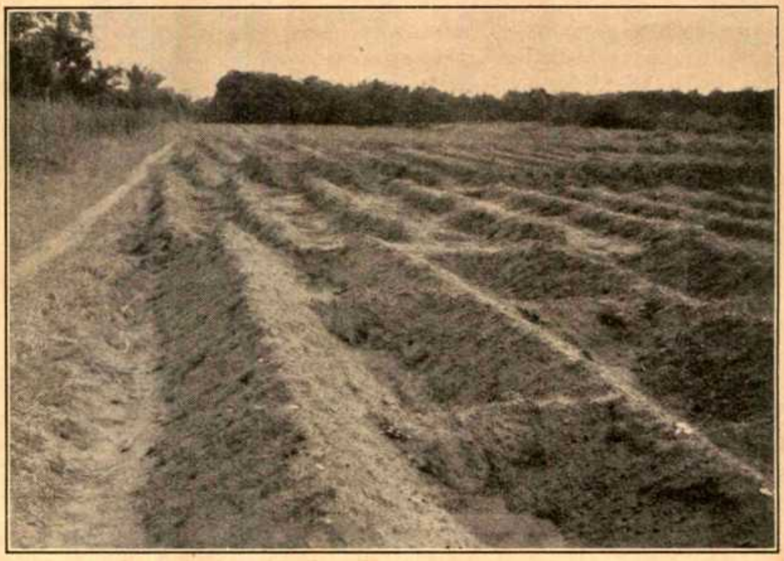

Fig. 2.

THE 'RIDGE AND BASIN' SYSTEM OF NATIVE CULTIVATION IN NIGERIA. THE METHOD IS VERY EFFECTIVE IN PREVENTING SOIL EROSION; THE RAIN WATER ACCUMULATES IN THE BASINS AND SEEPS GRADUALLY AWAY.

The donkeys and goats, so universal in the north, are similarly to be penned and manure prepared in the same way. On this system a family can easily farm twelve acres.

A visit to the experimental farm near Kano, which fortunately took place after nearly four inches of rain had fallen during the night, convinced me that the introduction of the plough into the light land of northern Nigeria is liable to prove a curse which will more than outweigh the blessing conferred by mixed farming. Every furrow is a water course taking off the needed water, every one an incipient erosion gully (Fig. 1). Cross-ploughing at intervals is not a remedy—a new gully is formed—nor is contour ploughing in this gently undulating plain land sufficient.

Fortunately the local cultivator has already evolved a system which points the way. Instead of the yam hills of the south are ridges (from three to six feet apart and from nine inches to thirty inches high) crossed at intervals by ridges at right angles. Instead of the long straight plough-furrow the result is a series of isolated basins. Into these are swept the finer particles of soil during a storm but no soil is lost, for the basins fill with water, which later seeps away. Only rarely does a ridge give way, and even so it is easily repaired. When the land is prepared for the next year's crop the new ridge takes the place of the previous hollow, so that the soil is well mixed again (Fig. 2). The same result can be achieved by ploughing, if the plough is lifted at intervals. This can readily be done with the light plough used. It is clear that the careful use of cover-crops (a dirty farm is probably better than a well-weeded one), the restoration of fertility by leguminous crops, and the maintenance of wind breaks or 'protection forests' (the Forestry Department in conjunction with the French authorities are to preserve the remaining tracts of scrub and woodland along the international border) are all necessary in addition, as well as the control of areas where erosion is already serious.

If America could invent a plough which will imitate the Nigerian system by replacing the long furrow by a series of isolated elongated basins, one at least of her major problems in the dry lands of the Middle West might be solved.

Observations made in the Highest Stratosphere Flight

A DETAILED account has been published* of the scientific results of the flight of *Explorer II*, in which, on November 11, 1935, Major A. W. Stevens and Captain O. A. Anderson ascended to a height of 72,395 feet, or 12·7 miles. This is the greatest height ever reached by man.

To prevent any possibility of a repetition of the disastrous explosion which occurred during the descent of *Explorer I*, it was decided to fill *Explorer II* with helium, even although this meant making the balloon considerably larger. The difficulties of filling these huge balloons are very considerable, and the most suitable place that could be found for carrying out this operation was the "Stratosphere Bowl", a natural crater in South Dakota providing complete shelter from the wind. It was intended to make the ascent in June, but when the balloon was half full the fabric burst round the 'rip-panel'. This panel was to be used for rapid deflation when the balloon landed. As a result of this mishap, the balloon had to be considerably modified and was not ready until October, and suitable weather for the ascent did not occur until November.

A great many people co-operated to make this flight a success. Measurements were made of the angular distribution of cosmic rays, and the nature of the corpuscles forming them, the distribution of ozone, the conductivity and constitution of the air in the stratosphere, and of the intensity of solar and terrestrial radiation. It was proved that the spores of certain moulds and bacteria can and do exist in the stratosphere, and an attempt was made with rather inconclusive results to find whether the great intensity of cosmic radiation would accelerate mutation in *Drosophila*.

Cosmic Rays

The cosmic ray measurements were for the most part carried out under the direction of G. F. Swann. For measuring the angular distribution of cosmic rays a battery of ten cosmic ray telescopes and 210 Geiger counters were used. Five of the telescopes were shielded with lead. The results of this work are illustrated in Fig. 1. In the case of the vertical telescopes, maxima were obtained at the heights corresponding to one and two metres of water below the top of the atmosphere respectively, but these maxima were less pronounced at greater zenith angles. The existence of a maximum in the ionization-depth curve shows that it is secondary and not primary particles which do most of the ionizing, and the depth of the maximum gives a measure of the range of these particles. The cause of the second maximum is rather obscure.

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* "The National Geographic Society—U.S. Army Air Corps Stratosphere Flight of 1935 in the Balloon 'Explorer II'." (Contributed Technical Papers, Stratosphere Series, No. 2.) (Washington: National Geographic Society, 1936.)

It was unfortunately considered impracticable to take cloud chamber photographs of cosmic rays although a special chamber was ready to be taken up. This seems a great pity and in the opinion of the reviewer more useful information would have been obtained by taking up a cloud chamber than a wireless transmitting set. Instead, the balloon carried a number of photographic plates specially prepared with pinacryptol yellow. Such plates serve as continuously acting cloud chambers, in that ionizing particles leave characteristic tracks when the plates are developed; moreover, by counting the grain spacing under a microscope, it is possible to distinguish the track of a proton from that of a heavier particle. The plates were packed in flat nitrogen-filled rubber bags, and some of them were placed almost in contact with compounds of different elements so that the effect of bombardment of these elements by cosmic ray particles could be observed. Locker and Rumbaugh concluded that α-particles form at most a fraction of 1 per cent of the ionizing particles. The neutron intensity at an equivalent of half a metre of water is more than 2,000 times as great as at six metres, and at this height they form a considerable proportion of the ionizing particles although they carry less than 2 per cent of the energy. The rest of the energy must be carried by photons, positrons and electrons, which cannot be detected by this means.

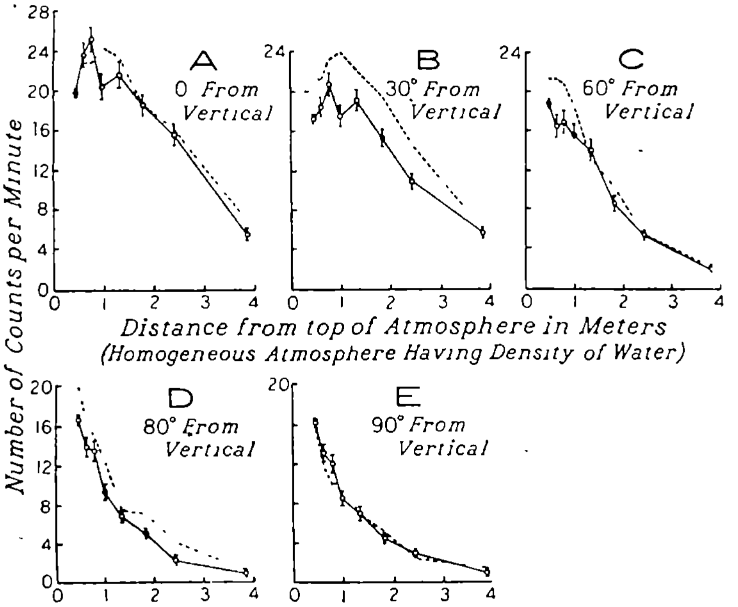


Fig. 1.

IONIZATION-DEPTH CURVES. THE FULL LINES REFER TO SHIELDED, THE DOTTED LINES TO UNSHIELDED, COUNTERS.

The technique which has been evolved for using photographic plates as continuously acting cloud chambers should prove very valuable and, as there is no need to have a manned balloon to carry the plates into the stratosphere, it is to be hoped that this work will be continued with unmanned balloons.

OZONE

The ozone measurements were made with an ultra-violet spectroscope developed by O'Brian, the amount of ozone between the observer and the sun being deduced from the absorption of the ultra-violet rays. As it was not possible to keep the instrument pointed directly at the sun, sunlight was scattered into the instrument by a diffusing sphere. This also scattered sky light into the instrument, but the effect of this seems to have been neglected. A second instrument was carried to make spectrograms of the sky 9° above the horizon, and with this it was hoped to deduce the distribution of ozone above the balloon, although it is not very clear how O'Brian intended to do this. The second instrument might have been better employed on the ground to measure the changes in the total amount of ozone during the flight.

It is evident from Fig. 2 that the distribution of ozone found by O'Brian on the flights of *Explorer I* and *II* do not agree well with those found by Regener with unmanned balloons, nor with those found by Götz, Meetham and Dobson at Arosa from measurements on the ultra-violet spectrum of the zenith sky at sunset. His distribution agrees more closely with those found by Meetham at Tromsø in latitude 69° 40′ than that at Arosa, which is at about the same latitude, namely, 40°. There was little ozone near the ground or below 15 km., and the maximum concentration was at 22 km., almost exactly the height reached by the balloon. The other workers found much larger concentrations near the ground.

CONDUCTIVITY

Knowledge of the electrical conductivity of the atmosphere in fine weather is of great importance as it enables us to find the potential of the Heaviside layer. If we assume that the vertical air-earth current is constant and equal to i units per sq. cm., then if λ is the total conductivity (equal to the sum $\lambda_+ + \lambda_-$), the potential is $i\int_0^H \frac{dz}{\lambda}$.

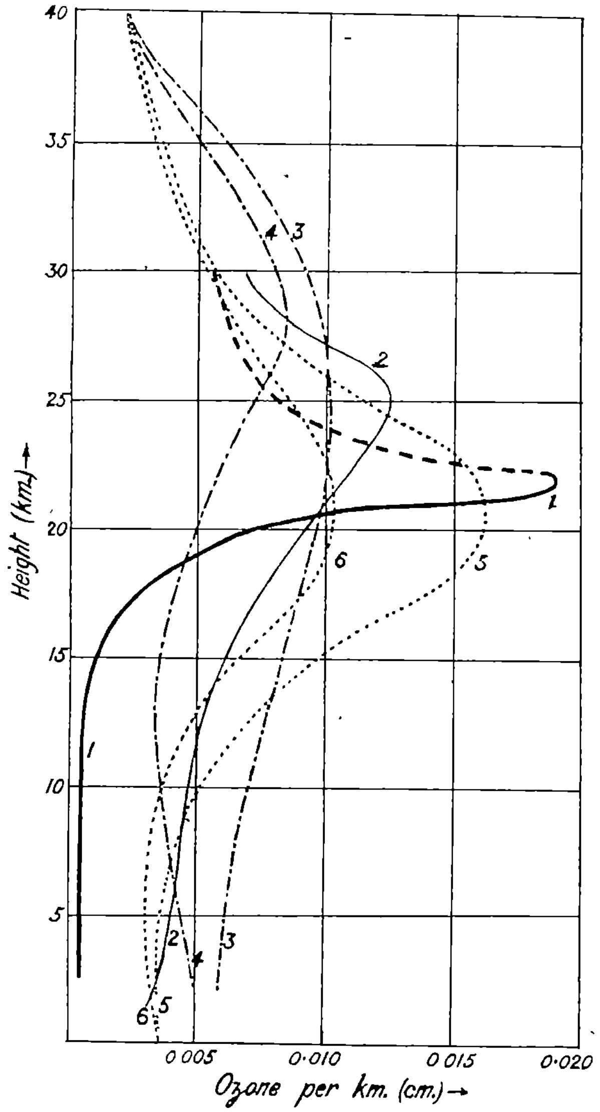


Fig. 2.

Ozone per kilometre as a function of altitude.

Curve 1. Flight of *Explorer II*. Total ozone. $x = 0 \cdot 19$ cm. Dotted part derived from sky observations.

Curve 2. Regener's sounding balloon. $x = 0 \cdot 28$ cm.

Curves 3 and 4. Ground determinations by Gotz, Meetham and Dobson at Arosa. Curve 3: $x = 0 \cdot 20$ cm. Curve 4: $x = 0 \cdot 30$ cm.

Curves 5 and 6: Ground determinations by Meetham at Tromsø. Curve 5: $x = 0 \cdot 30$ cm. Curve 6: $x = 0 \cdot 22$ cm.

Regener and others have measured the ionizing power of cosmic rays at different heights at the same latitude as Dakota; making certain assumptions and neglecting the effect of nuclei of condensation, the positive conductivity should be

$$\lambda_+ = 9{\cdot}8 \times 10^{-6}\frac{T^{5/3}}{p}I^{\frac{1}{2}}.$$

It is of great interest to compare this value with a direct determination.

Gish and Sherman constructed a rather ingenious modification of Gerdien's apparatus for measuring the conductivity. It consisted of a charged insulated rod in a cylindrical condenser through which air was aspirated. When the rod had lost a certain charge and therefore reached a critical potential, it was automatically recharged and a mark was made on a spiral record. By means of switches the potential to which the rod was charged could be made positive or negative and could be given various values, so that the same apparatus could be used for measuring positive and negative conductivities at several sensitivities.

The air conductivity was enormously greater at high altitudes than near the ground, but at all altitudes the positive and negative conductivities were in the constant ratio 0·78. This is not in agreement with laboratory experiments, but these are probably vitiated by free electrons. The conductivity on the descent was less than that on the ascent, but the authors believe that on the ascent the air was contaminated by gases from the balloon.

The conductivity was not equal to $9{\cdot}8 \times 10^{-6}\frac{T^{5/3}}{p}I^{\frac{1}{2}}$, but it can be seen from Fig. 3 that from 3 km. to 18 km. it agreed very well with the formula

$$\lambda_+ = 9{\cdot}8 \times 10^{-6}\frac{T^{5/3}}{p}I^{\frac{1}{2}}.\left(\frac{p}{p_0}\right)^{0\cdot36}$$

where p_0 is the pressure on the ground.

Below 3 km. divergence from this value was to be expected because of the presence of nuclei of condensation. The authors suggest that the discrepancy above 18 km. was either due to the fact that the air was not drawn sufficiently fast through the Gerdien condenser, or to the presence of more nuclei. Some support to the latter hypothesis is provided by the fact that a new air mass was encountered at about this height. That there can be nuclei of condensation in the stratosphere is proved by the occasional occurrence of mother of pearl clouds at 18–30 km.

It is very much to be hoped that this work will be followed by further experiments with unmanned balloons. In any event Gish and Sherman are to be congratulated on a very valuable piece of work. They deduce a potential for the Heaviside layer of about 400,000 volts.

AIR COMPOSITION

In the troposphere, the air is being constantly mixed, and has almost perfectly uniform composition except with regard to water vapour and carbon dioxide. The great stability of air in the stratosphere to be expected from the absence of temperature gradient led people to expect that in this region each gas would behave independently of the others, so that there should be an increasing preponderance of light gases at great heights, for example, hydrogen and helium. However, the behaviour of balloons in the stratosphere has shown the existence of considerable winds giving rise to mixing; the extent to which this mixing is complete is of considerable interest to the geophysicist.

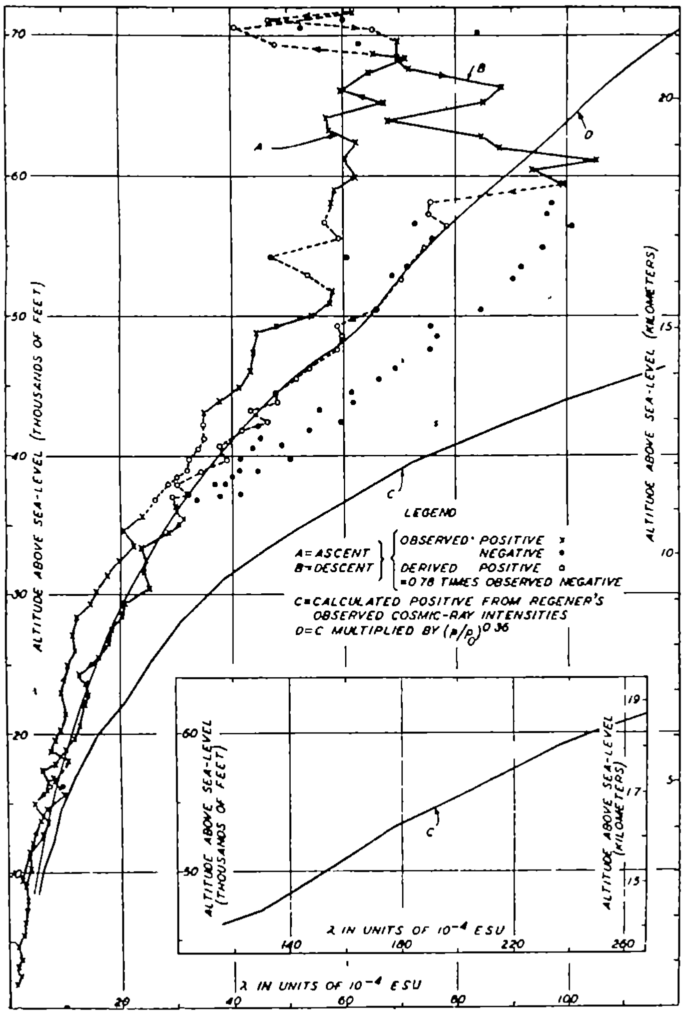


Fig. 3.

AIR CONDUCTIVITY, FLIGHT OF *Explorer II* NEAR RAPID CITY, SOUTH DAKOTA, NOVEMBER 11, 1935.

Various methods have been devised by which samples can be taken with unmanned balloons, and in England a good deal of work of this nature has been done by Paneth and Dines; with small sounding balloons, however, it is difficult to get large enough samples for very accurate analyses. *Explorer II* carried up three flasks, all of which were exposed at about 21·5 km., just at the beginning of the descent. The third of these had a very ingenious valve for admitting air, but unfortunately this failed owing to the presence of a drop of oil in a capillary tube.

Paneth has shown that helium provides the best criterion of mixing, since the amount of hydrogen is everywhere negligible, and helium is the next lightest gas. The two samples were analysed for helium, oxygen and carbon dioxide, the former by measuring the residue when the other gases were absorbed in charcoal. The amount of helium was about fifty times what was to be expected, but this only shows that the air was contaminated by helium from the balloon.

Oxygen was determined both by absorption in potassium pyrogallate and by combustion with hydrogen. The two methods agreed well, and the final results were:

Carbon dioxide	0·029 ± 0·002
Oxygen	20·895 ± 0·003

At ground-level the proportion of oxygen is 20·945 per cent. The authors are uncertain whether the difference can be regarded as representative or whether under the peculiar weather conditions of the flight the air which they sampled was not brought down from even greater heights.

MICRO-ORGANISMS

Rogers and Meier performed experiments to determine whether there are any spores present in the stratosphere. It is well known that these can withstand great extremes of cold; their presence in the stratosphere would throw much light on the spread of micro-organisms, and would also demonstrate the mixing between stratosphere and troposphere air.

A special spore-collecting apparatus was devised which was dropped from the stratostat at 71,000 feet. It was carried down by a parachute which would open some time after leaving the balloon. As soon as the parachute opened the collector was exposed. It was afterwards closed by syphon bellows at 36,000 ft., which is just about the height of the base of the stratosphere.

Every precaution was taken to avoid contamination, and on incubation on agar jelly at 30° C. five colonies of bacteria and five moulds developed. The bacteria were all different and afterwards withstood temperatures much lower than those encountered on the stratosphere flight. The moulds were identified as *Rhizopus*, *Aspergillus niger*, *Aspergillus fumigatus*, *Penicillium cyclopium* and *Macrosporium tenuis*, all of which have frequently been collected on aeroplane flights.

CONCLUSION

A considerable amount of very useful data was obtained on this flight, and one has great admiration for the intrepid aeronauts who navigated the balloon, and the ground staff who made the flight possible. Nevertheless, one is inclined to wonder whether, from a purely scientific point of view, the money would not have been better spent in sending up a large number of unmanned balloons. Practically all the apparatus was entirely automatic in operation and it was merely necessary for the crew to press a few switches. It might be rather difficult to operate the cosmic ray apparatus and ozone spectrographs in an unmanned balloon, but Regener has succeeded in doing this. The total weight to be carried up was enormously increased, both by the passengers themselves and by the air-tight stratostat with its air-conditioning apparatus. On the other hand, the popular appeal was far greater, which doubtless made it much easier to collect the necessary funds.

It is hoped that this flight will soon be repeated, as isolated observations become far more useful when substantiated by further data.

The report of the flight contains several very interesting photographs taken at the top of the flight. The most striking features in these pictures are the effects of erosion on the topography of South Dakota, and the sharpness of the top of the haze layer. Even more interesting are the photographs taken from an aeroplane at the exact moment of landing of the balloon.

R. T. P. W.

Obituary Notices

Sir James Crichton-Browne, F.R.S.

SIR JAMES CRICHTON-BROWNE, who died on January 31 at the age of ninety-seven years, was born at Dumfries in 1840. His father was Dr. W.A.F. Browne, who became Commissioner on Lunacy for Scotland, and was at the time of his son's birth head of a famous private asylum in Dumfries—the Crichton Royal Institution. Crichton-Browne as a boy saw his father applying new methods to the treatment of the insane; they were treated as if they were rational human beings—they were employed according to their bent in the day-time, entertained in the evening and surrounded with the comforts of a home. His father believed in education—particularly of the young medical men who were to devote their lives to the care and treatment of insanity. It was in the late fifties of last century, when Crichton-Browne was a medical student in the University of Edinburgh, that Prof. Laycock of that University began to give lectures on the disordered psychology of the insane. In no other university or medical school in Great Britain was any attempt made to give systematic lectures on insanity. It was otherwise on the Continent.

It cannot, therefore, be a matter of surprise to find young Crichton-Browne, when he became a qualified medical man in 1861—he being then twenty-one years of age—resolving to do for the insane of England what his father had done for their unfortunate brethren in Scotland. In the year in which he qualified, he gave a paper to the Royal Medical Society of London on "The Clinical Teaching of Psychology". It is difficult to believe, as one reads that lecture now, that its mature thoughts are those of a young man of twenty-one. "There are," said he, "in the midst of your civilization, currents swift and relentless which are ever hurrying on countless contributions to that whirlpool in the vortex of which so many minds float wrecked". The full and rounded style with which he enlightened his listeners in those later days was already developed in 1861.

Newcastle-on-Tyne had discernment, and snapped up this young medical Scot and placed him in charge of its asylum, and the medical school of that city made him its lecturer on medical psychology. While still in his twenties (1866), he was made medical director of the West Riding Asylum at Wakefield. He brought enlightened and humane methods with him, and believing that the foundation of all progress in medicine depends on research, had a laboratory built and equipped in connexion with the asylum. A glance at the reports which were issued under his direction will show how well he planned. The most famous of all the researches done there was that which laid the fame of the late Sir David Ferrier (1843–1928). In the spring of 1873, Ferrier visited the West Riding Asylum, Ferrier being then thirty years of age. Crichton-Browne was his senior by three years, they had been at the University of Edinburgh together. A discussion sprang up on the experiments which Fritsch and Hitzig had done on the brains of dogs. The result was that Ferrier stayed on to repeat similar experiments and ultimately proceeded to apply faradic stimulation to the cortex of the brains of monkeys. These experiments laid the basis of our knowledge of localization of function in the cortex of the human brain. The incident is worthy of notice, for it illustrates the manner in which Crichton-Browne helped in the growth of scientific knowledge. There was no jealousy in his composition; he welcomed knowledge from any source, so long as it was real knowledge.

In 1875, Crichton-Browne left Wakefield to become a Lord Chancellor's visitor in lunacy. It was thus early that he became a feature of London social life: no gathering of medical or of scientific men seemed complete without him; he had a rare zest for public life. He was elected to the Royal Society in 1883, and at the time of his death he was senior fellow. In 1880, he became a member of the Royal Institution. James Dewar was then in the fourth year of his directorate; both men were steeped in the Edinburgh tradition. In 1889 he took over the honorary treasurership of the Institution, and held that office and all that it embraces until 1926. He was elected to the Athenæum Club in 1893. He took an active part in all medical societies which concern themselves with the life and disorders of the human brain.

It was during the later part of his treasurership at the Royal Institution that the writer of this note had the privilege of his friendship. One incident may be mentioned because of the light it throws on Crichton-Browne's character. Sir James Dewar was not always an easy colleague and was at times dictatorial—almost outrageously so. It so happened that towards the end of the Great War, Prof. H. H. Turner of Oxford was busy in the theatre of the Institution making ready for his Christmas lectures for children. Dewar entered to find Turner grouping a class of young children to represent the heavenly bodies and their movements. "What is this?" demanded Dewar. Turner explained. Dewar banned the scheme out of hand. Turner banged the lecture-room door and refused to return—on the eve of Christmas. It was then that Sir James Crichton-Browne appeared on the scene and in two days had peace restored and lectures assured. It was all accomplished by clear thinking, honest speaking and the pertinacity of a good heart. He combined in his person and in his mentality traits of both the centuries in which he had lived. He dressed his beard and his hair to the last in the fashion which prevailed when he was a young man in the late 'fifties; his oratory was of the kind beloved by the Gladstonians, but his attitude towards affairs was always modern.

Crichton-Browne loved his native town—Dumfries and all connected with it—especially Burns and Carlyle. His pen never wearied in their defence. Next to Dumfries came Edinburgh and its great men—especially Walter Scott. His interests were so diverse and so wide. Among his writers, Shakespeare stood highest, Scott next. His pen was always busy—always in search of his country's good. It is not necessary here to give a list of the non-professional books he wrote—from "The Nemesis of Froude" (1903) until the last of his reminiscences, which began to appear after his official retirement in 1922. The first volume of this series, "Victorian Jottings", appeared in 1926; the fifth, "The Doctors After-Thoughts", in 1932. Up to the last he and Lady Crichton-Browne went every year—spring and autumn—to breathe his native air at Crindau, Dumfries. It was during a visit to Crindau that death came to him. His brother, Balfour Browne, was the most successful parliamentary barrister of his time. Crichton-Browne himself had the makings of a great judge. Indeed he was a very great Victorian, the last of them. He was great not because of any contribution he himself made to medicine or science, but because he fostered the conditions which ensure the birth of knowledge in others. He was great both for what he did and for what he was. A. K.

Sir Thomas Stanton, K.C.M.G.

THE sudden death on January 25, at the age of sixty-two years, of Sir Thomas Stanton has come as a great shock to his many friends, both at home and abroad. Although Stanton, as director of Government Laboratories, Federated Malay States, and later, as chief medical adviser to the Colonial Office, occupied prominent positions throughout a large part of his life, he never sought publicity, and the public never fully appreciated the work which he had done on beriberi, on malaria and other diseases, or his work at the Colonial Office in reorganizing the Colonial Medical Service.

Stanton went to Malaya in 1907 and was soon engaged in the work with which, perhaps more than any other, his name will be permanently associated—the discovery of the cause of beriberi and of means for its prevention. At the beginning of this century, beriberi was certainly a medical puzzle. Its neuritis and paralysis were so similar to alcoholic and lead poisoning that few people doubted that beriberi was the result of the entry into the body of some poison. The late Dr. W. L. Braddon strongly maintained the hypothesis that the poison entered the system in white polished rice, and that it was absent from par-boiled and partly polished rice. But evidence that rice was not a factor seemed so conclusive from experiments conducted by the late Dr. E. A. O. Travers in two jails at Kuala Lumpur that in Manson's "Tropical Diseases", third edition (1903), it is stated: "This view has been disposed of effectively by experiments by Dr. Travers. This experiment was prolonged and scrupulously carried out." Braddon was not convinced, and a polemic ensued, as a result of which Dr. William Fletcher carried out an experiment in his hospital wards at Kuala Lumpur at the suggestion of his chief, Dr. Travers.

The question was far from being one of merely academic interest. There were hundreds of new cases of beriberi every year in Malaya. The tin mines suffered severely. Sometimes the disease attacked the jails so seriously that a sentence of six months' imprisonment threatened to be a sentence of death, or what might perhaps be regarded as worse, a life sentence of paralysis following beriberi. Fletcher set out to confirm Travers's view that rice played no part in causing beriberi. At the end of the experiment, he was convinced that rice was the cause of the disease. The next question was, How did the rice produce beriberi? It was at this point that Stanton and Fraser of the Institute for Medical Research entered on their work, which not only showed exactly how rice produced beriberi but also what rice produced beriberi and what rice did not produce the disease. They showed further that the disease was not, as Braddon maintained, caused by a poison in the rice, but was a deficiency disease caused by the removal of the pericarp in the polishing of the rice; and they proved that if a fowl were suffering from beriberi as a result of being fed on a polished rice, it could be rapidly cured by giving it the polishings. They found that unpolished rice never produced beriberi in fowls, and with the introduction of unpolished rice into the jails the disease rapidly disappeared. For a time it looked as if the amount of phosphorus pentoxide (P_2O_5) in rice could be taken as an indicator of the danger of beriberi developing, but further observations showed that this test could not be relied on.

The discovery was of great value in itself, and of vast economic importance to Malaya; so much so that had it stood alone it would have justified all the money that had been spent on the Institute for Medical Research from its foundation. But it had a still greater significance, for it suggested lines of research into other diseases, which in their turn proved to be deficiency diseases. To-day vitamins are a household word, and the accessory foodstuffs are studied in probably every country in the world. There can be few Governments which are not inquiring into and trying to improve the food of their nationals on the lines of the discovery made by Stanton and Fraser.

Space will not allow me to say much more on Stanton's work in Malaya. From 1911 until 1926 we were colleagues on the Malaria Advisory Board in the Federated Malay States, and Stanton's interest in this subject was shown not only by his valuable contributions to the discussions of the Board, but also by his researches into the morphology of the anopheline larvæ, which were of material assistance to the practical work of mosquito control and the prevention of malaria in Malaya.

May I conclude with a personal remark. No one could come into contact with Stanton without realizing that behind a quiet demeanour lay an active brain, carefully balancing the pros and cons of everything he discussed. What was perhaps not less important, he was a man who could be trusted; a scientific investigator of distinction and a great gentleman.

MALCOLM WATSON.

Dr. W. W. Vaughan

NEWS of the death on February 4 of Dr. W. W. Vaughan, as the result of an accident, will be received with deep regret by his many friends in scientific circles. A note in last week's issue of NATURE, p. 236, described the circumstances of the unfortunate fall, while visiting the Taj Mahal at Agra, which resulted in his death. When we went to press, it was reported by cable that his condition after the amputation of his leg was favourable, and it was hoped that he would make satisfactory progress toward the recovery of his normal good health. Those, however, who saw the serious nature of the accident at the time of its occurrence, when Dr. Vaughan had to lie in the open with a compound fracture for more than an hour before an ambulance could be found to move him to the Thomason Hospital, scarcely expected that he could recover, and their fears have been sadly confirmed by the fatal result.

Dr. Vaughan was one of the few headmasters of public schools who had been presidents of the Educational Science Section of the British Association; and he was distinguished among all of them who have occupied this office in the continued part he played in the work of the Association. It was while visiting India as a member of the delegation of the Association to the jubilee meeting of the Indian Science Congress Association that he met with the accident which has led to his death.

Dr. Vaughan was born in 1865 and was the son of Prof. H. H. Vaughan, regius professor of modern history in the University of Oxford. He was educated at Rugby School, New College, Oxford, and the University of Paris; and his main subjects were modern languages. In 1890 he became an assistant master at Clifton College, where he remained until 1904, when he was headmaster of Giggleswick School. From 1910 until 1921 he was master of Wellington College, and he then returned as headmaster to his old school, Rugby, where he remained until his retirement in 1931. He was president of the Modern Language Association in 1915, of the Incorporated Association of Headmasters in 1916, of the Science Masters' Association in 1919, and of the Education Section of the British Association in 1925. He served on the Consultative Committee of the Board of Education and on the Government committee appointed in 1916 under the chairmanship of Sir J. J. Thomson, on the position of natural science in the educational system of Great Britain. At the time of his death he was a member of the Council of the British Association and of the Advisory Committee on Education in the Colonies.

When Dr. Vaughan was president of the Science Masters' Association he dealt, in his presidential address, with the importance of science as part of a liberal education. He urged that the aim of scientific instruction should not be purely utilitarian but that of education as a whole—the liberation of man's soul. He referred to these objects again in his address to the Educational Science Section of the British Association. "We seem almost to have lost the will," he said, "to keep by education the pores of the soul and the mind ever open to the impressions of experience, to the stirrings of emotion, to the slow and enduring influence of the reason. We have too often pinned our faith on the production of dexterity, of mental facility, of almost thoughtless accuracy, and we have our reward in our educational looms being ill-adapted to the production of contentment and beauty and the power or the will to reason."

It was because Dr. Vaughan cherished these high educational ideals that his influence while a school master and since his retirement is appreciated by all who have come under it. By his lamented death, the educational interests of science have suffered a severe loss and his many scientific friends have to mourn the passing into silence of a helpful colleague.

WE regret to announce the following deaths:

Prof. H. H. Donaldson, for thirty-two years professor of neurology in the Wistar Institute of Anatomy and Biology, Philadelphia, known for his work on growth, particularly of the nervous system, on January 23, aged eighty years.

Mr. Alan E. Munby, architect of Clifton College Science School and other important science laboratories, on January 19, aged sixty-eight years.

Dr. Andrei Vassilievitch Martynov, professor in the Institute of Palæontology at Moscow, well known for his work on Trichoptera and fossil insects, on January 29, aged fifty-nine years.

Dr. F. G. Pease, of Mount Wilson Observatory, where he was responsible for the design of many large instruments, on February 7, aged fifty-seven years.

Prof. Herman Schlundt, chairman of the Department of Chemistry of the University of Missouri, known for his work on radioactivity, on December 30, aged sixty-eight years.

News and Views

The London School of Economics

IN a leading article on "Realistic Social Studies" in NATURE of January 22, incidental reference was made to the London School of Economics and it was stated "that responsible bodies which administer funds for research . . . have refused to renew temporary grants such as the Rockefeller subsidy to the London School". We are informed that the facts with regard to the Rockefeller Foundation are as follows: "During the past three years, four temporary grants from the Foundation to the School have been in force. Two of these for the purpose of site extension and library development still remain available; a third, providing funds for research, terminated in 1935 and was then renewed on a somewhat different basis for a five-year period; the fourth grant, providing facilities for post-graduate teaching and research, does not expire until the end of the current academic year. No formal application has yet been made by the School for the renewal of this grant: hence, no action has yet been taken. If the editorial of January 22 seems to imply that there has been any criticism offered or expressed by 'responsible bodies which administer funds for research' such an implication does not exist. In point of fact, no criticism as to the teaching and research in economics under way at the London School has ever been made on the part of any Foundations which have assisted it in the past and assist it now." The context of our comment made it clear that it referred to the grant which terminated in 1935, and that it had no relevance to any allocations for the purchase of books, for site extension or for post-graduate instruction. We were in receipt of full information concerning the "somewhat different basis" on which the grant was renewed. If, as we understand, the previous annual grant which terminated in 1935 was replaced by a reduced and tapering allocation, there seems little ground for objection to the statement published in our editorial. The main purpose of the article was to urge that the new Institute of Economic and Social Research should "tackle the fundamental problems arising from the way in which expanding technical resources react upon, and are used by, existing social institutions"; and the purpose will have been served if the article leads to the extension of social research in these directions. With Prof. Carr-Saunders as the new director of the School it may confidently be expected that increased encouragement will be given to such studies.

American Institute Awards

DR. W. CROCKER has been awarded the Gold Medal of the American Institute of the City of New York for "his contribution to knowledge of life processes in plants and for his unique leadership in the organization of plant research". Dr. Crocker was professor and director of research in plant physiology at the University of Chicago for many years. He organized and has directed the Boyce Thompson Institute for Plant Research from the time it was founded in 1921 to the present day. At the University of Chicago and the Boyce Thompson Institute for Plant Research he has acquired a reputation as an organizer and director of research. His method has been to bring together specialists in different fields of knowledge and to give these specialists an opportunity to work co-operatively on biological problems that have not yielded to attacks by individuals working single-handed. Dr. Crocker has also done noteworthy research. He was the first to show that ethylene gas in air in amounts far too small to be detected by any known chemical means causes profound reactions in plants. He proved that ethylene 'puts plants to sleep'. He has shown how certain seeds that remain dormant for many years may be induced to grow if given proper treatments. Low temperatures, chemicals, light and other environmental agencies have been used to break these long rest periods. His work on the physiology of dormancy in seeds has contributed to fundamental knowledge of life processes. The Gold Medal of the American Institute may be awarded either to organizations or to individuals.

WALDEMAR KAEMPFFERT, science editor of the *New York Times*, and Dr. Raymond L. Ditmars, curator of reptiles and mammals of the New York Zoological Park, have been awarded fellowships of the American Institute for their contributions to science. Mr. Waldemar Kaempffert was awarded the fellowship "for his scholarly interpretation of scientific advances, for his editorial wisdom, for his adroit cultivation of the public mind toward a rational outlook and for his leadership in enforcing their social responsibilities upon scientists". Mr. Kaempffert, who is president of the National Association of Science Writers, has for many years been a leader in the promotion and maintenance of the high standards of science reporting in the United States. He took up his duties as science editor of the *New York Times* in 1927, leaving in 1928 to become the first director of the Museum of Science and Industry in Chicago. He is responsible for the real establishment of that great institution for the interpretation of science to the public. Mr. Kaempffert returned to the *New York Times* in 1931, where his weekly columns on the latest developments of science have become a source of invaluable information to thousands of readers not only on the facts of science but also on its philosophy.

DR. RAYMOND L. DITMARS has received the American Institute fellowship "for his thirty-seven years of distinguished service in the care, understanding and interpretation of the reptile world and for his inspiring of youthful spirits with the zeal of the naturalist". Dr. Ditmars is the author of many fascinating volumes on his work with snakes, including "The Making of a Scientist", "The Thrills of a Naturalist's Quest", "Snakes of the World" and "The Forest of Adventure", which latter presents his subject especially for boys and girls. At his laboratory in the New York Zoological Park, Dr. Ditmars is engaged in biochemical research on the subject of snake poisons as a useful substance for the treatment of certain human ailments, including hæmophilia, the reduction of pain, and epilepsy. In announcing these fellowships, Dr. Gerald Wendt, director of the American Institute, explained that they were awarded each year by the Institute to "persons who have done outstanding work in the interpretation of scientific, engineering or industrial work, which promotes with effectiveness the knowledge and general understanding of these arts and sciences. The recognition of these interpreters of science is an important element in the Institute's programme, which has as its primary purpose the integration of scientific advances with the social structure."

The Soviet North Polar Station

DURING the last two months, the Soviet observatory placed on a floe near the North Pole in May 1937 has been drifting rapidly southward in the East Greenland current. Fortunately for the safety of Papanin and his three companions, the drift cleared the north-east corner of Greenland and the floe appears to have kept to the outside of the stream of ice down the coast On February 3, the station was reported to be in lat. 74° 8′ N., long. 16° 24′ W., which was within about eighty miles of the Norwegian observatory o Myggbukten at the mouth of Franz Josef Fjord in East Greenland. It is reported that although this station is not functioning, it shelters a wintering party of four men provided with dog teams. To try to reach the shore, however, over the drifting and grinding pack would be difficult and hazardous The floe on which the Soviet party is living has split; the men have lost some of their equipment and are now on a small floe, but they have their tents, instruments, three months' stores and sledges.

RELIEF for the expedition is being hurried forward but will be impeded by the winter darkness and the difficulty of finding an adequate landing place for aeroplanes. *The Times* reports that the small wooden survey vessel *Murmanets* is near Jan Mayen, a distance of less than two hundred miles, and that the Arctic ship *Taimyr* has left Murmansk with aeroplanes and dog teams. Cinematograph equipment is being taken by the *Taimyr* and it is hoped to film the voyage of the vessel, the North Polar station, the removal of Papanin and his companions from the ice-floe and their return home. As the work will have to be done in the darkness of the Polar night, portable lighting equipment to be operated by current from the *Taimyr* is being taken. In th event of the vessel being unable to approach clos enough to the ice-floe, a small portable generator and magnesium flares will be used. The *Taimyr* ha been delayed by heavy weather and the mor powerful *Murman* sailed from Murmansk on February 6. The icebreaker *Yermak*, with aeroplanes, was to leave Leningrad on February 8, but has a long journey ahead of her. Aeroplanes are also leaving Green Harbour, Spitsbergen. Prof. O. Schmidt i directing the relief operations. Papanin's messag that wireless communication may be interrupted bu that there is no immediate danger expresses th daring of these adventurous men. The Norwegian and Danish authorities have offered to assist in th rescue work.

Colour Television at the Dominion Theatre, London

ON February 4, a surprise item was introduced into the regular programme of the Dominion Pictur Theatre, London. At 8 p.m. an experimental demon stration of Baird colour television was effected fo the first time in public. The sending station was the South Tower of the Crystal Palace, the wave-length employed being 8·3 metres. The quality of the pictures was naturally much inferior to those with which the present-day viewer is familiar: only 120 scanning lines being used as compared with the 400 lines now employed by the British Broadcasting Corporation. The projected picture was twelve feet by nine feet and could be clearly seen by everyone in this large theatre. It was illuminated by a high-intensity arc lamp. The programme included the transmission of fashion plates of ladies hats; the various coloured flowers were quite brilliant and the gaily and variegated headgear sometimes used by officers abroad came out very distinctly. A coloured cartoon of Popeye the Sailor caused much amusement. Colour television is still in the early stages of development, but the transmission was very successful and the unexpected show was well received by the spectators.

The present apparatus used by Baird Television transmits a 120-line picture, the scanning at both transmitter and receiver being by mechanical means. The transmitter consists of a mirror drum with twenty mirrors inclined at different angles revolving at 6,000 r.p.m. These mirrors reflect the scene to be transmitted through a lens, causing an image to be formed on a rotating disk with twelve concentric slots at different distances from its periphery. By this means the field given by the 20-line drum is interlaced six times to give a 120-line picture repeated twice for each revolution of the disk. Each of the slots is covered with a light filter, blue-green and red being used alternately, the effect of this being to transmit alternate lines of the picture corresponding to a blue-green image and a red image. At the receiving station a similar device is employed, the rotating drum in this case being much larger (12 in. in diameter in place of the 8 in. at the transmitter). Light from a high intensity arc lamp is concentrated on the moving aperture in the disk and yields sufficient light to fill a screen 12 ft. × 9 ft.

Archæological Expedition to Syria

Sir Leonard and Lady Woolley, it is announced, are leaving England for Syria, where the British Museum Expedition under Sir Leonard's direction will resume excavations immediately at Tell Atchana in the Amk plain on the Orontes, North Syria. This site, as has been shown by the previous seasons' excavations, has surpassed anticipation in its importance for the cultural relations of Asia and the eastern Mediterranean at an early date. The results which have been obtained already, as has recently been demonstrated by Sir Arthur Evans, when correlated with the information now accruing from the excavations of French archæologists at the Syrian site of Ras Shamra, have already thrown light on chronological and other problems of the Minoan civilization of Crete, as well as indicated the extent of Cretan influence on Asianic culture. The work of the British Museum Expedition in the coming season will be devoted mainly to the further exploration and clearing of the palace, of which, as was pointed out by Sir Leonard Woolley in his recent lecture before the Royal Institution (see Nature, January 29, p. 194), the architecture both in material and in style is as essentially Cretan as the painted pottery discovered on this site. It is hoped that additions to knowledge of political and social conditions of the time may accrue from further discoveries of the cuneiform tablets, from which it has already been established that the building is a royal palace dating to about 1600 B.C. Sir Leonard Woolley will be accompanied by Mr. P. W. Murray-Threepland, who will again act as his assistant, and by Mr. Ralph Lavers, acting as architect of the expedition, who has had previous experience of archæological investigation at Tell el-Amarna in Egypt and in Crete.

Dynamic Ecology of Sand Dunes

At the Friday evening discourse at the Royal Institution on February 4, Prof. E. J. Salisbury discussed "Plants of the Sand Dunes and Why They Grow There". Sand dunes are a unique type of habitat. They depend on plants for their development. They show such rapid changes that the dynamic character of communities of plants is here forced upon our notice. Moreover, because a sequence in space corresponds to the sequence of development in time, the nature of these changes can be ascertained with certainty. The pioneer plants are rapidly growing grasses equipped with leaves which are so constructed that they automatically adjust their rate of water loss to the water income. Further, these grasses can endure burial by sand and are indeed stimulated thereby to grow through to the new surface. All these features enable them to endure the desert-like conditions and mobility of their rooting medium. Although the water content of young dunes is less than four per cent, it is maintained at a comparatively constant though low level owing to the occurrence in sunny weather of conditions that promote internal deposition of dew within the dunes. Sand dunes thus illustrate in a striking manner the dynamic character of vegetation and the fallacy of the widespread belief that to preserve a natural area all that is necessary is to leave it alone.

Dublin Zoo and Bird Sanctuary

At the annual meeting of the Royal Zoological Society of Ireland, held at Dublin on January 26, Lord HolmPatrick was re-elected president, Dr. J. Agar Matson honorary secretary, Mr. Cecil Pim honorary treasurer. It was announced that Dr. B. B. Farrer, superintendent and secretary of Dublin Zoo for the past twenty-six years, is retiring. Dr. Matson reported that during the year 1937 there was an increased attendance at the Zoo of 152,173 visitors as against 151,109 in 1936, receipts having increased from £3,561 to £3,661. Membership increased by 54. The Government's grant of £1,000 was continued and various improvements and works are being carried out, the new bear enclosure now nearing completion. More than £520 was spent purchasing and transporting animals like penguins, sea-lion, wolves, wallabies and laughing jackass; but owing to various restrictions some valuable animals offered could not be accepted. The meeting was followed by a lecture by Father P. J. Kennedy, a well-known local ornithologist, on the birds of Phœnix Park. Father Kennedy gave a detailed history of the formation of the Park until it was turned into a bird sanctuary in 1937, its trees, shrubs, lakes and ponds being so valuable. The birds he then discussed were the 83 species which have been observed in the Park, and included grey crow, rook, jackdaw, magpie, jay, starling, greenfinch, goldfinch (which he said is increasing), chaffinch, bullfinch, linnet, crossbill, yellow-hammer, skylark, pied wagtail, tree-creeper, black-cap and spotted fly-catcher.

The Maidenhair Tree

THE origin of the curious generic name, *Ginkgo biloba*, of this tree is very fully discussed, with reference to original Chinese and Japanese descriptions, by Prof. A. C. Moule in *T'Oung Pao*, 23, published by the firm of E. J. Brill, Leyden. The name seems to be due to Engelbert Kaempfer, a German naturalist (1651–1716) who was in Japan apparently about 1690–2. The Kaempfer MSS. are stated by Larousse to be preserved in the Museum of Botany at Leyden where, however, search has failed to find them; Prof. Moule, however, through Sir Albert Seward, has traced the original entries of Kaempfer in his manuscripts in the British Museum. These seem to make it clear that when Kaempfer, some eighteen years later, published the names from his original descriptions, he deciphered incorrectly an original manuscript entry of Sankyo in the form of *Ginkgo*, where it is difficult to decide whether the 'g' is a slip in transcription or a misprint that has been overlooked. Thus "this strange word, which is unpronounceable and probably ought never to have existed, has been for nearly two centuries and, I suppose, will always be the generic name of this beautiful and interesting tree". There is a very full discussion of the numerous Chinese names of this tree which are all either descriptive names of two or more words or are frankly borrowed from other trees, suggesting that the tree was not known in northern China during the centuries when the Chinese classical civilization and language were being formed. This may confirm the view of F. N. Meyer and others that the tree is indigenous in the forests of Chê-Chiang, but in favour of the other view that it survives only in cultivation is the fact that no large speqimens have been reported from forests. There is an interesting discussion of its fire-resisting qualities, which were exemplified by the recovery of many trees in Tokyo after the big fire that followed the earthquake in 1923; popular testimony thus made a huge *Ginkgo* tree largely responsible for the survival of the great temple of Kwannon at Asakasa; it was believed that the tree literally rained moisture on the roof, and also protected it against burning fragments carried in the wind.

Health Committee of the League of Nations

AT the twenty-fifth session of the Health Committe of the League of Nations, April 26–May 1 (G. Alle and Unwin, League of Nations Department 40 Museum St., London, W.C.1: Report to th Council on the Work of the 25th Session o the Health Committee, 1*s*.) the next three-yea programme was discussed and approved. Amon the permanent activities of the Committee, it work on biological standards is far from bein completed. New therapeutic agents gain acceptan with the advance of science and require assay i terms of some common standard, and other standard already adopted are either open to improvement or being composite, are liable to be replaced sooner o later by the active substance in pure form, apar from the possibility of physical or chemical method replacing the biological method. Forty-one countrie have adopted or are about to adopt the internationa standards recommended by the Permanent Commission on Biological Standards, and thirty-on Governments have established or are about t establish national centres, thus simplifying the tas of the central institutes at Copenhagen and Hampstead. For drugs like digitalis, pituitary extract an arsphenamine, no insuperable difficulties are anticipated in preparing national standards, but it is expected that for serological standards the Copenhage Institute will have to continue to supply internationa standard sera to most of the national centres. Th standardization of anti-anthrax serum, examined i 1925, requires further investigation in collaboratio with the Institute at Budapest and Bucharest Further study of the standardization of anti-swine-erysipelas serum is also necessary as well as consideration of changes in the international standard for tuberculin and staphylococcus anti-toxin. The standardization of anti-snake venom sera, pharmacological standards, as well as those for vitamins and sex hormones, also fall within the next three-yea programme of the Commission. Other matters i the programme of the Committee are leprosy, rural hygiene, housing, physical education, nutrition an opium and other dangerous drugs.

Dietetics and Social Problems

THE problem to what extent a wise social policy, taking into account modern scientific developments in the field of nutrition, can help to raise the standard of living in certain countries, or for certain categorie of population, which at present suffer from undernourishment or malnutrition, is being investigated by the International Labour Office, assisted by a Committee of Experts which met at Geneva on April 9–10, under the chairmanship of Mr. Bramsnaes. This committee discussed the efforts of the International Labour Office to demonstrate the progres of dietetic science and its importance in regard t social questions. Special stress was laid on th necessity of distinguishing between the physiological, health and social aspects of the problem, and it wa agreed that the studies should be studied simultaneously in various countries according to a uniform plan which would assist international co-ordination of comparative results. The projected investigations are aimed at determining the relation between nutritional requirements and different occupations, the economic and social effects of different policies of improving the standard of nutrition of workers and their families, and at defining the principles on which the regulation of wages, where it exists, is based and methods of fixing benefits under social insurance or assistance schemes. Other studies will deal with the nutrition of apprentices and young persons and of the unemployed, etc.

Rural Electrification

AT the present time many people are interested in the supply of electricity for thinly populated districts, but they are only beginning to realize that it is a very safe commercial venture. There is a great demand for an electric supply at a reasonable cost and the expense of advertising by demonstration vans, etc., is not great. In a paper on this subject read by J. S. Pickles to the Institution of Electrical Engineers on December 2 it is pointed out that in many countries abroad the public supply of electricity is regarded as a necessity. As a practical example of what can be done by borough councils, he gives a description of the Dumfries scheme, which covers the whole of a geographical county of 1,070 square miles in area. With the exception of only one town, no electrical development had previously taken place in the supply area. The scheme was begun six years ago, the electric supply being purchased by the borough from the Central Electricity Board. The policy adopted aimed at providing supply to every consumer without asking him to make a contribution towards the capital cost, no matter what was the length of his necessary service main. Neither was he asked to pay any guaranteed minimum revenue. The adopted scheme provided for the immediate erection of a comprehensive system of overhead wires with the necessary transformers, etc., capable of giving a supply practically to all prospective consumers within the area. It was recognized that the expenditure of large capital sums in the early years would lead to commercial deficits unless the development amongst consumers was very rapid.

THERE is an assisted wiring scheme extending over five years for the consumer and no initial payments of any kind are required. A two-part tariff is usually adopted. The consumer pays ¾*d*. per unit for running costs and 5 shillings per room per quarter, no charge being made for sculleries, bath rooms, box-rooms, etc., and 20 is the maximum number of rooms for which a charge is made. A radiator can be hired for 1*s*. 6*d*. per quarter and a wash boiler for 2*s*. 6*d*. A two-part tariff meter has been adopted, which collects both the fixed and the running charges. Very few of the consumers go for long holidays, and so the supply is never cut off for long periods. As many of the consumers have 'all-mains' wireless sets they never allow their supply to be cut off for long. During the first five years of working the scheme there have been small deficits in the year's working, but it is estimated that from the sixth year onwards there will be a profit. Doubtless later on there will be a reduction in the consumer's charges, as the demand seems constantly increasing.

The *Modern Quarterly*

WE welcome the first number of the *Modern Quarterly* (offices: 2 Parton Street, London, W.C.1), because throughout it proclaims the supreme importance and the social function of science in the contemporary world. But we must add a qualifying regret that it appears both from its contents and the personnel of its editorial council to be inclined to identify the progress of science with one form of the organization of society and especially of industry. This must prejudice many readers against the suggestive ideas and generally high aims of the promotors. Must we accept Marx, Lenin and Russia, it will be asked, as the gospel and best exemplification of science in society? Are not the more liberal, though more slowly moving societies, like our own, perhaps doing the work of human evolution even more effectively in the long run, certainly without the bitterness and the bloodshed of the revolutionary method? But these are large questions impossible to discuss in a note. Of the articles in this number, two should be especially mentioned: the first, by Prof. H. Levy, acutely criticizing the mechanistic explanation of the universe, and the fourth, by Dr. Joseph Needham (the bulk of his Herbert Spencer Lecture at Oxford), in which he attempts a revaluation of Spencer's presentation of the idea of progress. This is the most valuable part of this first number and deserves careful study, none the less because it contains conspicuous examples of the communistic doctrines referred to above. Mr. Max Black has an article carefully considering and criticizing the doctrines of Wittgenstein and the logical Positivists. It is rather a remarkable feat to be able to write a complete, though short, account of "The Evolution of Positivism" (including the nineteenth century) without even mentioning the man who first systematized that way of thinking and gave it its name.

Earthquake in the East Indies

ONE of the greatest earthquakes for several months past occurred on February 1. The first movements were recorded at Kew at 7 h. 19 m. 52 s., p.m., and the largest oscillation about three-quarters of an hour later. According to Mr. J. J. Shaw, it was a very deep-seated earthquake. The records at Kew and Bombay show that the distances of the origin from these two places are respectively 8,250 and 4,250 miles. Thus, the earthquake occurred in the Banda Sea in about lat. 5° S., long. 130° E., at 7·5 p.m., G.M.T. (February 2, 1.45 a.m., local time). Three earthquakes, with a focal depth of about 260 miles, occurred close to the spot indicated (in lat. 5·5° S., 130° E.) on May 10, 1920, and March 23 and 24, 1921; while two others, with the same focal depth, originated in a centre lying five degrees to the east on October 10, 1921, and February 19, 1923.

Both foci lie close to the great arc of Sumatra, Java, Sumbawa, Flores, etc., along which many other earthquake centres, deep-seated and otherwise, are clustered.

Association for Physical Medicine

THIS society was inaugurated on January 27 at 56 Russell Street, W.C.1, with Dr. P. Dalton in the chair. The aims of the Society are: (1) To co-ordinate the various branches of physical medicine under one control; (2) to co-operate with manufacturers in the production of suitable appliances for medical and surgical use, and to prevent their sale to unsuitable persons; (3) to secure a national register of those practising the science and to affiliate all appropriate bodies; (4) to institute a chair of physical medicine in one or more of the universities and to establish a post-graduate school; (5) to establish contact with the general practitioner and to keep him informed of the changes in the subject; (6) to establish a technical board to act in an advisory capacity.

Announcements

ON February 12, two men of science of international reputation celebrate their birthdays. Prof. W. B. Scott, emeritus professor of palæontology in Princeton University, is eighty years of age; and Prof. Otto Pettersson, the Swedish chemist and oceanographer, is ninety years on that date. They may be assured that they have the congratulations and best wishes of scientific workers everywhere.

THE fifteenth Duddell Medal of the Physical Society has been awarded to Prof. H. Geiger, professor of physics in the University of Tubingen.

THE triennial award of the Coopers Hill War Memorial Prize and Medal, which fell in 1937 to the Institution of Electrical Engineers, has been made to Dr. T. E. Allibone for his paper on "The Mechanism of the Long Spark".

THE Council of the Institution of Civil Engineers has made the first award of the James Alfred Ewing Medal to Mr. Charles Samuel Franklin. This medal was founded in 1936 in memory of Sir Alfred Ewing, and is awarded, irrespective of membership of the Institution, for specially meritorious contributions to the science of engineering in the field of research.

PROF. W. P. JORISSEN, of the University of Leyden, will deliver a lecture entitled "Reactions in Gaseous and Solid Mixtures", in the Chemistry Lecture Theatre of the Imperial College of Science and Technology, on February 21, at 5.15 p.m. Admission to the lecture is free.

FIVE lectures on science and industry have been arranged by the Association of Scientific Workers, to be given in the Chemistry Theatre, University College, London. The lectures are as follows: February 16, Sir Richard Gregory on "Science and Industry"; February 24, Sir John Russell on "The Application of Science to Food Production"; March 2, Major F. A. Freeth on "Science and the Chemical Industry"; March 9, Dr. E. A. Rudge on "Training for Industry"; March 17, Dr. F. S. Sinnatt on "The Fuel Research Survey". The lectures will be given at 8.15 p.m. Tickets are obtainable from the Secretary, Association of Scientific Workers, 28 Hogarth Road, London, S.W.5, free to members and 1*s*. 6*d*. to non-members for the series, or 6*d*. for a single lecture.

AT the annual general meeting of the National Institute of Sciences of India, held on January 8, the following were elected officers: *President*, Prof. M. N. Saha; *Vice-Presidents*, Prof. S. S. Bhatnagar and Brevet-Colonel R. N. Chopra; *Treasurer*, Dr. B. S. Guha; *Foreign Secretary*, Prof. B. Sahni; *Secretaries*, Prof. S. P. Agharkar and Dr. A. M. Heron.

THE Medical Research Council has been entrusted with an annuity of £350 for a period of twenty-five years, provided by the late Mr. Eugen M. Schlesinger and by Mrs. Schlesinger to establish a memorial to their daughter in the form of a Kathleen Schlesinger Research Fellowship. This is to be given for investigations on the subject of cysts of the brain or allied conditions, and will ordinarily be tenable at the National Hospital for Diseases of the Nervous System, Queen Square, London, for periods of from one to three years. Awards will be made by the Council with the assistance of a special advisory committee appointed in terms of the trust deed.

DR. EUGEN FISCHER, professor of anthropology in the University of Berlin, and Dr. Hermann Lautensach, professor of geography at Greifswald, have been nominated for honorary doctorates of the University of Coimbra.

THE annual congress of the German Society of Balneology and Climatology will be held at Kiel on February 24–27. Further information can be obtained from Dr. Pfleiderer, Tirpitzstrasse 12, Kiel.

THE fortieth Congress of the German Zoological Society will be held at Giessen on July 4–6, 1938. Further information can be obtained from the Secretary of the Society, Invalidenstrasse 43, Berlin, N.4.

DR. G. D. BHALERAO, helminthologist of the Imperial Veterinary Research Institute, Muktesar-Kumaun, India, is to prepare a volume in the "Fauna of British India" on Trematoda.

IN the article entitled "Museum Study of Man and his Work" in NATURE of December 25 (p. 1108), reference is made to the Colonial Institute at Haarlem. This is incorrect; the Colonial Institute is at Amsterdam.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 291.

Correspondents are invited to attach similar summaries to their communications.

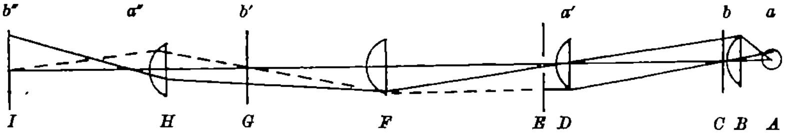
Direct Photography of Ultracentrifuge Sedimentation Curves

Several good methods now exist for observing the sedimentation boundary in the ultracentrifuge. That described here should, however, be useful because it is the least laborious way of producing a 'sedimentation diagram' (that is, a curve relating concentration gradient to distance from the axis of rotation). It is probably not so accurate as the 'scale' method[1], though this question seems worth investigating; but certainly the accuracy is sufficient for a great many purposes.

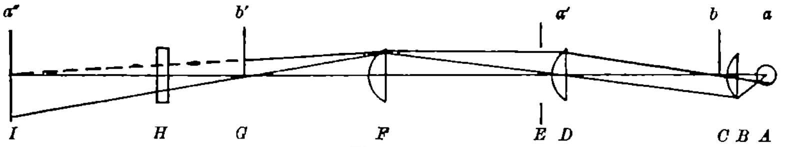
The method is based on the *Schlieren* principle as adapted to the ultracentrifuge by Tiselius *et al.*[2]. Added to this is a modified form of Thovert's principle[3] involving a diagonal edge and a cylindrical lens. The limitation which makes Thovert's own arrangement unsuited to the ultracentrifuge (cf. Lamm[1]) has been circumvented in that the optical path through the centrifuge cell can be made as narrow as desired without restricting the width of the photograph.

The optical path is shown in Fig. 1. Conjugate foci are marked *a*, *a′*, *a″* or *b*, *b′*, *b″*. *A* is the light-source, *B* a condensing lens which focuses a large image of *A* on the centrifuge cell *E*. *C* is a rectangular stop, the upper edge of which is smooth and straight. It is focused by the spherical lenses *D* and *F* on a similar stop *G*, which is inclined at an angle to *C*. *H* is a cylindrical lens with vertical axis. Seen in plan, it focuses *G* on the photographic plate *I*. In elevation *H* has no effect, but *F* focuses *E* on *I*.

From *A* to *G* the arrangement is identical with an ordinary *Schlieren* arrangement, except that *G* happens to be farther from *F* than is usual. At *G* the diagonal edge causes light which is deviated upwards to be obstructed at one side but not at the other, and the cutting-off point is shifted sideways proportionately to the upward deviation. The cylindrical lens *H* focuses the sideways shift on the plate while the cell is still focused vertically. The dividing line between light and darkness therefore takes the form of the required sedimentation diagram since the upward deviation at *G* (and therefore the sideways shift at *I*) is proportional to the gradient of refractive index and concentration. If θ is the angle at any particular height in the cell made by the edge *G* with the vertical, the sideways shift caused by unit concentration gradient varies as $\tan\theta$. Hence the sensitivity may be varied between zero and infinity by rotating the edge.



Plan



Elevation.

Fig. 1.

The compression in the cell introduces a linear term in the gradient of refractive index, which is equivalent to the introduction of a horizontal cylindrical lens. This may be compensated by introducing a cylindrical lens of opposite sign at *D*, but in practice it is sufficient to move the stop *C* or the spherical lens *D* along the optical axis. There is also some irregular curvature due to bulging of the quartz plates in the cell, which cannot be compensated automatically and must be allowed for if high sensitivities are used.

Introduction of another vertical cylindrical lens between *E* and *F* improves the illumination, but is not essential.

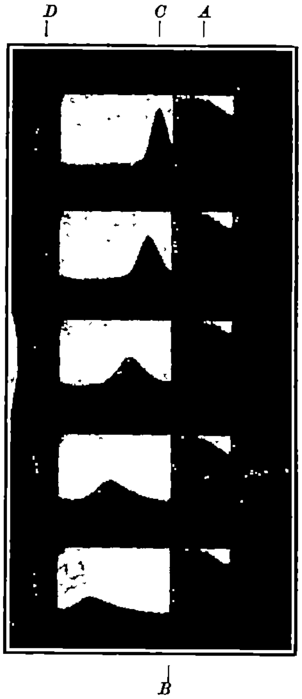


Fig. 2.

Sedimentation of lysozyme. *A*, paraffin; *B*, meniscus; *C*, sedimentation boundary; *D*, index'. Force, 300,000 times gravity; exposure interval, half an hour; concentration, 0·6 per cent; cell thickness, 6 mm. Specimen provided by Dr. E. R. H. Roberts.

Fig. 2 shows photographs of the sedimentation of lysozyme ($s = 2 \times 10^{-13}$) taken by this method. The edge of the curve is not quite sharp. Simple theory, verified by experiment, shows that the sharpness increases with increasing brightness of the source or time of exposure, and decreases with increasing sensitivity. The source used at present is a Pointolite, without colour-filter, and there is slight chromatic aberration due to dispersion by the protein and to residual error in the corrected lenses *D* and *E*. For these reasons it is preferable to use intense monochromatic light, from a filtered high-pressure mercury arc.

In interpreting the photographs it is sufficient for many purposes to note the general shape of the curves and to measure the positions of the maxima to the nearest 50 μ with a rough comparator. For the highest accuracy the sideways shift is best measured with a photo-electric comparator and plotted out after subtracting the base-line obtained from a control run. This is as laborious as the scale method and is seldom worth while. If the concentration of sedimenting protein is required, the curves must be integrated, and the particular arrangement of black and white should be ideally suited to photo-electric integration. This has not yet been attempted.

No exact comparison of accuracy with that of the scale method has yet been made. It is easy to obtain a sideways shift twenty times as great as the upward one given by the most sensitive setting of the scale method, and to measure it photo-electrically to the nearest 20 μ with high reproducibility, but there are many possible systematic errors analogous to those which have been studied in the scale method (Lamm[1]) and of which a similar study will have to be undertaken.

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[2] Tiselius, Pederson and Eriksson-Quensel, NATURE, **139**, 546 (1937).

[3] Thovert, J., *Ann. Phys*, (9) **2**, 369 (1914).

Electron-Multiplier as an Electron-Counting Device

MY efforts aiming at improving the electron-counting devices already known and extending their range in the visible part of the spectrum when used for counting photons have led to the application of the so-called electron-multiplier, based on the secondary emission principle. Recent experiments which I have carried out have shown its usefulness in the detection of individual electrons. The application of the method described here is easy and gives reliable and reproducible data.

An electron-multiplier tube with cæsium electrodes has some inherent disturbing effects that hinder the direct application of this tube as a counting device. Among them are the thermal emission of the cæsium surfaces and the leakage current.

The thermal emission, calculated according to Richardson's law, is 10^{10} electrons/cm.^{2}/sec. at room temperature, taking $\varphi = 0{\cdot}75$ volt for the work function and $A = 9{\cdot}8 \times 10^{-2}$ amp./cm.^{2} degr.^{2} for the first Richardson constant. (The electrons emitted by the first electrode give rise to a multiplication in n stages, the electrons of the ith electrode to that in the $n-i+1$ stages and these together create a basic current in the collector corresponding to the zero illumination. For example, this current has been found in one case to be 17×10^{-6} amp. at room temperature, in accordance with the value given above.) This current determines the lowest limit of the sensitivity of the multiplier and seems to prevent the use of the multiplier as an electron-counting device. It is easy to see that cooling in liquid air practically annihilates the thermal emission. Using the same data as above, Richardson's law gives immediately the number of electrons/cm.^{2}/sec.:

$$n = 0{\cdot}35 \text{ at } 150^\circ \text{ K. and } n = 6{\cdot}7 \times 10^{-10} \text{ at } 120^\circ \text{ K.}$$

Another disturbing factor, the leakage current, has been eliminated by suitable spacing of the lead-in wire of the collector and that of the other electrodes, and by enclosing the whole tube in a vessel containing dry nitrogen. The insulation was found to be greater than 10^{12} ohms.

With regard to the output capacity and the multiplication factor of the multiplier tube, and the input capacity of the amplifier used, the voltage amplitude at the first stage of the amplifier has been calculated to be 50μv., a value which exceeds the natural noises of the amplifier (the thermal agitation and the shot-effect) by one order of magnitude. Experiments have proved the expected result and by observation of the output voltage (on the screen of a cathode ray tube) it has been possible to count the individual electrons.

Low-speed electrons generated in vacuum can be counted by the method described here *by vacuum processes* only. It is the first counting method of its kind.

Compared to the counting devices already known using the production of ions in a gas-filled space, our method has the advantage of extremely good resolving power, which is in principle limited only by the transit time of the electrons in the multiplier tube. The counting gives always reproducible data.

As a first and simple application of the new device, I used it for counting photons, and it proved to be very successful. The zero illumination effect was found to be 40 electrons/minute, a number which can be further reduced by suitable improvement of the working conditions. Corresponding experiments are in preparation.

Our experiments having proved that the cooling process did not alter the light sensitivity and multiplication factor of the multiplier tube, we are justified in applying the data to the light sensitivity and photo-electrical output of the cæsium photo-cell obtained by previous workers at room temperature. The counting rate[1] is 2 per cent in the red maximum. Thanks to the excellent quality of the cæsium, this value is better than those obtained by other photon-counting methods[2].

Naturally the method of electron-counting presented here is not restricted to the use of liquid air, It is possible to get similar results by the application of a multiplier tube that has emitting surfaces made of a material having an appropriate high work function. and which accordingly has a low thermal emission.

A detailed communication is in preparation.

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Dec. 18.

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[1] Kluge, *Z. tech. Phys.*, **16**, 185 (1935). Kreuchen, P. A., *Z. Phys*, **94**, 549 (1935); **97**, 625 (1935).

[2] Klepenheuer, K. O., *Z. Phys.*, **107**, 145 (1937).

Effects of Methylcholanthrene and Colchicine administered with Plant Extracts on the Rat

IN the course of investigations on the response of plants and of 'phytocarcinomata' to various carcinogenic hydrocarbons and other compounds having the phenanthrene nucleus[1,2,3], it was found that some of these substances had an inhibitory action on the general somatic growth of certain plants. It was also found that it was possible to restore the normal growth-rate of these plants by simultaneous administration of certain plant extracts.

Haddow, C. M. Scott and J. D. Scott[4] have demonstrated that certain carcinogenic hydrocarbons and other chemically related substances had a persistent or temporary inhibitory influence on the body-growth of the rat, when administered by intraperitoneal injection.

We tested the above-mentioned combined treatment of plants on animals by the following methods.

Two series of experiments were made, one in early summer and one in late autumn. We used albino rats (150 in all) weighing 50–60 gm. The animals were divided into different groups and treated as follows: one group was given intraperitoneal injections of 10 mgm. of methylcholanthrene dissolved in 2 c.c. sesame oil; the second group was given intraperitoneal injections of 0·03 mgm. of colchicine dissolved in 2 c.c. sesame oil. Other groups were given, simultaneously with the intraperitoneal injections of methylcholanthrene or colchicine, subcutaneous injections of 1 c.c. lettuce or mistletoe extracts[5]. Control groups were given corresponding quantities of either sesame oil alone by intraperitoneal injection, or one or the other of the two plant extracts alone, by subcutaneous injection. Finally, one group was left without any treatment.

TABLE 1.

Treatment	No. of animals	Average mortality rate (days)	Percentage increase in body-weight in 21 days	% weight of testis in relation to body-weight	Ascorbic acid content of liver per (mgm./100 gm)
Oil	23	Until the end of the experiments (60 days)	51 34	1·37	13 740
Methyl-cholanthrene	28	21	15 17	0·97	8 535
Colchicine	8	Until the end of the experiments (34 days)	36 62	1·76	11·291
Control	23	Until the end of the experiments (60 days)	48 64	1·50	11 472

Table 1 shows the principal results of the summer and winter experiments. It may be added, however, that while the results of the summer and autumn experiments agreed as regards the body-growth of animals treated with methylcholanthrene alone, there was a discrepancy in the effects of the simultaneous treatment with methylcholanthrene and the above-mentioned plant extracts; the inhibitory influence of the combined treatment being about the same in summer as that of methylcholanthrene alone, while in autumn the percentage increase of the body weight of the animals subjected to the combined treatment was about four times as great as that obtained in animals treated with methylcholanthrene alone.

TABLE 2.

PERCENTAGE OF ANIMALS WITH FAT DEPOSITS.

Numerals 0 to 5 indicate the degree of fat deposits: 0 = none, 5 = maximum

Treatment	0	1	2	3	4	5
Oil	100	—	—	—	—	—
Methylcholanthrene	6·6	—	6 6	26 8	20	40
,, + lettuce	46 8	20	6 6	6·6	20	—
,, + mistletoe	74 6	14 2	—	14·2	—	—
Control	100	—	—	—	—	—

The most striking effect of methylcholanthrene was, however, the deposit of fat formed on the surface of the different organs of the abdominal cavity. In extreme cases, these coatings of hard fat attained a thickness of 3–4 mm. Table 2 shows, moreover, that the formation of these fat deposits could be considerably reduced by simultaneous subcutaneous injections of the plant extracts.

Animals treated with colchicine did not show fat deposits at all.

Preliminary observations have further shown an increased rate of cell division in the animals treated by us with methylcholanthrene alone, as revealed by Prof. A. P. Dustin after an injection of colchicine. It seems that methylcholanthrene sensitizes a great number of cells to the action of colchicine, such as the histiocytes and certain parenchymatous cells (amongst others those of the thyroid and salivary glands).

Summing up the various observations made in the course of the present preliminary experiments, it appears that profound metabolic and probably hormonal changes are involved in the carcinogenic action of methylcholanthrene, long before any morphological signs of tumour growth can be detected.

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EMERY GAL.

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Biological Research Institute,
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Dec. 19.

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[1] Havas, L., NATURE, **139**, 371 (Feb. 27, 1937)

[2] Havas, L., NATURE, **140**, 191 (July 31, 1937).

[3] Havas, L., *Bull. Ass. f. Cancer*, Dec. 1937 (in the Press).

[4] Haddow, A., Scott, C. M., and Scott, J. D., *Proc. Roy Soc.*, B, **122**, 477 (1937).

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Autonomous Rhythmical Activity of Sense Organs

LIKE the lateral-line organs of fishes and the receptors of the semicircular canals of the dogfish[1], the nerves supplying the ampullæ of Lorenzini in elasmobranch fishes exhibit a spontaneous discharge of impulses. The receptors of the lateral line can be excited to a higher frequency of discharge by a flow of fluid in the canal[2], and although there is no evidence that such a flow can actually occur except when artificially produced, the possibility cannot be entirely ruled out that some unidentified mechanical agency external to the receptor is responsible for the maintenance of a permanent state of excitation. Hoagland[3], indeed, has argued that the spontaneous activity of lateral-line organs is due to a ciliary activity of the hair cells. It is therefore especially significant that a capsule containing a group of ampullæ of Lorenzini, with the nerve supplying it, can be isolated from a pithed ray, and can continue to discharge impulses spontaneously for more than 24 hours.

The capsule, no larger than a match head, contains no muscular tissue, and there are no hair cells in the receptors[4]. The capsule with its nerve was completely freed from its surrounding tissue and mounted in a moist chamber with the nerve resting on a pair of electrodes leading to an amplifier and oscillograph. The nerve was cut down so as to leave only a few intact fibres. A record taken soon after the preparation was installed shows three impulse trains at frequencies 5, 8 and 9 a second. A record taken the next day, 24 hours later, shows the same three fibres discharging at 9, 9 and 10 a second. The preparation was not disturbed between the taking of the two records; indeed, the moist chamber was not opened, and the temperature remained at 12–13° C. The preparation ceased to function 36 ± 6 hours after it was removed from the fish.

Even if hair processes were present as some earlier histologists have maintained, it is scarcely possible that they should beat at a rate of 10 a second in so viscous a medium as the jelly contained in the ampullary canals.

This observation rigidly fulfils the conditions for the demonstration of an independent physiological rhythm and there can be little doubt, therefore, that the spontaneous discharge represents an autonomous rhythm of excitations within the receptor cells.

A. SAND.

Marine Biological Association
of the United Kingdom,
The Laboratory,
Citadel Hill,
Plymouth. Jan. 7.

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[2] Sand, A., *Proc. Roy. Soc.*, B, **123**, 472 (1937).

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Secretory Elements of the Pars Nervosa of the Pituitary

UNTIL recently it had been widely held that the nervosa hormones pitocin and pitressin, or their antecedents, were elaborated by the pars intermedia and were, from there, transferred to the nervous lobe. However, De Lawder, Tarr, and Geiling[1] have demonstrated the presence of these hormones in the pars nervosa of the fowl's pituitary, where there is no possibility of contamination of nervosa tissue with that of a pars intermedia. Hence the hormones must be formed by the endogenous constituents of the nervosa.

Bucy and Ibanez[2] have demonstrated the presence of characteristic glial cells, nerve fibres and terminals in mammalian partes nervosæ. Bucy termed the glial cells pituicytes, and naturally suspicion has fallen on these as the secretors of the hormones[3]. I have demonstrated the presence of pituicytes in all classes of the vertebrates (a full report of this work has been submitted to the Linnean Society of New South Wales for publication). If the pituicytes are secretory, it is to be expected that the hormones would be present in the various groups of vertebrates. This is so[4]; pitocin, pitressin and pituicytes occur in Tetrapods and Teleostei, while in Elasmobranchs pituicytes and pitocin occur. Pitressin may be present, but in the small doses used to date, it has not been detected.

Cowdry[5] considers it possible that the nerve fibre terminals may be secretory. The tissue culture work of Geiling and Lewis[6], however, shows that pitressin, at least, cannot be secreted by these agents. They made cultures of mouse pars nervosa, and in doing so, inevitably separated each nerve fibre from its perikaryon in the supra-optic nucleus; thus Wallerian degeneration would occur. Pitressin was conclusively demonstrated fifty days after explantation, and the only characteristic elements present were "extensive networks of large cells resembling neuroglia cells". These were undoubtedly the glial pituicytes, so it may be said that very probably the pitressin was elaborated by these cells. No test was made for pitocin, but since the nucleus supra-opticus is sympathetic in character[7] and all the evidence points to the fact that the secretory activity of the nerve terminals of the autonomic system is confined to the production of acetylcholine or an adrenalin-like body[8], it does not seem likely that pitocin is secreted by nerve terminals, which suggests that it also is secreted by pituicytes.

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Dec. 2.

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[3] Geiling, *J. Amer. Med. Assoc.*, **104**, 738 (1935)

[4] Herring, *Q. J. Exp. Physiol.*, **6**, 73 (1913). Hogben and de Beer, *Q. J. Exp. Physiol.*, **15**, 163 (1925).

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Adrenal Cortex Differences in Male and Female Mice

THE letter from Miss Deanesly published in NATURE of January 8, and dealing with the adrenal of the mouse, contains several inaccuracies. I feel bound to correct one which is not open to argument. Miss Deanesly gives what purports to be a brief account of the relevant literature. She has omitted to include a paper published six months ago by Dr. E. S. Horning and myself[1], which records observations having an important bearing on the subject under discussion. This paper contains a section entitled "The So-called X-zone and its Significance", to which readers of NATURE interested in the subject are referred. The warning given therein, that the adrenals of mice of inbred strains may show abnormalities and should, therefore, not be used for the interpretation of histological changes in the adrenal of normal mice, has unfortunately not been heeded by Miss Deanesly. The paper also points out the inadequacy of the histological methods used by other workers, including Miss Deanesly, in the study of the adrenal gland of the mouse.

W. CRAMER.

Imperial Cancer Research Fund,
London. Jan. 11.

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[1] Cramer, W., and Horning, E. S., *J. Path. and Bact.*, **44**, 633 (1937).

DR. CRAMER alleges "several inaccuracies" in my letter, but the only "inaccuracy" specified, is the failure to cite a paper by himself and Dr. Horning dealing with pathological conditions in the adrenals. It was obviously impossible to give a full bibliography of the subject, and reference was made to the more recent paper (Cramer and Horning, *Lancet*, June 1937). The main facts regarding the sex difference in the mouse adrenal are well established, and various histological techniques have been successfully used by different workers. No good purpose would be served by controversy on the subject in these columns. The size of the *X*-zone in the female may vary in different mice, but its presence is certainly independent of inbreeding or pathological conditions. The dwarf mice referred to in my letter are born from phenotypically normal parents carrying a recessive Mendelian factor, and their production is not dependent on inbreeding. Their interest lies in the congenital pituitary deficiency, to which one may reasonably ascribe the absence of the usual response of the adrenal cortex to castration.

Ruth Deanesly.

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Jan. 28.

Optimum Temperature of Formation of a Blood Clot

In the course of experiments designed for the practical purpose of finding the most suitable conditions for the assay of hæmostatic surgical dressings containing thrombin, we have encountered a blood-clotting phenomenon which is apparently new. Not all the thrombin present can readily be extracted from these dressings, so that a new method has to be used for the estimation, depending on the measurement of the amount of clot produced on the fabric by soaking in an excess of citrated blood under specified conditions, the whole specimen being subjected to micro-Kjeldahl nitrogen estimation after removing the unclotted blood by washing. The quantity of clot is measured in milligrams of nitrogen per sq. cm. of fabric.

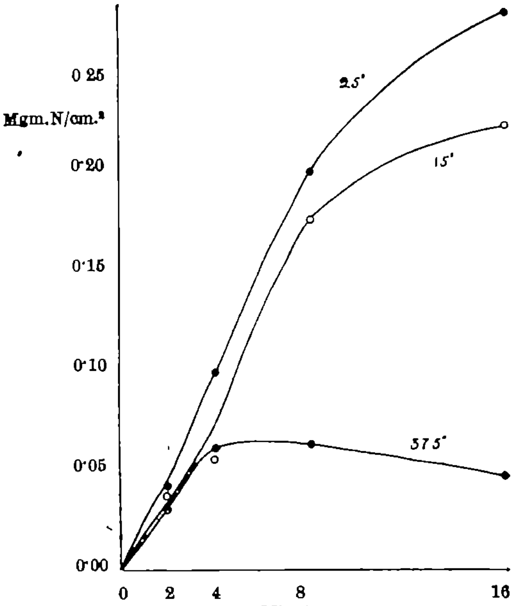

Fig. 1.

The relation of time to amount of clot at three temperatures. Points are means of five trials.

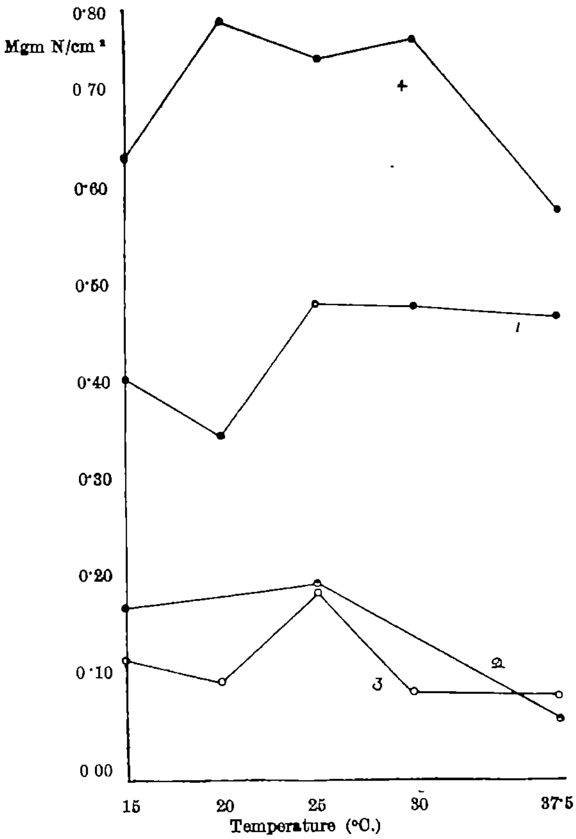

Fig. 2.

The relation of temperature to amount of clot. All determinations are at 8 minutes, and are means of five trials. Curve 2 is re-drawn from Fig. 1.

When, in addition to varying the time of soaking, different temperatures were used, we found that there was less clot at 37·5° C. than at lower temperatures, the maximum being at about 25°. Fig. 1 shows the results. The experiments were obtained from randomized blocks, and statistical analysis shows that the conclusion is significant. In order to obtain a self-contained confirmatory experiment, another series of tests were made, using five different temperatures. The 25° optimum was once more observed, and the difference between the trials at this temperature and at the higher temperatures is again statistically significant. A further trial (1, Fig. 2), using more heavily impregnated lint showed that in this case the optimum at 25°, although observed, is not pronounced enough to be significant, but it is important to note that 37·5° was certainly not an optimum. Yet another trial (No. 4, Fig. 2), using heavily impregnated lint washed in a large quantity of water and dried before testing, yielded an amount of clot at 37·5° which was significantly lower than at any of the three temperatures 20°, 25° and 30°, affording confirmation under widely differing conditions.

We do not consider that our results conflict at all with the numerous experiments showing that the maximum rate of clotting is at about 37·5°, since we are measuring the total amount formed—a different question. Our results are consistent with the view that two processes are proceeding together, one being clot formation by thrombin and the other an inactivation of the thrombin by the blood. If both processes have similar optima at about 37·5°, but different temperature coefficients, a peaked curve such as we find would result. In this connexion the 37·5° curve in Fig. 1 is illuminating, since the clot does not grow after the fourth minute, but actually becomes smaller, to an extent which is not significant from the statistical point of view, but may be real, and due to syneresis. Although some later workers have not found it, Landsberg[1] in 1913 reported a maximum clotting rate, under some conditions, at 25°, and our work appears to be confirmatory. There may be adaptive significance in the results, since clotting is normally required not in the recesses of the body, but at the surface, where the shed blood is not at 37·5° but at a lower temperature, whilst clotting in deeper and warmer positions is sometimes dangerous.

The details of the experiments will be published elsewhere.

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W. P. CHAMBERS.

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S. Maw, Son and Sons, Ltd.,
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Jan. 7.

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[1] Landsberg, W., *Biochem. Z.*, 50, 245 (1913)

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d-Glyceric Aldehyde and Tumour Glycolysis

IT was found some years ago[1] that *dl*-glyceric aldehyde inhibits glycolysis of tumour cells. Anaerobic glycolysis is inhibited about 75 per cent by 10^{-3} M., whereas aerobic glycolysis is not affected by this concentration. Aerobically, it takes four times this amount to produce the same effect. Concentrations higher than 4×10^{-3} M. of the aldehyde are toxic.

In 1932 experiments were carried out with *d*-glyceric aldehyde kindly supplied by Dr. A. I. Virtanen of Helsingfors (Finland). As this compound was prepared by bacterial action on *dl*-glyceric aldehyde, there was some doubt as to its purity and we hesitated to publish our results. Now having obtained the pure *d*-glyceric aldehyde prepared synthetically by Prof. H. O. L. Fischer and Dr. E. Baer, of Toronto, to whom we are much indebted for a gift of the aldehyde, we were able to reproduce the results obtained five years ago, thus confirming the purity of Dr. Virtanen's preparation.

On April 19, 1932, we found that 10^{-3} M. of racemic glyceric aldehyde inhibited anaerobic glycolysis of Jensen rat sarcoma 74 per cent, whereas the same concentration of *d*-glyceric aldehyde gave only the slight inhibition of 11 per cent. With 2×10^{-3} M. we found inhibition of 91 per cent with the racemic and 33 per cent with *d*-glyceric aldehyde.

In recent experiments carried out with the new synthetic' preparation the following results were obtained :

INHIBITION OF ANAEROBIC GLYCOLYSIS OF RAT SARCOMA 39 BY GLYCERIC ALDEHYDE.

Conc of Aldehyde	Racemic	*d*
10^{-3} M	78 per cent	0 per cent
	68	8
	74	0
2×10^{-3} M.	95	33
	84	32
	92	38

INHIBITION OF AEROBIC GLYCOLYSIS OF RAT SARCOMA 39 BY GLYCERIC ALDEHYDE.

Conc. of Aldehyde	Racemic	*d*
2×10^{-3} M.	52 per cent	12 per cent
3×10^{-3} M.	66	18
4×10^{-3} M.	83	31

As the strong inhibition of tumour glycolysis found with small amounts of racemic glyceric aldehyde is not brought about by the *d*-component, the effect is obviously due to the *l*-form, which therefore should be at least twice as effective as the racemic. Lately some experiments have suggested the possibility that *l*-glyceric aldehyde may even be three to four times as active as the *dl*-form.

In this connexion it is noteworthy that J. Needham[2] recently obtained similar results in his most interesting experiments with *d*-glyceric aldehyde on glycolysis of chick embryo. We are able to confirm his results.

Addendum, January 3 : With a new sample of *d*-glyceric aldehyde, just obtained, no inhibition either of anaerobic or aerobic glycolysis was found with concentrations given in the above tables.

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FRIDA STRELITZ.
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Dec. 28.

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[1] Mendel, B., *Klin. Woch.*, 8, 169 (1929).

[2] Needham, J., and Lehmann, H., NATURE, 140, 198 (1937). *Biochem. J.*, 31, 1210, 1913 (1937).

Drift of Net Assimilation Rate in Plants

IN reply to the letter from R. F. Williams[1], may I say that I much regret not having mentioned his paper[2] and that of Ballard and Petrie[3] in my note on the effect of age on net assimilation and relative growth-rates in the cotton plant[4], but I have just seen them for the first time. In stating that the absence of general trend of net assimilation rate up to time of flowering in my experiments was not *proved*, I was merely mentioning an inherent characteristic of the statistical test of significance. In testing the significance of a linear regression coefficient, the hypothesis is made that its true value is zero. This hypothesis may be disproved, at a given level of significance, in which case a significant general trend is shown, but it can never be finally *proved*. My results were clearly consistent with the hypothesis that the linear regression of net assimilation rate on time up to first flowering was zero, that is, that there was no general rise or fall, and it would seem, therefore, that to claim that my data confirmed the findings of Gregory[5] for barley was justifiable. Furthermore, my results agreed with those obtained for cotton by Crowther[6] in the Sudan, although no rigid statistical test was in the latter case applied.

With regard to the contention that the basis of estimation is important, it is worth noting that conversion of my data from a dry weight to a leaf area basis would introduce a rising tendency, since the area per unit leaf dry weight for the cotton plant falls somewhat in time[7]. If a significant upward trend were thus produced, my results for cotton would conflict even more markedly with the findings of Ballard and Petrie, and of Williams, that the net assimilation rate falls in time during the vegetative phase.

In using the term "flowering", Williams presumably refers to anthesis. So far as Gregory's results for barley are concerned, he claimed only that net assimilation rate was independent of time up to maximum leaf area, that is, for about the first six weeks, which corresponds with the stage of first differentiation of the flowers, not anthesis. After this point he also noted a rapid fall in net assimilation rate. For only one of the two experiments on oats described by Williams[2] does he appear to have obtained "unit leaf rate" data before six weeks, and in this case the rate appears to be remarkably constant up to 4–6 weeks. In so far as the cited experiments with temperate cereals are concerned, the results thus appear to confirm Gregory's findings. In the case of the single experiment with Sudan grass[3], the unit leaf rate appears to fall from the first observation (two weeks). It would be interesting to know the time of differentiation of flowers in this species.

The further interpretation of the data will be awaited with interest.

O. V. S. HEATH.

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London, S.W.7.
Jan. 17.

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[2] Williams, R. F., *Austral. J. Exp. Biol.*, 14, 165 (1936).

[3] Ballard, L. A. T., and Petrie, A. H. K., *Austral. J. Exp Biol.* 14, 135 (1936).

[4] Heath, O. V. S., *Ann. Bot.*, N.S., 1, 565 (1937).

[5] Gregory, F. G., *Ann. Bot.*, 40, 1 (1926).

[6] Crowther, F., *Ann. Bot.*, 48, 877 (1934).

[7] Portsmouth, G B., *Ann. Bot.*, N.S., 1, 277 (1937).

Blindness in Freshwater Fishes

THE cause of blindness in some rainbow trout was recently described by me[1] as being due to a trematode, *Diplostomum volvens* Nord., being present in large numbers in the lens of the eye. Since that date, two more lots of rainbow trout and one lot of roach have been examined, and in each case about five per cent of the fish were blind, due to a similar cause to that already recorded.

I have also been informed from a reliable source that the disease is well known in Holland and other countries of Europe. Further, my attention has been directed by the Hon. Miss M. Rothschild to further literature of the subject, particularly to a recent account of this trematode by Wesenberg-Lund in his work on freshwater fauna[2] which records that *Diplostomum volvens* Nord. does not possess a direct life-cycle from bird to fish but that the fertilized eggs, which pass out of a water bird, develop into a miracidium which penetrates a molluscan and there produces the asexual cycle generation of sporocysts. These in turn give rise to fork-tailed cercariæ, which in due course escape from the snail or first intermediate host into the water. It is at this stage that the worm enters the second intermediate host.

The cercariæ penetrate the skin of the fish and reach the lens of the eye via the blood stream; the final host invariably acquires the parasite by eating fish which have become infected in this way.

WILFRID RUSHTON.

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Jan. 19.

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[1] NATURE, 140, 1014 (Dec. 11, 1937).

[2] "Ferskvandsfaunaen, Biologiste Belyst", Invertebrata, vol. 1. Trematoda-iken, pp. 123–127, Fig. 135–140; 1937.

Density of Living Aquatic Organisms

FOR some reason, the determination of the density of aquatic organisms has always presented to biologists a really difficult problem. The usual method has been to kill or narcotize the organisms and find the rate at which they sank in a liquid of known density, or alternatively to find a liquid of such density that the organisms floated or rather just did not sink in it. The density of the liquid was taken as the density of the organism. Neither of these methods need, I think, be seriously considered further. They may be suitable for minerals but scarcely for living organisms.

There is a very simple and accurate method available and this is best described by giving an actual example. Three typical specimens of the common polychæte worm *Nereis diversicolor* were sent from Plymouth in a large jar of sea-water. They arrived in perfect condition. The jar was placed in a sink of cold water until the temperature was constant. A specific gravity bottle was cleaned, weighed and standardized. The bottle was then weighed full of distilled water at 7·4° C., which was the temperature of the water in the sink. It was then filled with the sea-water and weighed, and finally the three worms were introduced and the bottle again weighed.

The only remaining problem was then to find the exact volume of the worms. This was quite readily done by pouring the contents of the bottle after the last weighing into a 200 ml. flask. The worms were retained in a funnel with a small plug of glass wool. When practically all the sea-water had gone the worms were just rinsed with a little distilled water. (If this is thought objectionable a little isotonic solution of sodium nitrate could have been substituted, but actually this was quite unnecessary since the worms went straight back to sea-water and were alive after two days.) They were only in contact with the distilled water for a few seconds. The solution of sea-water in the 200 ml. flask was made up to the proper mark. We can call this solution *A*.

The same specific gravity bottle was then again filled with the sea-water and the contents washed into another 200 ml. flask. We can call this solution *B*. The two solutions have different concentrations which can be determined by a very simple titration with *N*/10 silver nitrate, which incidentally need be only approximately *N*/10. From these two titrations the exact volume of the worms is obtained. The accompanying figures give the density of *Nereis* fairly exactly. The last two figures should probably be disregarded since the density of *Nereis* must vary with such factors as the contents of the gut, etc., or the sex. Again, it represents the average density of the three worms. Finally, densities given to six places of decimals are meaningless unless the density of the distilled water has been redetermined since the discovery of heavy water.

Volume of S.G. bottle at 20° C. and 760 mm.	51·21 ml.
Weight of distilled water at 7 4° C.	51·4198 gm.
,, ,, sea ,, ,, ,,	52·8384 ,,
,, ,, sea-water plus *Nereis* at 7·4° C.	53·0733 ,,
Calculated density of sea-water at 7·4° C.	1·02766

Volume of *Nereis*. Titrations with silver nitrate *N*/10 : 14·35 ml.; 12 91 ml.

$$\text{Vol.} = 51{\cdot}21 - \left(\frac{12{\cdot}91}{14\ 35} \times 51\ 21\right) = 5{\cdot}14 \text{ ml.}$$

		gm.
Weight of sea-water displaced by *Nereis*	= 5·14 × 1·02766	= 5 2822
,, ,, ,, in bottle with ,,	= 52·8384 − 5·2822	= 47 5562
Weight of *Nereis*	= 53·0733 − 47·5562	= 5·5171

$$\text{Density of } Nereis \text{ at } 7\ 4° \text{ C.} = \frac{5\ 5171}{5\ 14} = 1{\cdot}07336.$$

The method is applicable to freshwater animals, but to find their volume they are placed in a 100 ml. flask and 25 ml. of a 1 per cent solution of glucose added. The concentration of the glucose is easily determined by MacLean's blood sugar test, while the solution of glucose is too weak to have any effect on osmotic pressure. Again, the rate of diffusion of glucose is far too low to have any effect on the tissues except perhaps on naked protoplasm itself.

The density of several living organisms has been determined in this way. Thus the density of the living three-spined stickleback at 10° C. was found to be 1·00286 swimming in Marlborough tap-water with a density of 1·00011 at the same temperature. The density of any living tissue can be determined in the same way provided a suitable Ringer solution is available.

A. G. LOWNDES.

Marlborough College,
Wilts.
Jan. 12.

Salaries in Soviet Universities

THE equivalent figures given in NATURE of December 11, p. 1007, namely, 1100 rouble = £42, are about three times too high on the actual purchasing power of these salaries. Sir Walter Citrine has published a thorough study of prices and standard of living in Russia[1], and finds the purchasing power of the rouble for food and necessities of life is equivalent to 3*d*. in England. This figure is confirmed by Andre Gide and Trotsky in recent books, and I have myself gone very thoroughly into the matter and would say that for January 1938 this is still not an unfair estimate[2]. On this basis the Russian salaries are as follows :

Directors of chairs in universities	=	average	£190	per annum.
Professors	=	,,	£175	,,
Senior lecturers	=	,,	£120	,,

First-year students, at 130 roubles per month, are paid the same as the mass of unskilled workers in Russia, equivalent to 8*s*. 4*d*. per week in Great Britain.

The services received free in addition to salary, while not negligible, are, owing to overcrowding, very much curtailed compared with our own as received by the poorer members of the community in England ; for example, the schools are usually run in two shifts per day and some even in three shifts.

Of the 542,000 students attending higher educational institutions, probably not as many as 5 per cent approach the standard of training and have the facilities we understand by university education; the rest receiving a training corresponding more to the higher forms of secondary schools, evening classes, etc.

Most of us would be glad to see a rise in the standard of living in Soviet Russia, but at present it is deplorably low, even more as regards wages than salaries.

L. H. CALLENDAR.

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Withington,
Manchester.
Jan. 17.

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[1] "I Search for Truth in Russia", by Sir Walter Citrine (1936).

[2] Cf. articles in *Manchester Guardian*, "Russia under Stalin—Wages" (Oct. 1937)

Apparent Enlargement of the Sun at the time of Rising and Setting

I HAVE always thought that the accepted explanation of the apparent enlargement of the sun, moon and constellations near the horizon was that we look on the sky as a very shallow inverted bowl, and therefore look on the horizon as very much farther off than the zenith. The sun having the same angular diameter wherever it is seems a larger body when on the horizon because we apprehend it as being much farther off than when in a high altitude.

The experiment described by Mr. Trotter in NATURE of January 15 supports this. It is not necessary to wait for sunshine to repeat it ; look at an electric lamp until a retinal after-image is formed ; look at a sheet of paper held at reading distance and then hold it at arm's length ; the after-image will apparently increase in size.

There is another observation which bears on the same point. I have not seen it described and only noticed it for the first time last summer in Chichester Harbour : look down on to a perfectly still sheet of water at night ; the constellations near the zenith look absurdly small ; the mind places them on the surface of the water quite close at hand. To me the reflected constellations look only half the size of the real ones in the zenith.

C. J. P. CAVE.

Stoner Hill,
Petersfield.
Jan. 16.

Axial Spin of Arrows

THE correspondence referring to the feathering of arrows[1] recalls some seen at Parà about the beginning of the century in a collection of various gear and costume of the Amazon Indians. It would seem that these folk liked their arrows to spin, for at any rate some of them were feathered with fairly long narrow feathers, the tips of a pair were bound on opposite sides near the butt and again tied further along the shaft again on opposite sides but with a half turn ; so that one feather was on one side at the end and on the other further along. If memory serves me, many of the feathers were those of the 'arà' or macaw, of which, too, were made wonderful helmets or head-dresses.

H. E. DURHAM.

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[1] NATURE, 140, 1016 (Dec. 11, 1937) ; 141, 123 (Jan. 15, 1938).

Prof. Alfred Lodge

MAY I add a few words to the obituary notice of Alfred Lodge, written by one whom I count amongst my friends ? I had the privilege of being taught mathematics by Alfred Lodge, and although I was a mere boy at the time, I remember distinctly realizing my good fortune in having a teacher quite out of the ordinary. Whereas others taught us the usefulness of mathematics, it was Alfred Lodge who impressed on us its beauty. Under his influence one acquired the attitude towards any problem that it was not completely solved until one had found the neatest solution. Sometimes direct attack on a problem had led to a surprisingly simple result, and I remember how on such occasions Lodge would be asked either by a colleague or by a pupil if he could not find a more elegant derivation. It usually took him less than half an hour to produce it. The affectionate regard that we as schoolboys had for him was reflected in his nickname, "Daddy Lodge".

E. A. G.

Jan. 28.

A New Monochromator

IN a letter published in NATURE of January 22, I described a monochromator based on the principle of interference of polarized light in a number of quartz plates, and some experiments carried out with such an instrument. From a private communication received from Dr. B. Lyot on January 29, I have learned that much the same principle for the construction of a monochromator was outlined by him in the *Comptes rendus* of the Paris Academy of Sciences in December 1933. Dr. Lyot did not plan to use Polaroid film in his construction, and has not yet completed an instrument according to his design. I regret the omission of reference to his work, with which I was unfortunately completely unaware when I wrote my letter.

YNGVE ÖHMAN.

Stockholm Observatory.
Jan. 29.

Points from Foregoing Letters

A METHOD whereby ultracentrifugal sedimentation diagrams, giving the shape of the curve relating concentration gradient to distance from the axis, may be obtained by direct photography, is described by J. St. L. Philpot. The *Schlieren* principle is used together with a diagonal edge and cylindrical lens.

Prof. Z. Bay states that the sensitivity of the electron-multiplier tube with cæsium electrodes, when used as an electron-counting device, is greatly improved by cooling in liquid air, so that no spurious electrons shall be liberated by thermal agitation. Another disturbing factor, the leakage current, can be eliminated by suitable spacing of the lead-in wires and by insulation in dry nitrogen. The improved apparatus can be used for counting low-speed electrons generated in a vacuum, by vacuum processes only.

The effects of injection of the cancer-producing substance methylcholanthrene upon the body weight and metabolism of rats have been investigated by Dr. L. Havas and E. Gal. They find that this substance brings about fat deposition on various organs of the abdominal cavity. This effect can be counteracted to some extent by simultaneous injections of lettuce or mistletoe extract. Methylcholanthrene also brings about an increase in the rate of cell division and renders certain cells more sensitive to the action of colchicine.

A spontaneous discharge of impulses has been recorded by A. Sand from an isolated preparation of ampullæ of Lorenzini over a period of 24 hours. This furnishes complete evidence that these organs possess an autonomous rhythm of activity.

In support of his view that the hormones pitocin and pitressin (found in the pars nervosa of the pituitary) are secreted by special cells, pituicytes, M. Griffiths points out that the hormones are present in all classes of vertebrates where pituicytes are found. Since pitocin was found by Geiling and Lewis in tissue cultures of pars nervosa which were free from nerve fibre terminals, the latter cannot be responsible for the secretion of the hormones.

Referring to Dr. R. Deanesly's recent account of adrenal cortex differences in male and female mice, Dr. W. Cramer states that the adrenals of mice of inbred strains may show abnormalities, and should, therefore, not be used for the interpretation of histological changes in the adrenal of normal mice. Dr. Deanesly considers that, although the X-zone in the female may vary in different mice, its presence is independent of inbreeding or pathological conditions.

R. Maxwell Savage and W. P. Chambers show that the size of blood-clots formed by thrombin-impregnated cotton is at a maximum not at body temperature but below it. They attribute this to differences in the temperature coefficients of clotting and inactivation, and suggest that it is one of the adaptive mechanisms by which intravascular clotting is avoided, since normally clotting is required in shed blood at about the optima found.

Dr. B. Mendel, F. Strelitz and D. Mundell report that, unlike the racemic *dl*-glyceric aldehyde, the dextro-rotatory form, *d*-glyceric aldehyde, does not inhibit the transformation of glycogen to lactic acid by tumour cells. This confirms results of unpublished experiments carried out several years ago by the authors with *d*-glyceric aldehyde obtained by the action of bacteria upon the racemic form. The inhibition of glycolysis is apparently to be ascribed to the lævo form, the activity of which may be several times as high as that of the *dl*-form.

Replying to a letter from R. F. Williams on the time drift of net assimilation rate in plants, O. V. S. Heath points out that a re-examination of the published data of Williams and of Ballard and Petrie indicates that their contention of a fall in net assimilation rate before flowering does not apply to the first six weeks (flower differentiation) in the case of temperate cereals. This is precisely what Gregory found for barley, while Heath himself found no fall in cotton before first flowering.

Referring to his recent note on the blindness of freshwater fishes caused by the trematode *Diplostomum volvens*, Dr. W. Rushton quotes further references indicating that the parasite does not possess a direct life-cycle from bird to fish, but passes as an intermediate stage through a mollusc, where it produces the asexual cycle generation of sporocysts.

A. G. Lowndes describes a simple indirect method for determining the specific gravity of aquatic organisms. It employs the usual specific gravity bottle and determines the volume displaced by the organism by chemically titrating some constituent present or added to the water, for example, chlorine in sea water or glucose added to fresh water.

Research Items

Duration of Life in Prehistoric Man

DR. HENRI V. VALLOIS, in view of the fact that the age of the individual in the study of skeletal remains of prehistoric man has been treated as a matter of secondary importance, has endeavoured to arrive at a more precise statement of the facts on the recorded evidence and in the light of a personal examination of a number of the specimens (*L'Anthropologie*, 47, 5–6). Of two criteria of age, the evidence of the teeth and the closure of the sutures of the cranium, the latter is taken as the more generally trustworthy and suitable for this purpose. The evidence is classified as Neanderthal, upper palæolithic and mesolithic. On the whole, the striking fact emerges that the life of fossil man was short. Of one hundred and eighty-seven subjects of determinable age, 55 per cent Neanderthal, 34·3 per cent upper palæolithic and 37 per cent mesolithic subjects died before reaching the age of twenty years; while of the remainder, the majority, 40 per cent Neanderthal, 53 per cent upper palæolithic and 58·5 mesolithic, died between twenty and forty years. Of the remaining sixteen, 5, 10·8, and 1·5 per cent respectively died between forty and fifty years, while only three survived the age of fifty years. Yet even these three had not attained true old age, as important sutures were still not closed. In addition to the numbers given above, there were thirty-one specimens for whom it was not possible to determine the exact age; but of these nineteen were not yet adult, and it is practically certain that the remaining twelve had not attained old age. These additional specimens bring the total up to 218. Notwithstanding defective evidence, there would appear to be a marked increase in the duration of life in the Bronze Age and among the Egyptians of the Roman period. In the fossil groups, man appears to have lived longer than woman. Especially below the age of forty is feminine mortality higher. As regards the cause of the early mortality, so far from civilization having shortened the natural span of life by 'dysharmonics' as Metchnikoff thought, it appears to have lengthened it.

Easter Island Inscriptions

DR. A. MÉTRAUX, Bishop Museum fellow, figures and describes in *Man* of January two inscribed tablets and an inscribed fragment from Easter Island, now in the Bernice Pauahi Bishop Museum, Honolulu, which have not been recorded by those who have written previously on the subject of the Easter Island inscriptions. Sixteen authentic tablets deposited in various institutions are now known. Most of these have been described. When the Easter Island tablets were first discovered the islanders were perfectly willing to part with them; but the modern natives, realizing the interest taken in them by Europeans, have manufactured imitations. The tablet acquired by the British Museum in 1903 is probably modern in origin. The signs are poorly engraved and suggest the style of modern artists. Faked tablets were made in the island even prior to 1882, as witness a faked gorget in the Australian Museum. The two tablets of the Bishop Museum are in poor condition, the wood being partly rotted away. Signs appear on one side only, the other side being decayed. The best preserved specimen is twelve inches long, three and three-quarter inches wide and three-quarters of an inch thick. The signs are incized according to the best classical tradition. The symbols have been engraved with an obsidian or shark's tooth point. The signs form eleven rows; of the characters, one hundred and twenty are legible. The rows of signs are reversed alternately. The second tablet, twenty-seven and a half inches long, three and a quarter inches wide, and one inch thick, contains twenty-five unobliterated signs around a natural hole in the wood. A few years ago it was suggested by Mr. de Hevezy, a Hungarian linguist, that there were striking and incontrovertible parallels between the Easter Island script and the Indus Valley inscriptions from Mohenjo-daro and Harappa. It is now shown that the resemblances were due to inaccurate reproductions of both groups. The only resemblances are simple geometrical signs. The Hungarian author suggested that the Easter Island signs might be thousands of years old; but the largest tablet in existence in the Museum of Brain-Lecombe is carved on a European oar.

Effectiveness of Administered Hormones

THE preparation in pure form of the products of those endocrine glands which produce chronic effects in the body, has had the untoward result of making more difficult the experimental or therapeutic imitation of their actions. The hormones of the gonads, anterior pituitary and adrenal cortex and insulin appear to be utilized or eliminated soon after they enter the circulation, and in these circumstances their physiological effectiveness depends very largely on the method by which they are administered. Thus, a given dose of œstrone in aqueous solution is known to be more effective if given in a series of divided doses than when given in a single large dose; similarly, esterification of œstrone and of androsterone and testosterone has been found to increase their activity; but whether this increase in activity was due to delayed absorption or to slow hydrolysis after absorption was not clear. Drs. Deanesly and Parkes (*Proc. Roy. Soc.*, B, 124, 279; 1937) have recently studied the variations in effectiveness of a large number of gynæcogenic and androgenic compounds brought about by different methods of administration, involving subdivision of the dose, the nature and volume of the solvent, the addition of fatty acid, esterification and mode of administration. It is clear that the increased effectiveness of the esters is due to delayed absorption from the site of injection, since they are no more effective than the free hormone, when both are given intravenously. The esters are most effective when given in such a form that they might be expected to crystallize out in the tissues, and this finding led the authors to investigate the effects of giving the hormone by subcutaneous implantation of crystals or compressed tablets. This method was found to be extremely effective. A further advantage of the method is that, at the end of the experimental period, the tablet can be removed and weighed, and a reasonably accurate determination made of the actual amount of hormone absorbed.

Control of the Bed-bug

THE common bed-bug, *Cimex lectularius*, has spread during recent years to an extent that probably about four million people in Greater London alone are, to some degree, troubled by this pest. Slum clearance campaigns have caused the demolition of many bug-infested quarters. Unfortunately, in many instances precautions were not taken to eradicate the bed-bugs before the families moved into their new homes. The result has been that new colonies of the insect have been founded and new areas, formerly free from the pest, have now become infested. Probably the chief means of dissemination is the carriage of bed-bugs in furniture and bedding, but there are many other methods of lesser importance. While bed-bugs do not transmit any actual disease in Great Britain, the constant irritation due to the injection of minute doses of the insects' saliva into the blood is likely to contribute largely to the ill-health of children and even sometimes of adults. The habits, behaviour and means of control of this insect are dealt with in a pamphlet on the subject, entitled "The Bed Bug" and issued by the British Museum (Natural History) as No. 5 of the Economic Series. This pamphlet, which is in its fourth edition (1937), is written by Mr. A. W. McKenny-Hughes, assistant keeper in the Department of Entomology. It is obtainable either from the Museum or through booksellers, price 6*d.*

Genitalia of Hymenopterous Insects

THE attention of students of insect morphology is directed to a paper by Mr. O. Peck (*Canadian J. Res.*, 15*D*, 221; 1937) which embodies an illustrated account of the structure and supposed homologies of the male genitalia in the Hymenoptera. Four main components are distinguishable in these organs. (1) An annular basal gonocardo which bears a pair of claspers (2), and each of these latter carries an inner clasper or volsella (3). A median organ or ædeagus (4) with a pair of lateral parameres or sagittæ are supported by the claspers and volsellæ. The true homologies of these parts are very uncertain and have not as yet been definitely established. The remainder of the paper is devoted to a detailed study of the male genitalia of the Ichneumonidæ in particular. This account is to be completed in a later issue of the *Journal.*

Anatomy of Protobranchs

PROF. HAROLD HEATH in his paper "The Anatomy of some Protobranch Mollusks" (Mémoires du Musée royal d'Histoire Naturelle de Belgique, deuxième série, fasc. 10, 1937) shows several important points in connexion with the comparative study of various species belonging to six genera obtained from both Atlantic and Pacific coasts: *Nucula* (10 species), *Acilia* (4 species), *Yoldia* (8 species), *Yoldiella* (2 species), *Malletia* (one species), *Leda* (6 species). It is shown that the muscular system in all is very similar, the pedal muscles especially being complicated. It is interesting that differences exist between the specimens of *Yoldia thraciæformis* from the Atlantic and Pacific, the western representatives being considerably smaller than the eastern, yet all are sexually mature, and the larger individuals possess certain small muscles in the vicinity of the anterior adductor which are apparently not present in the smaller form. In studying the digestive system, the author finds that the simplest types of intestine occur in *Nucula* and *Acila* from shallow water, between 5 and 125 fathoms, whilst in the deeper water species of *Nucula* it is much more complicated. However, *Yoldia, Yoldiella, Malletia* and *Leda* possess intestines of the same relative length and with the same arrangement in species from all depths ranging from 11 to 1569 fathoms. There thus appears to be in *Nucula* a correlation between length of intestine and depth; but it is carefully stated that too few specimens have been examined as yet to be quite sure of the fact. "If such be the case it may be that nutritive material diminishes according to depth and that complete digestion and absorption of food demands correspondingly elongated intestines".

Vitamin C in the Potato

FOLLOWING the publication by Ijdo of work on the vitamin C content of different varieties of potato (cf. NATURE, 140, 977–78; 1937), A. M. Smith and W. Y. Paterson record in the *Biochemical Journal* (31, 1992–9; 1937) results which confirm and extend those of the Dutch investigator. These authors examined a large number of tubers, from the 1935, 1936 and 1937 crops, for ascorbic acid, using the usual method of extraction with trichloroacetic acid and titration with 2 : 6-dichlorophenol-indophenol, and also a modification of it suitable for rapid routine testing. They found that the vitamin C content varied with the variety of potato and with the time and temperature of storage, but was independent of size and weight of tuber, of environment, including soil conditions and manuring, and possibly season. They also discovered that the content was significantly higher in tubers suffering from mosaic disease or leaf-roll. Therefore, determination of ascorbic acid in potatoes affords not only a method of identifying variety, but also of testing the presence of virus disease, under uniform storage conditions. The test should assist growers in selecting stock seed for the next season's crop.

A Criticism of Warnstorf's "Sphagnologia Universalis"

As the result of a visit to the Warnstorf Herbarium at Berlin-Dahlem, A. le Roy Andrews expresses his opinion that the Warnstorf "Sphagnologia Universalis" is "inflationary" and needs drastic revision (*Ann. Bryologici*, 9, 1936. Leyden. British agents, Dawson, London). As a new and simplified classification Andrews suggests that the two main sections (termed sub-genera by Andrews) *Inophlœa* (*Cymbifolia*) and *Litophlœa* (the other groups), which date back to Russow, still stand, but the sub-sections of these according to Warnstorf appear to be of unequal rank. Andrews separates *Rigida* under Müller's name Section *Malacosphagnum* from the remaining groups which fall under Section *Acisphagnum*. As a result of careful comparison, it is also suggested that Warnstorf's eight groups of *Litophlœa* (exclusive of *Rigida*) may justifiably be reduced to three: A. Series *Squarrosa*, B. *Cuspidata* (including *Subsecundum*, which appears to have no fundamental distinction from *Cuspidata*) and C. *Acutifolia*. This classification is based on the usual characters of leaf section, pores, etc., in conjunction with certain features of specialized stem leaves and perichætial leaves. Andrews points out that the presence or absence of fibrils needs to be used with caution, as also the degree of exposure of chlorophyll cells; the latter, as shown by Russow, have equal exposure at both surfaces in initial stages and only reach unequal exposure during subsequent development. In Warnstorf's "Sphagnologia" 342 *Sphagnum* species are described and to these subsequent additions have been made. Andrews doubts that any really critical student could confirm at most more than a 100 good species.

Antirrhinum Rust

A SEVERE infection of antirrhinum plants in 1934 by the rust fungus *Puccinia antirrhini* stimulated the prosecution of much intensive research on the disease by D. E. Green, mycologist to the Royal Horticultural Society. The text of a lecture which reviewed these investigations is now published in the Society's *Journal* (62, Pt. 12, pp. 530–537, Dec. 1937). Antirrhinums in Canada, California and Bermuda have been attacked very severely by the fungus for a decade or more, but the disease had not been reported from Europe prior to 1933. Uredospores are produced, and also teleutospores, which, however, have not been found to re-infect snapdragon plants. The method of overwintering is still a problem, but the most obvious means would appear to be persistence of the fungus in perennating antirrhinum plants in frost-free localities. Uredospores appear thereon in the following summer, and infect other plants. Spraying is an exorbitant and economically ineffective control, but Mr. Green's lecture ended with an account of progress with rust-resistant snapdragons. Some American strains can claim 70–90 per cent resistance, largely at the expense of their horticultural beauty, but the results of work in 1937 at the Society's gardens at Wisley show that a number of more attractive strains obtained by crossing have achieved 50–75 per cent resistance.

Leaf Diseases of *Narcissus*

DR. P. H. GREGORY has collected information upon diseases of *Narcissus* leaves, in the Royal Horticultural Society's Daffodil Year-book for 1937. *Narcissus* leaf scorch is caused by the fungus *Stagonospora Curtisii*; white mould results from the activities of *Ramularia Vallisumbrosæ*, whilst a grey mould is induced by *Botrytis narcissicola*. *B. polyblastis* is responsible for the condition known as 'fire'. *Narcissus* 'stripe' is probably caused by a virus. Symptoms, life-histories and control are described from a horticultural aspect, and the paper should prove a useful review for the practical grower.

New Zealand Earthquake of June 17, 1929

MR. J. HENDERSON, the director of the New Zealand Geological Survey, has written a detailed report on this earthquake (*N.Z. J. Sci. and Tech.*, 19, 65–144; 1937). Its origin lay near Murchison along a fault directed a few degrees east of north. During the earthquake, the crust on the east side rose over a length of about five miles, especially where the fault crosses the Buller River. A few years before, bench-marks were laid along the railway line of the district. They were re-observed in August 1929, and again in March–July, 1930. The first measurements showed that, to the west of the fault, there was an uplift of 5 ft., dying out within one quarter of a mile. At the fault itself, the uplift of the east side was 14 ft. 9 in., rising to 16 ft. in about a mile, and decreasing irregularly to zero at a distance of about 15 miles. The interval between the two surveys was marked by a general settling of the crust in four blocks. In that nearest the fault, about one mile wide, the changes were small. The next, about three miles across, was uplifted, at one point by 3 ft. 3 in. In the third, five miles wide, the crust sank uniformly by about 18 in.; while, in the fourth, of slightly less width, the subsidence decreased from about 17 in. to zero. The only evidence of horizontal displacement was provided by shifts in the railroad near the fault. Three points on the west side were moved about 4 in. west; while, on the east side, the average movements of five points were 9 ft. 5 in. north and 7 ft. 10 in. west. The terminal stations on the west side, distant 242 yards, are now nearly 6 in. farther apart, while those on the east side, distant 594 yards, are now nearer by 27 in.

Crystal Structure of Uranium

THE X-ray powder diagrams of uranium found by C. W. Jacob and B. E. Warren (*J. Amer. Chem. Soc.*, 59, 2588; 1937) indicate that the structure can be considered as a deformed hexagonal close-packed structure with four neighbours closer than the other eight. From its position in the periodic table, it might be suspected that uranium would have the body-centred cubic structure of chromium, molybdenum and tungsten, but this is not the case. It is also found that the densities of chromium, molybdenum and tungsten, when plotted against the atomic numbers, fall on a smooth curve, whilst uranium is off the curve. The structure of uranium is quite different from that of any other element. The only element which is in the same column of the periodic table and shows any relationship to uranium is neodymium, which crystallizes in the close-packed hexagonal system. The structure of uranium is essentially that of a pseudo-metal such as antimony or gallium. The four closest neighbours in the crystal structure indicate a tendency to form four covalent bonds.

Compensation of Spherical Aberration in Telescopes

C. R. BURCH has recently published a paper (*J. Brit. Astro. Assoc.*, 48, 3, January 1938) in which he describes his experiments with an under-corrected Newtonian telescope, of aperture 9½ in. He cancelled the spherical aberration by means of a compensating plate—a "pseudo-plane-parallel" glass plate having spherically aberrant surfaces, placed at a suitable distance in front of the eyepiece. When this compensator was in its best position, stellar images at focus appeared appreciably smaller and lunar detail appeared sharper. While Mr. Burch does not suggest that compensators should be used for imperfectly figured mirrors, nevertheless as compensators of the low power required are easy to figure, they might prove extremely useful. During the discussion, Mr. F. J. Hargreaves suggested that a compensator mounted in a tube with rack and pinion might be utilized to allow for changes in spherical correction occurring during observing. Capt. M. A. Ainslie remarked that he had once utilized the spherical aberration of an ordinary biconcave lens, mounted a few inches in front of the eyepiece, to compensate for under-correction, the spherical aberration of the lens being opposite to that of the mirror. Those who use reflectors should read the paper and also the account of the proceedings of the meeting. They will derive a considerable amount of useful information on methods for dealing with under-corrections.

Science in India

ONE of the many happy results of sending a delegation from the British Association to the Silver Jubilee Session of the Indian Science Congress Association has been to arouse among the universities and scientific institutions in Great Britain a wider interest in the scientific work of India. As most of the delegates have now returned, the British Association may perhaps provide an opportunity for some of them to speak upon this subject, but meanwhile a good impression of the Congress can be gained from two of its publications that have now reached this country; namely, the *Proceedings*, and the "Outline of the Field Sciences of India"—volumes which correspond in a general way with publications of the British Association.

The "Outline" contains admirable accounts of the natural conditions of India and it is hoped that copies may be readily obtainable by scientific libraries. Dr. C. W. B. Normand begins with a concise account of the weather of India, in which he sets out clearly the phenomena of the monsoons that play so large a part in Indian life. The surrounding oceans are described by Lieut.-Colonel Seymour Sewell, and the geological history by Mr. D. N. Wadia: both chapters are full of information and in a short compass give the reader a clear idea of the physical environment, while Mr. Calder, Dr. Srinivasa Rao, and Sir Bryce Burt deal respectively with the flora, the fauna and the agriculture. Accounts of the racial ethnology and of the archæology by Dr. B. S. Guha and Rao Bahadur Dikshit complete an unusually interesting volume.

The *Proceedings* give a general impression of the extraordinarily wide range of subjects discussed by the Congress. As in the British Association, there are thirteen sections, though they are not identical in the two organizations, the Indian Congress including sections on entomology, medical research, and veterinary research, but not on economics, engineering or education. Well over eight hundred papers were presented: more than two hundred of these went to the chemistry section, while physics and medical research each had just under one hundred. Some of the laboratories from which this work has come are of course well known in Great Britain: Calcutta, Dacca, the various colleges at Madras, Bangalore, Allahabad, Bombay, Benares, but on looking through the volume one sees the names of other laboratories not yet as well known but where, nevertheless, much research activity is being shown.

This wide distribution of the research habit in the Indian colleges and universities is perhaps the most pleasing feature that emerges from a study of the volume. Western science has not simply been admitted into Indian universities; it has been taken up with eagerness and pursued by the Western method of experiment, observation and deduction. The extent of the development is all the more remarkable because of its recent growth: the founder of Indian chemical study, P. C. Ray, is still living, and the first experimental biologist, Jagadis Chandra Bose, has only recently died. Scientific investigation is very largely a modern activity in India, and there has been insufficient time for the evolution of a tradition of scientific work such as exists in the older laboratories of Great Britain, yet already men like Venkata Raman, Meghnad Saha, Birbal Sahni and others have made notable contributions to science and there are a number of younger ones whose work is full of promise for the future.

Hitherto it has been customary at the Indian universities to cast the net very widely, and the impression one obtains both from seeing the work and from perusing these summaries is of extensive rather than intensive investigation. Now that scientific work has begun to flourish so vigorously, it will become possible for the best of the leaders to impress their own high standards on their enthusiastic followers, and so ensure that Indian science may take its proper place in the laboratories of the world. There are, of course, many difficulties to be faced and overcome, but the results already achieved show what can be done, and it remains now to ensure to the gifted Indian worker the best conditions for development and for self-expression.

E. J. RUSSELL.

SOURCES OF ENERGY OF STORMS

The general theme of Dr. C. W. B. Normand's remarks in his presidential address to the Physics and Mathematics Section may be summed up as the thermodynamical approach to the study of storms.

At the basis of it all, following Margules, there is the simple enough proposition: if the whole air-mass around and including a storm can be circumscribed and considered as a closed system, it should be possible from a study of the initial and final conditions alone to decide the main source of the kinetic energy that has been created and displayed during the storm's existence. Before either the gravitational or the internal energies can decrease within a closed system, the stored-up energy must be present in a state of instability, actual or potential. The possible diversities of instability are believed to be composites of three main kinds, which for brevity are called the vertical, horizontal and latent types, the latter referring particularly to the instability that may arise from the latent heat of water vapour. Horizontal instability arises when two air currents of different temperature meet, as, for example, polar and tropical air. The horizontal and latent types are the two that can store up energy until favourable conditions allow its release. Latent instability develops behind a veneer of stability. It is analogous to the energy of a hydrogen balloon caught in the corridor of a large hall where it can be fed with more and more hydrogen but cannot escape up to the dome until given a relatively small, yet distinctly appreciable, push.

How are we to estimate quantitatively the relative importance of these main types of instability in originating storms? The standard method of attack is that of Margules, which, however, can be clarified and extended by graphical methods. The temperature-entropy diagram is chosen, with mass as a third co-ordinate. Solid models were shown, of which the volume represents the total energy available from a closed system, wherein all the elements rearrange themselves in the most efficient manner thermodynamically while passing from the initial unstable to the final stable configuration. In two simple examples of horizontal instability, one with discontinuous and the other with continuous change of temperatures, the volumes take the shapes of a wedge and a pyramid respectively.

The energy of a closed system in which latent instability alone is operative, can also be represented by the volume of a solid figure. Imagining a very extreme example and illustrating it by models, Dr. Normand stated that the average available energy may give rise to velocities of as much as 80 miles an hour, when the effect of rain on the descending air is neglected, and to a hurricane of 115 miles an hour throughout the mass, if full advantage is taken of the chance to saturate the descending air by the simultaneously falling rain. The atmospheric engine does not possess this ideal degree of efficiency but these calculations show how important latent instability may be, especially in the tropics.

The application of these ideas to dust-storms, thunder-storms and cyclones was briefly discussed. More field work is required to settle even the primary thermodynamical questions that should precede any full discussion of the dynamics of storms. The required upper air data must include reliable observations of humidity or of wet-bulb temperature as well as of air temperature. The Bay of Bengal, with its tropical cyclones, is ever a challenge to meteorologists in India.

MAGNETISM RELATING TO CHEMISTRY

It is only within recent years that the magnetic properties of matter have attained the same order of usefulness as the electrical ones in the solution of chemical problems. Recent advances in this subject formed the topic of Prof. S. S. Bhatnagar's presidential address before the Chemistry Section. From the point of view of nuclear chemistry, the nuclear magnetic moments are of considerable importance to theories of the 'neutron-proton' constitution of nuclei.

The actual values of the nuclear moments, however, are very small relative to those arising from the orbital momentum and spin of the electrons, and the main part of the magnetic moments of free atoms and molecules thus arises from the motion of the electrons around the nucleus. The magnitudes of these moments can be determined directly with the help of the atomic and molecular beam deflection methods and the results have been found to be in agreement with theoretical predictions based on spectroscopic evidence. For example, oxygen atoms obtained in their normal ^3P state from an electrodeless discharge are found to have a moment of 1·67 Bohr magnetons; while similarly the magnetic moment of the iron atom has been found to be 2·03 Bohr magnetons. The paramagnetism of oxygen, sulphur and selenium vapours shows that the ground states of these molecules are triplet in character.

In liquids and solids, the magnetic properties of the free molecules are greatly affected by interaction with neighbouring molecules, but in special cases like the rare earths this effect may be very small on account of the deep-seated nature of the electronic orbits from which the paramagnetism arises. Magnetic susceptibilities have been found to vary along the different axes of a crystal and this has been made the basis of an auxiliary method for determining their structure. Thus, for example, the high diamagnetism of graphite in the direction normal to the basal plane is to be expected from its layer lattice structure.

Pascal's discovery that the diamagnetic susceptibilities of many organic compounds are an additive property shows that the atomic orbits are but little distorted by the molecular bonds, and deviations from additivity can be used to establish different electronic structures. Attempts have been made to extend this to electrovalent salts by considering the molecular susceptibility to be the sum of the ionic susceptibilities. It has been established that the ionic susceptibilities of the elements of the first transitional series arise from spin alone, the orbital momentum being completely inoperative for copper and manganese ions, though it does not seem to be altogether quenched for nickel and cobalt. In the rare earth ions, on the other hand, the contribution of the orbital momentum to the paramagnetism of the ions is appreciable since it arises from inner protected shells.

While the ions of the transitional metals of the first series are paramagnetic, some of the complex salts formed from them are diamagnetic, indicating that during the process of co-ordination, the unpaired electrons of the outer shells become paired and a closed (inert gas) configuration results. If the paramagnetism does not disappear, then the complex is presumed to be held together by weak electrovalent forces, for example, $Cu(NH_3)_4$. The recent application of this method to the elucidation of the structure of some constituents of the blood is of considerable interest. It has been shown from magnetic measurements that the oxygen molecule undergoes a profound change in electronic structure on attachment to hæmoglobin, and that the bonds from the iron to the surrounding atoms are ionic in hæmoglobin and covalent in oxyhæmoglobin and carbon monoxyhæmoglobin.

Magnetic measurements have also yielded valuable information regarding the existence of 'free radicals' and have made it possible to distinguish them from dimeric molecules. Information about processes of polymerization has been obtained from observations of the changes in mass susceptibility, and compounds have been detected in systems of alloys by the same method. It also appears that magnetic fields can influence the rate of chemical reactions if the total molecular susceptibility of the products differs from that of the initial substances.

STRUCTURE OF THE HIMALAYA AND OF THE NORTH INDIAN FORELAND

Geological work carried out during the last few years, which was discussed by Mr. D. N. Wadia in his presidential address to the Section of Geology, has thrown much light on the structure of Northern India, a region of extraordinary geotectonic interest as much on account of the magnitude and intensity of the crustal deformations, involving the upwarp of the Himalayan chain and the formation at its foot of the deep parallel Indo-Gangetic depressions, as on account of the extreme youth of these world-transforming events.

The region of Northern India resolves itself tectonically into two broad belts, the plicated geosyncline of the Himalayas, and the edge of the Indian peninsular massif, that has acted as the foreland, and in the process sagged under the strain of the folding of the northern orogen. The structure of this foreland is revealed in four principal units: (1) The Rajputana plateau, prolonged northwards into the 'Punjab wedge' of Gondwanaland, which has played such an important part in moulding the trend of north-west Himalaya; its main tectonic strike is transverse to the Himalayan strike. (2) The Potwar trough, a tertiary geosyncline containing 25,000 ft. of fluviatile deposits. (3) To the south-east the Potwar geosyncline widens into the great synclinorium of the Gangetic trough, 1200 miles long and 200 miles wide, mostly filled up by late Pleistocene alluviation. (4) The Assam plateau, a tongue of the Gondwana mainland, has played the same part as the Punjab wedge in moulding the Himalayan trend at its eastern extremity. The Assam valley is a 'ramp' valley.

Few parts of the Himalayas have so far been investigated in detail for their structural plan. Areas in which detailed mapping and stratigraphic and tectonic work have been carried out are the Kashmir mountains, the Simla area, a part of Garhwal, and the neighbourhood of Mt. Everest, in Sikkim. In Kashmir the Himalayan system of earth-folds undergoes a deep syntaxial bend round a pivotal point—a narrow promontory of the Punjab foreland hidden under the late Tertiary deposits. The most important tectonic feature of this north-west Himalaya re-entrant are two concurrent thrust-planes delimiting the autochthonous fold-belt at the south foot of the Himalayas against the edge of the foreland, which have been traced around the syntaxis for a distance of 250 miles. The inner of these thrusts marks the front of the Kashmir *nappe* of pre-Cambrian and older Palæozoic rocks, which has moved southwards along a low plane of thrust and encroached upon the autochthonous belt of Carboniferous-Eocene succession, obliterating it at places. Four overthrusts have been noted in the Simla mountains, representing flat, recumbent folds of great amplitude. The Pre-Cambrian here is piled up on the Carboniferous and Permian sequence. The Simla rocks are totally unfossiliferous and the evidence of the superposition of highly metamorphosed pre-Cambrian, building some of the prominent peaks near Simla (*Klippen*) over the less altered younger rocks, is obtained by a study of relative metamorphism, unconformities, thrusts, etc. In the Garhwal area recent mapping has proved two superposed *nappes*, the Krol and Garhwal *nappes*, composed of the older rock-formations overriding the autochthonous Carboniferous-Eocene sequence of the Outer Himalayas.

Evidence of the extreme youth of Himalayan orogeny has multiplied in recent years; investigations in the Pleistocene, glacial and fluviatile deposits of the Kashmir valley suggest that some 5,000–8,000 ft. of uplift has taken place since the end of the Pliocene. A part of the address dealt with the recently discovered gravity anomalies, both positive and negative, in the Himalayan region, which cannot be explained on the hypothesis of isostasy. On the whole, compensation is in excess in the central Himalayan ranges, while the outer Himalaya is an area of overload and under-compensation.

The arcuate form of the Himalayas, presenting to the south three prominent festoons, is best explained as the result of three crustal pegs arresting the free movement of the plastic folds pressing against the Indian horst under pressures from the north. The Great Himalayan range, built mostly of granite or pre-Cambrian sediments, from the Brahmaputra gorge to Nanga Parbat on the Indus, thus denotes the Himalayan protaxis, the axis of original upwarp of the Tethyan geosyncline. At both its ends it has undergone sharp southward deflections to accommodate itself to the shape of the foreland.

[*To be continued.*]

Research on Crustacea from the "Discovery" Expedition*

VOL. 14 of the "Discovery" Reports is devoted to Crustacea and includes important memoirs on *Euphausia superba*, on the southern species of the genus *Euphausia*, and on Decapod larvæ. The whale krill *Euphausia superba* may be said to be the key animal of antarctic plankton. Its importance as whale food and its enormous abundance make it an ideal subject for research, and the authors of the respective monographs have utilized their unique opportunities to the best advantage. We now definitely know a considerable amount about the development, larval distribution and breeding of one species, the knowledge being based on the examination of a huge number of specimens. There is more to come, for at least another memoir is in progress which will deal with development and distribution of the adult animal. No member of the group has ever been studied so thoroughly as *Euphausia superba*, and the thorough study of this one species will serve as a basis for all future research.

Dr. Gurney's work on the Hippolytidæ is illuminating in many ways, and it is significant that, in this one family of the Caridea where nine larval stages are frequently present and not known to be exceeded, he should refer to both Fraser's and John's present accounts of the development of the Euphausidæ, noting that they find three *Calyptopis* stages and six (or rarely seven) *Furcilia* stages (the term *Furcilia* being used to include all stages between *Calyptopis* and post-larval). Now if we accept the interpreting of stages 1–3 of Caridea as equivalent to the *Protozœa* of Penæidea and the *Calyptopis* of Euphausidæ, as suggested by Gurney in 1926, the total number of possible stages in Caridea is precisely the same as it is in Euphausidæ—a fact certainly in favour of the placing of the Euphausidæ among the Decapods.

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* Discovery Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Title Page and List of Contents: On the Development and Distribution of the Young Stages of Krill (*Euphausia superba*) (published December 7, 1936) by F. C Fraser. The Southern Species of the Genus Euphausia (published December 14, 1936) by D. Dilwyn John: The Reproductive System of *Euphausia superba* (published June 25, 1937) by Helene E. Bargmann: Larvæ of Decapod Crustacea. Part 4. Hippolytidæ (published June 25, 1937) by Robert Gurney. Vol. 14. (Cambridge: University Press, 1937).

Fraser has established the principle that there are certain important essential *Furcilia* stages, recognized by the number and state of development of the pleopods, and that these stages predominate to such an extent that one must regard any intermediate stages as unessential and as occurring only occasionally. He also shows that breeding takes place in the deep water, and all early stages are found in the deep water of the far south; *Calyptopis* and early *Furcilias* in warm deep water and in the intermediate vicinity of antarctic surface water, but that the last *Furcilias* and adolescents are always found at the surface and at the ice edge. Adolescents remain at the surface but early stages have a well-defined diurnal migration. Miss Bargmann in her account of the reproductive organs of *E. superba* states that it is probable that the process of egg-laying takes place at a depth of 200 metres or more. She has dissected and examined more than 5,000 specimens in order to determine the state of development of the sexual organs. John describes the adult characters of ten species of *Euphausia*, including *Euphausia superba*, and the development of five others, with their distribution, which is exceedingly interesting; the genus in the cold southern waters consists of two groups of species, one reaching to the far south and each of the four species concerned occupying one of four successive zones of water from north to south, the other, which includes *Euphausia superba*, being circumpolar in range and not so successful in breeding and colonization.

Dr. Gurney is describing group by group the very large collection of decapod larvæ obtained by the *Discovery*. This is the fourth part and in it he has included certain members of the Hippolytidæ from the collection of the Great Barrier Reef Expedition and from his own collections from Gardaqa in the Red Sea. In so doing he has made a very valuable contribution to our knowledge of the larvæ of this difficult family, the larvæ of which are extremely varied and interesting. Besides describing much new material, he has summarized the larval characters in eight genera, and amongst other things has established the fact that Bate's peculiar larval genus *Eretmocaris* is a composite one, made up of a group of forms, probably mostly, but not all, belonging to the hippolytid genus *Lysmata* or some near relative. In thus summarizing our knowledge of the Hippolytidæ, Dr. Gurney shows how much more there is to be done and indicates the essential gaps which should be filled in order to understand the natural relationships of those larvæ.

Irrigation in Egypt

THE Irrigation Services of Lower Egypt, Upper Egypt and the Sudan are the subject of Part II of the annual report of the Egyptian Ministry of Public Works for the year 1929–30, which has only lately been issued (Cairo: The Government Press. P.T. 100). The control and distribution of the Nile waters according to the requirements and crops of the cultivated lands, and the safeguarding of the country from the possible dangers and losses of flooding are regarded as the first and principal duty of the Ministry. In broad terms, this consists in regulating the periodic variations in the river flow to meet the seasonal needs of the agriculturists and in adjusting the authorized croppage to the supplies of water likely to be available. To ensure that an adequate proportion of the plentiful flood waters is retained in storage in order to make up for the natural deficiency during summer, forecasts of the expected state of the river at all seasons are made from time to time, and on these forecasts programmes of distribution are made and progressively adapted as the situation defines itself more clearly. On these and the reports of conditions the Ministry also prepares and executes schemes for the improvement of the system and for the development of cultivable areas to provide for the steadily increasing population.

In the year under review, early forecasts made it necessary, in the first instance, to allot all the supply to the cotton crop, but later forecasts made in April resulted in a modification whereby it was possible, ultimately, to authorize the cultivation of rice areas to the extent of 400,000 feddan. In this year also, the forecasts indicated that the flood would be dangerously high, whereupon the necessary steps were taken to cope with this threat and to carry out such measures of defence and protection as were necessary. In the result, the flood passed safely and without serious accidents or cuts in the banks.

The report is very largely concerned with the day-to-day routine of records of flood, supply, distribution, discharges, allowances, etc., in each of the many areas into which the whole system is divided, and much of this work is illustrated by charts and diagrams. There are also particulars of the buildings, additions, repairs and other constructional and maintenance work undertaken to preserve and extend the facilities and advantages of this vital undertaking.

Closely connected with the work of irrigation in some of its services is the Physical Department, which also comes under the Ministry of Public Works and the report of which is included in this volume. It includes meteorological, hydrological and weights and measures services and a scientific instrument workshop where surveying and other measuring and scientific instruments are repaired, adjusted and calibrated.

The Meteorological Service in 1929–30 with 78 stations, and the Hydrological Service with 345 rainfall stations were very fully occupied in connexion with the needs of the irrigation system, and the report emphasizes the necessity for their enlargement not only in size but also in the scope and development of their work, particularly in research. "New work and new ideas are the life of a scientific department." The growing demand of aviation urges expansion of the meteorological service and the value of instituting research in relation to agriculture and to the climatic causes of the Nile flood are quoted as immediate strong reasons for putting into effect the plans for the extension of its work. Nevertheless, a certain amount of research work is being carried on, including investigations of evaporation at Lake Qaroun and at Gebel Zeraf, and of swamp growths and silting at Aswân, Wadi Halfa and Khaunaq. It is unfortunate that these reports are not available until so long after the period to which they refer.

University Events

EDINBURGH.—The University has awarded the Dewar research fellowship to Dr. C. A. Beevers, lecturer in physics at University College, Hull, for three years from April 1. This is the first award of the fellowship, which was recently established under a bequest of Lady Dewar, widow of Sir James Dewar, for research in physics and chemistry, and on this occasion it has been given for research in crystallography.

OXFORD.—W. H. Cashmore, J. S. Wilson, R. K. Macdowall, and W. J. West have been appointed research officers by the Committee for Rural Economy.

In Congregation on February 8 the University Chest was authorized to set aside out of the Nuffield Trust funds a sum not exceeding £99,944 for the erection and equipment of a laboratory of physical chemistry.

A grant was also made towards the expenses of the University Expeditions of this year to the Cayman Islands and to Greenland.

Science News a Century Ago

Meteorology in America

AT a meeting of the Ashmolean Society at Oxford on February 12, 1838, a letter from Prof. Daubeny, dated at Philadelphia, was read. The letter contained a survey of the state of meteorological science in America and in it Daubeny stated that regular observations were made at Montreal by Mr. M'Cord, who had spared no expense in obtaining the best instruments, and that Mr. Webster, of Albany, from a table of mean temperatures of fifty-three places in the State of New York, had found the highest mean temperature in that State to be 51° and the lowest 43° F. Mr. Redfield, of New York, had advanced a theory that the prevailing storms on the Atlantic coasts have the same character as tornadoes and had prepared a chart to illustrate his views. The phenomena of these storms were explained by Mr. Espy, of Philadelphia, not by a gyratory motion, but by an upward current, which rushes in from all points of the compass towards a central point, where there is a rapid rise of the superficial strata of air into the higher regions of the atmosphere. Mr. Espy's views were stated at length and the letter also contained Daubeny's objections to them. The State of Pennsylvania, it was added, had allotted 4,000 dollars towards instruments for meteorological observations.

James Pollard Espy, who was born on May 9, 1786, and died on January 24, 1860, published his "Philosophy of Storms" in 1841. In 1843 he was appointed to the Washington Observatory, and while there he laid the foundation of the U.S. Weather Bureau.

A Letter from von Humboldt

ON February 12, 1838, at a meeting of the Royal Geographical Society, a letter from Alexander von Humboldt, dated Berlin, January 10, 1838, was read. In the course of the letter, von Humboldt referred to Schmoburgk's travels in Guiana, the work of M. Federoff who had spent five years in northern Asia, the trigonometrial survey between the Black Sea and the Caspian Sea, and to the subject of magnetic observations. Of the observations being made at Berlin, he said, "As we make observations here, both with the needle of Gambey, furnished with microscopes, and with the new apparatus of Gauss, furnished with a mirror, we have an opportunity of convincing ourselves more and more of the greater perfection of the latter apparatus, which by degrees will be employed in all our great observatories.

"As I think that the subject is not without importance to seamen, I beg you to invite the influential members of your Society to be good enough to propagate Gauss's manner of observing in all new stations where intelligent people can be found. Points near the magnetic equator and those which are in high latitudes in the southern hemisphere . . . would be most desirable if they would observe at the same epochs indicated by M. Gauss."

Richard Owen receives the Wollaston Medal

AT the anniversary meeting of the Geological Society held on February 16, 1838, at which Darwin was elected one of the secretaries, the president, the Rev. W. Whewell, in presenting the Wollaston Medal to Richard Owen, said: "Mr. Owen,—I have peculiar pleasure in presenting to you this medal, awarded to you by this Society, for your services to Fossil Zoology in general, and in particular for the description of the fossil mammalia collected by Mr. Darwin. I trust it will be a satisfaction to you to receive this our testimony of the success with which you have cultivated that great science of comparative zoology, to which you have devoted your powers. I trust it will add to your satisfaction, to consider that the subject which we more particularly wish to mark on this occasion—the Study of Fossil Zoology—is one to which the resources of your new science were applied, while the subject was yet new, by that great man—John Hunter—whose museum and whose reputation are so worthily consigned to your care. . . ."

Milne-Edwards on Annelidæ

"M. Milne-Edwards", said the *Athenæum* of February 17, 1838, "has been making some interesting and important observations on the circulating apparatus of the Annelidæ, which has been but little studied, excepting in the leech and earthworm. He finds a great diversity among the different genera. For instance in the Terebellæ, the branchiæ act as an arterial heart and organ of respiration. Among the Arenicolæ, the vascular tufts on the back equally fulfil the double functions of heart and branchiæ and there are besides two ventricles, which by their pulsations, send the blood into the dorsal vessel. In the Eunice, the course of the blood is determined by the contraction of a series of vesicles, situated on each side of the ventral vessel, and sending out canals which go to the branchiæ. These vessels are consequently little pulmonary hearts; and as a pair of them exists in almost all the rings of the body, these singular Annelidæ often possess hundreds of hearts."

Henri Milne-Edwards (1800–1885) was elected to the Paris Academy of Sciences in 1838 and afterwards filled the chairs of entomology, zoology and physiology at the Jardin des Plantes.

Societies and Academies

London

Royal Society (*Proc.*, A, **164**, 151–306 ; January 21).

R. W. Gurney and N. F. Mott : The theory of the photolysis of silver bromide and the photographic latent image.

D. R. Hartree and W. Hartree : Self-consistent field with exchange for calcium.

Theodore de Kármán and Leslie Howarth : The statistical theory of isotropic turbulence.

H. J. A. Dartnall, C. F. Goodeve and R. J. Lythgoe : Effect of temperature on the photochemical bleaching of visual purple solutions.

Krishna Chandra : Instability of fluids heated from below.

T. Bjerge : Production of neutrons by bombardment of beryllium with α-particles.

H. J. Bhabha : The penetrating component of cosmic radiation.

E. A. Moelwyn-Hughes : Hydrolysis of the methyl halides.

Proc., B, **124**, 397–521 ; January 14.

D. Keilin and E. F. Hartree : The mechanism of the decomposition of hydrogen peroxide by catalase.

J. W. Hughes : The monaural threshold : effect of a subliminal contralateral stimulus.

P. D. F. Murray : Control of beating and of microfibrillation by means of potassium, calcium and sodium in the chick embryo heart. Calcium fibrillation and the control of beating.

E. Watchorn and P. D. F. Murray : Loss of potassium from embryonic chick hearts in potassium-free media with and without calcium.

R. B. Haines : Effect of freezing on bacteria.

T. McKeown and S. Zuckerman : Suppression of œstrus in the rat during pregnancy and lactation.

S. J. Folley and S. K. Kon : Effect of sex hormones on lactation in the rat.

I. W. Rowlands : Pro-gonadotropic sera. Specificity of antigonadotropic sera.

Paris

Academy of Sciences, December 27 (*C.R.*, **205**, 1333–1476).

Alfred Lacroix : The nature of the deposit of zircon of Mont Ampanobe in Madagascar.

H. Deslandres : The universal constant of band spectra. The attribution of the lines of the band to causes other than the rotation of the molecule.

Georges Giraud : A new method for treating certain problems relating to equations of the elliptic type.

Henri Devaux : The instantaneous disclosure of monomolecular films spread out on mercury by the formation of a mist.

Marc Krasner : Rectification of the author's earlier note on the definition of certain non-commutative rings.

Paul Dubreil and Mme. Marie Louise Dubreil-Jacotin : The algebraic properties of the relations of equivalence. The theorems of Schreier and of Jordan-Holder.

J. Le Roux : The analytical definition of equality in geometry.

R. de Misès : The geometric basis of the theorem of Mandelbrojt on the singular points of an analytical function.

Paul Lévy : Certain solutions of Chapman's equation.

Dragoslav S. Mitrinovitch : A problem on asymptotic lines and the method of logical integration of the differential equations of Jules Drach.

Stefan Bergmann : A connexion between the theory of partial differential equations and that of analytical functions of a variable.

Carlos Biggeri : A general theorem on the peripheral singularities of the series of Dirichlet.

Caïus Jacob : The approximate calculation of the coefficient of contraction of a gaseous jet.

Jacques Yvon : The tensorial equations of the magnetic electron.

Robert Pinoir : A method of measuring the densities of electrostatic charges. The method described, in which the measurement of the electrostatic charge is reduced to the measurement of a rectified current, is applicable to the study of the electrification produced in the manufacture of paper and of films.

Mlle. Suzanne Veil : The opposition of metals to platinum in solutions of their own salts. Study of the changes of E.M.F. produced in the cell copper – cupric chloride solution – platinum by dilution.

Stéfan Procopiu and Gérard d'Albon : The magnetic permeability at high frequency of thin layers of iron electrolytically deposited.

Pierre Grauwin : Characteristics of the thermoelectronic emission of thoriated molybdenum.

Jean Paul Mathieu and Mlle. N. Faraggi : The study of the circularly polarized light reflected by certain Coleoptera.

Roger Arnoult : The intensity of the principal electronic lines of conversion of the active deposit of thoron and on the photographic efficiency of the electrons.

Jean Thibaud and Martin Ferber : The independence of the disintegrations of the polonium atoms.

Pierre Brun : Study of the properties of metallic ions in alcohol. Measurements of the decomposition potentials and mobilities of the sodium and potassium ions of sodium and potassium ethylate in alcohol.

Georges Champetier and Rodolphe Viallard : The penetration of water into the cellulose network. The exchange reaction between cellulose and heavy water.

Mathieu Dobine : The adsorption by blood charcoal of the system acetic acid – water.

Enrique Moles : The adsorption correction in the method of limiting densities.

Wilfried Heller and Mlle. Germaine Quimfe : The influence of an orientation of non-spherical colloidal particles on their velocity of aggregation.

Edouard Rencker : The tempering and annealing of boric anhydride glass.

Roger Michaud : The law of the precipitation of the β phase by reheating an aluminium-magnesium alloy containing 12·7 per cent of magnesium. The changes produced by reheating a tempered aluminium magnesium alloy at varying temperatures were studied by means of X-ray diffraction.

Jean Amiel : The cupritrichlorides and cupritribromides.

André Chrétien : A simple method for determining directly the mass of gaseous bodies under normal conditions.

[*To be continued*]

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 10; 1937).

T. de Donder: Components of a chemical reaction.

E. de Wildeman: Abortion of the ovaries in certain phanerogams.

J. L. Verhaege: Intensity relationships of some intercombination lines in the spectrum of mercury. Considerable discrepancies between the observed and calculated intensity ratios were found for the lines $(7^3S_1-6^3P_2)$, $(7^3S_1-6^3P_1)$ and $(7^3S_1-6^3P_0)$.

L. Derwidué: Some birational hyperspatial transformations.

R. Debever: Mayer fields in the calculus of variations of multiple integrals.

H. Schots: Two interesting problems in the calculation of magic squares.

F. E. Nisoli: Reply to Mr. Cox's remarks concerning a note of May 4, 1937.

Moscow

Academy of Sciences (*C.R.*, 17, No. 5, 1937).

N. P. Erugin: Exponential substitution for an irregular system of linear differential equations.

I. Gelfand: (1) Theory of abstract functions. (2) Operators and abstract functions.

V. Fabrikant: Probability of collisions of the second kind between atoms and free electrons.

I. N. Antipov-Karatajev and I. D. Sedleckij: Genesis of colloidal metals in alkaline soils. Gedroitsite, a new mineral.

B. A. Rubin and O. T. Lutikova: Oxidizing-reducing activity of tissues, as a biological character in plants.

D. J. Vakulin: Effect of low and varying temperatures on variability in *Perilla*.

A. A. Drobkov: Influence of rare earths on plant growth.

M. Moisejeva: Application of the quantitative anatomical method to the division of the genus *Pinus* into smaller taxonomic units.

S. N. Jagužinskij: Structure of species of protococcous algæ, *Scenedesmus* Meyen.

Tokyo

Imperial Academy (*Proc.*, 13, No. 9; 1937).

Obituary notice of Prof. Toyokichi Takamatsu, known for his work in chemical industry in Japan.

Masao Sugawara: The transformation theory of Siegel's modular group of the *n*th degree.

Yukiyosi Kawada: Remarks on M. Moriya's construction of the classes of group theories of algebraic functions.

Takeshi Inagaki: The classes of constituents of complementary analytical groups.

Tokui Satô: The differential equation $y'' = f(x, y, y')$.

Masao Inouye: A consideration of the problem of Dirichlet.

Tokio Takéuchi and Takanosuke Sugita: A method of producing a photographic image of a dark hot body in darkness. The method adopted involves the quenching of phosphorescence by infra-red light.

Shinkichi Yashimura: Limnology of two lakes on the oceanic island, Kita-Daitô-zima.

Masuzô Ueno: Plankton of the lakes in Kita-Daitô-zima.

Tokio Shikama: Ossiferous fissure deposits of Kuzuii Totigi Prefecture.

Kiyoshi Takewaki: (1) Fate of the zona reticularis in the adrenal cortex of castrated male mice. In certain circumstances, the zona reticularis remains for a year and a half (sometimes longer) after castration; but various types of degenerative phenomena occur in the zone of males which have long been castrated. (2) Postponement of appearance of œstrus following interruption of pregnancy in lactating mice. Lactation inhibits for some time the advent of œstrus following the removal of the uterus containing fœtuses.

Takeo Kamada and Haruo Kinosita: Graded response of the muscle of the Japanese giant crab to indirect stimulation.

Yositiro Umeya: Preliminary note on experiments of ooplasm transfusion of silkworm eggs, with special reference to the embryo. Whether or not the development of the embryo in the wintering egg will begin depends upon the solubility of the yolk, and the phenomenon of egg-wintering is shown to be based primarily on the ooplasm and not on the embryo.

Forthcoming Events

Monday, February 14

Royal College of Surgeons of England, at 5.—Sir Arthur Keith, F.R.S.: "The Prehistoric People of Mount Carmel".

Royal Geographical Society, at 5.—J. Hanson-Lowe: "The Structure of the Lower Yangtze Terraces".

Wednesday, February 16

Royal College of Surgeons of England, at 5.—Dr. W. E. Gye: "Some Recent Work on Experimental Cancer Research"

Thursday, February 17

Chemical Society, at 8.—Prof. A. Findlay: Franklin Memorial Lecture.

Friday, February 18

Institution of Chemical Engineers (at the Hotel Victoria, Northumberland Avenue, London, W.C.2).—Annual Corporate Meeting.

Dr. William Cullen: "A Milestone" (Presidential Address).

Royal Institution, at 9.—Prof. E. N. da C. Andrade, F.R.S.: "Science in the Seventeenth Century".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned

Assistant (grade III) in the Ballistics Directorate and a Junior Scientific Officer in the Radiological Directorate of the Research Department, Woolwich, S.E.18—The Chief Superintendent (February 14).

Lecturer in Mechanical Engineering in the Leeds College of Technology—The Director of Education, Education Department, Calverley Street, Leeds 1 (February 16).

Junior Scientific Officer at the Air Defence Experimental Establishment, Biggin Hill, Kent—The Superintendent (February 18).

Assistants (grades II and III—refs. 6070 and 6270) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (February 19).

Lecturer (woman) in Geography in the Goldsmiths' College, New Cross, S.E. 14—The Warden (February 28)

Assistant Government Analysts in the Straits Settlements—The Director of Recruitment (Colonial Service) 8 Buckingham Gate, London, S.W.1 (March 21)

Two Demonstrators in Physiology in the University of Liverpool—The Registrar (April 1).

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Chapters in the Development of Industrial Organic Chemistry. Pp 112+10 plates. (London: Imperial Chemical Industries, Ltd) [121

University of London Council for Psychical Investigation. Bulletin 3: Preliminary Studies of a Vaudeville Telepathist. By S. G. Soal. Pp. 96+6 plates. (London. University of London Council for Psychical Investigation) 5*s*. net. [131

National Physical Laboratory. Abstracts of Papers published in the Year 1936. Pp. iii+65. (London· H.M. Stationery Office.) 1*s*. net. [191

The Journal of the Institute of Metals. Vol. 61. Edited by G. Shaw Scott. Pp. 332+29 plates. (London: Institute of Metals) [191

Department of Scientific and Industrial Research: Water Pollution Research. Summary of Current Literature. Vol. 11, No 1, January 1938, Abstracts Nos. 1–123. Pp. ii+36. (London: H.M. Stationery Office.) 2*s*. net. [191

Forensic Chemistry in the Criminal Courts. By Dr. C. Ainsworth Mitchell. Pp. 17. (London: Institute of Chemistry.) [191

University of Leeds in association with the Royal Bath Hospital, Harrogate, and the Leeds Public Dispensary and Hospital Annual Report of the Advisory Committee on Research into Rheumatism Pp. 6. (Leeds· The University.) [191

Lunacy and Mental Deficiency. The Twenty-third Annual Report of the Board of Control for the Year 1936. Part 2 Pp. iii+540. (London: H.M. Stationery Office.) 8*s* net. [191

Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Year ended 31st March, 1937. Pp. viii+120 (London. H.M. Stationery Office.) 3*s*. net. [191

Scientific Proceedings of the Royal Dublin Society. Vol 21 (N.S.), Nos. 54 and 55: A Method for determining the Radium Content of Rocks by direct Alpha-Ray Counting, by Dr J. H. J. Poole; The Theoretical Efficiency of Cylindrical Ionisation Chambers when used for estimating Radon by Alpha Particle Counting, by Dr. J H. J. Poole. Pp. 595–614. (Dublin: Hodges, Figgis and Co., Ltd.; London Williams and Norgate, Ltd) 2*s*. [191

Air Ministry· Aeronautical Research Committee: Reports and Memoranda. No. 1782 (2924): Calculated Flexural-Torsional Flutter Characteristics of some Typical Cantilever Wings. By Dr. W. J. Duncan and H. M. Lyon. Pp. 32. 4*s* 6*d*. net. No. 1786 (2943): A Review of Theoretical Investigations of the Aerodynamical Forces on a Wing in Non-uniform Motion. By H. M. Lyon. Pp. 33. 4*s*. 6*d*. net No. 1792 (2317). Note on the Drag of a Gauntlet as measured in the 24 ft. Tunnel. By W. G. Jennings. Pp. 8. 1*s*. 6*d*. net. (London H.M. Stationery Office.) [191

Ministry of Agriculture and Fisheries: Fisheries—England and Wales. Salmon and Freshwater Fisheries Report for the Year 1936. Pp. 53+3 plates. (London: H.M. Stationery Office.) 1*s*. net. [191

Fourth International Grassland Congress, Great Britain, 1937. Report containing Full Texts of all Papers delivered to the Congress at Aberystwyth on July 15, 16 and 17, 1937. Edited for the Organizing Committee by R. O. Whyte. Pp. x+486+xi+xxxiv. (Aberystwyth: Fourth International Grassland Congress.) 40*s*. [191

Other Countries

The South African Journal of Science. Vol. 34: Being the Report of the South African Association for the Advancement of Science, 1937, Windhoek. Pp. xliv+464. (Johannesburg: South African Association for the Advancement of Science.) 30*s*. net. [181

University of California Publications in American Archæology and Ethnology. Vol. 36, No. 4: The Tolowa and their Southwest Oregon Kin. By Philip Drucker. Pp. 221–300. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 4*s*. 6*d*. net. [191

Anthropological Records. Vol. 1, No. 1· Culture Element Distributions. 5: Southern California. By Philip Drucker. Pp. iii+52. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 2*s*. 3*d*. net. [191

Scientific Reports of the Imperial Agricultural Research Institute, New Delhi, for the Year ending 30th June, 1937, with a Brief Survey of Three Decades of Research at the Institute. Pp. iv+177+8 plates (Delhi: Manager of Publications.) 3 rupees; 5*s*. 3*d*. [191

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 118 Jahresversammlung vom 27 bis 29 August 1937 in Genf. Pp. 380+37. (Aarau: H. R. Sauerländer und Co) [191

Regenwaarnemingen in Nederlandsch-Indië. Acht en vijftigste Jaargang, 1936. Pp. 129. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [191

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 158. Further Studies of the Ground Effect on the Aerodynamic Characteristics of an Aeroplane, with Special Reference to Tail Moment. By Itirô Tani, Hideo Itokawa and Masuo Taima Pp. 115–146. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 40 sen. [191

South Australia. Annual Report of the Director of Mines and Government Geologist for 1936. Pp. 8. (Adelaide: Government Printer.) [191

Annalen van de Sterrewacht te Leiden. Deel 17, Stuk 2: Photographic Photometry of Variable Stars in the Globular Cluster ω Centauri, based on Plates taken by H. Van Gent with the Yale Refractor at Johannesburg, measured by C. J. Kooreman and W. Chr. Martin. Discussed by W. Chr. Martin. Pp. 166+2 plates. (Leiden: Sterrewacht.) [191

New Zealand: Department of Lands and Survey. Annual Report on Scenery Preservation for the Year ended 31st March 1937. Pp. 19+5 plates. (Wellington: Government Printer.) 1*s*. [191

Josiah Macy, Jr. Foundation. A Review by the President of the Activities for the Six Years ended 31st December, 1936, with Extracts from the Treasurer's Reports for the Years 1932–1936. Pp. 137. (New York: Josiah Macy, Jr. Foundation) [191

Australasian Antarctic Expedition, 1911–14. Scientific Reports. Section C: Zoology and Botany Vol. 2, Part 1: Mallophaga and Siphunculata. By the late Prof. Launcelot Harrison. Pp. 47+3 plates. 6*s*. Vol. 8, Part 4· Crinoidea. By Austin H Clark. Pp. 18. 3*s*. Vol. 10, Part 1· Trematoda. By Prof. T. Harvey Johnston. Pp 29. 4*s*. (Sydney: Government Printer.) [191

Bulletin of the American Museum of Natural History. Vol. 74, Art 3: Studies of Birds from Eastern Brazil and Paraguay, based on a Collection made by Emil Kaempfer By Elsie M. B. Naumburg. Pp. 139–205. Vol 74, Art 4: Observations on the Body Form of the Blue Marlin (*Makaira nigricans ampla* Poey). By G. Miles Conrad and Francesca La Monte. Pp 207–220. (New York. American Museum of Natural History) [191

U S Department of Agriculture. Circular No. 445: The Iris Thrips and its Control by Hot Water, with Notes on other Treatment. By Floyd F. Smith and L. G. Utter. Pp. 12. 5 cents. Farmers' Bulletin No. 1783: Feeding Wildlife in Winter. By Wallace B. Grange. Pp. ii+21. 5 cents. (Washington, D.C.: Government Printing Office.) [191

U.S. Department of the Interior: Office of Education. Leaflet No. 33: Housing and Equipment of School Libraries Compiled by Ellen L. Anderson. Pp 11. 5 cents. Vocational Education Leaflet No. 2: Suggestions for Teaching the Job of Controlling Bunt (Stinking Smut) of Wheat in Vocational Agriculture Classes. Revised edition. Pp iv+12 5 cents. (Washington, D.C.: Government Printing Office.) [191

U.S Department of Commerce: National Bureau of Standards. Handbook H 21: Code for Protection against Lightning. Parts 1, 2 and 3. (Supersedes M92 and H17.) Pp. x+96. (Washington, D.C.· Government Printing Office.) 15 cents. [191

Proceedings of the United States National Museum. Vol. 84, No. 3025: A Giant New Species of Fairy Shrimp of the Genus Branchinecta from the State of Washington. By James E. Lynch. Pp. 555–562+plates 77–80. (Washington, D.C.: Government Printing Office.) [191

University of California Publications in Zoology. Vol. 42, No. 1: Structural Modifications in the Hawaiian Goose (*Nesochen sandvicensis*), a Study in Adaptive Evolution. By Alden H. Miller. Pp. iii+80+6 plates. 1 dollar. Vol. 42, No. 2: Morphology of the Pocket Gopher Mammalian Genus Thomomys. By John Eric Hill. Pp. iii+81–182. 1 dollar. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) [201

II Internationaler Kongress für Krebsforschung und Krebsbekampfung (IInd International Congress of Scientific and Social Campaign against Cancer). 2: Mitteilungen (Communications). Pp. xii+628. (Bruselles: Marcel Hayez.) [211

Contributions from the Physical Laboratories of Harvard University for the Year 1936. Series 2, Vol. 3. Pp. vi+48 papers. (Cambridge, Mass: Harvard University.) [211

Smithsonian Miscellaneous Collections. Vol. 97, No. 3: Middle Cambrian Fossils from Pend Oreille Lake, Idaho. By Charles Elmer Resser. (Publication 3447.) Pp. 12+1 plate. (Washington, D.C.: Smithsonian Institution.) [211

U.S. Department of Agriculture. Leaflet No. 152: How to Control Fleas. By F. C. Bishopp. Pp. 4. (Washington, D.C.: Government Printing Office.) 5 cents. [211

Proceedings of the United States National Museum. Vol. 85, No. 3028: Synopsis of the Beetles of the Chilean Genus Phytholæma (Scarabæidæ. Melolonthinæ). By Lawrence W. Saylor. Pp. 5–12. Vol. 85, No. 3029. Redescription of the Capelin *Mallotus catervarius* (Pennant) of the North Pacific. By Leonard P. Schultz. Pp. 13–20. (Washington, D C.: Government Printing Office.) [211

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 22, No. 5: The Templeton Crocker Expedition of the California Academy of Sciences, 1932, No. 34: Report on the Sargassums. By Prof. William Albert Setchell. Pp. 127–158+plates 28–33. Vol. 22, No. 6: The Templeton Crocker Expedition of the California Academy of Sciences, 1932, No. 35: New Species of Recent Mollusks from the Coast of Western North America. By A. M. Strong and Leo George Hertlein. Pp. 159–178+plates 34–35. Vol. 23, No. 10: A New Marine Turtle from the Miocene of California By Charles W. Gilmore. Pp. 171–174+plate 14. Vol 23, No. 11: Contributions to Oriental Herpetology, 5. Honshu or Hondo, the neighboring Islands of Sado and Awaji, and the Seven Islands of Idzu. By Joseph R. Slevin. Pp. 175–190. Vol. 23, No. 12· Marine Mollusca of San Martin Island, Mexico. By A. M. Strong. Pp. 191–194. Vol. 23, No. 13 A Record of the Fossil Grebe, *Colymbus parvus*, from the Pliocene of California, with Remarks on other American Fossils of this Family. By Alexander Wetmore. Pp. 195–201. (San Francisco, Calif.· California Academy of Sciences.) [211

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 89. Lepidoptera collected in Northern British Columbia by Miss Josephine de N. Henry. Part 1: Rhopalocera. By John W. Cadbury, 3d. Pp. 387–413. (Philadelphia: Academy of Natural Sciences.) [211

Catalogues, etc.

Australasia: a Catalogue of Books and Prints relating to Australia, New Zealand, the Pacific Ocean and Tasmania. (Catalogue No. 621) Pp. 46. (London: Francis Edwards, Ltd.)

Humidity Control and its Importance. (Publication No. 334.) Pp. 6. (London: A. Gallenkamp and Co., Ltd.)

Standard Meteorological Instruments. (List M.3.) Pp. 136. (London: Negretti and Zambra)

Selected List of Publishers' Remainders: being New Books offered at Greatly Reduced Prices. (Catalogue No. 622) Pp. 28. (London. Francis Edwards, Ltd.)

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Overcrowded Professions

AN 'unemployment' problem which has for years baffled university and State authorities in many countries and has, in some, assumed an aspect of tragic intensity for the individuals immediately concerned and of menace for the community, is dealt with by Prof. W. M. Kotschnig in a valuable survey of the subject recently published*. It is scarcely too much to say that the magnitude of the problem is not yet fully appreciated. Here, in Great Britain, where unemployment of university graduates has been on a relatively small scale, although it has given rise to some anxiety in the case of the teaching profession, it has not been 'in the news', but it has been the subject of intermittent investigation and discussion since 1930, and a series of precautionary and preventive measures were suggested at last year's congress of the National Union of Students. The consideration of any such suggestions will be greatly facilitated by reference to Prof. Kotschnig's lucid account of the conditions of the problem and of solutions attempted in various countries, and his comments, criticisms, and suggestions which are evidently the fruit of close observation and long study. In his "Planless Education", published in 1935, he gave a preliminary report of the results of the world-wide survey of the situation undertaken in 1932 by International Student Service, Geneva, of which he was formerly general secretary. For the present volume, that report has been revised, brought up to date, amplified, and developed.

The main theme—unemployment of university graduates—is introduced by an account of the actual situation in each of twenty-two countries and this is followed by an estimate of causes and effects. The situation is blackest in Austria and Hungary, where the overcrowding of the professions is described as complete and absolute. "In Germany, the 40,000 or 50,000 workless university graduates in 1931–33 became, together with unemployed subalterns of the old Imperial army, the spearhead of the National-Socialist movement." There is, as yet, no other country in the world with such tens of thousands of unemployed graduates, "but there are many countries which are not far from the danger point".

The social problems created by the surplus of university graduates have created "counter-measures", to which Prof. Kotschnig devotes particular attention. A discussion of numerical restriction, the *numerus clausus*, leads on to a consideration of the German law of April 1933, which had the effect of reducing admissions by a half. This drastic limitation of numbers was accompanied by a change in the quality of entrants, due to the introduction of new criteria of selection: race, sex, character, and national reliability (*nationale zuverlassigkeit*), sincerity of outlook (*lauterheit der gesinnung*), bodily prowess, and capacity for comradeship and devotion. This accords with the new conception of the university, introduced with the Nazi regime, as existing for the advancement, not of knowledge in general or of the education of the individual, but of the National-Socialist State. Simultaneously, there was a ruthless elimination from the professions of Jews and others obnoxious on account of their political opinions or affinities. By this rough surgery the urge for higher education (or its diplomas) was checked, and overcrowding relieved.

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* "Unemployment in the Learned Professions: an International Study of Occupational and Educational Planning." By Prof. Walter M. Kotschnig. Pp. xii+348. (London: Oxford University Press, 1937.) 12*s*. 6*d*. net

Upon the subject of occupational and educational planning Prof. Kotschnig insists, with perhaps exaggerated emphasis, on the irresistible, "almost elemental" strength of the modern urge for education (most of which might, perhaps, be more justly called "urge for diplomas"), as evidenced by statistical tables. The forces manifesting themselves in this urge—craving for a fuller life, desire for the better pay and social standing to which academic qualifications lead, and faith in the power of knowledge—these forces, far from being played out, are, in many countries, gaining momentum as progress is made towards educational emancipation of the "under-privileged". In Germany this historical trend has been arrested. Under the National-Socialist regime, educational planning has there involved drastic restriction of educational opportunities, and a solution of the problem of overcrowded professions has been reached as part and parcel of a reactionary movement which scorns academic freedom, has little use for the ideal of equal educational opportunity, and has resuscitated the warrior ideal—"a nation of soldiers" (Dr. Goebbels). Elsewhere, such a solution will not, in Prof. Kotschnig's opinion, prove acceptable, and it is suggested that a more excellent way—or, rather, ways, for diversity of conditions in different countries forbid the application of a general prescription.

It is especially in the field of secondary education that replanning is indicated. Except in Italy, where, as a result of Gentile's reorganization of 1923, half of the secondary education is now vocational, there has been a wholly inadequate adjustment in this field to changing social needs. It is pointed out that, in communities where the process of mechanization of industry has been most highly developed, the great majority of young people leaving secondary schools must enter occupations which do not call for any prolonged vocational training, but rather for a well-trained mind and adaptability. Hence the ruling aim of the ordinary secondary school in such communities should be "an education broad enough to fit them not only for work, but for an intelligent and creative use of their leisure time, a training enabling them to be active members of an enlightened citizenry". There should be, in addition, schools of two special types for those pupils whose special aptitudes mark them out for a career (1) in the professions, or (2) as highly skilled craftsmen or technicians. It is suggested that such a clarification of aims and differentiation of types of secondary schools should lead to an improvement in quality of their product so great that the social prestige and equipment for life of the secondary school graduate would approximate to those of the ordinary university graduate.

Palæolithic Age in Palestine

The Stone Age of Mount Carmel:
Excavations at the Wady el-Mughara. By D. A. E. Garrod and D. M. A. Bate. (Report of the Joint Expedition of the British School of Archæology in Jerusalem and the American School of Prehistoric Research, 1929–1934.) Vol. 1. Pp. xii + 240 + 55 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 42*s*. net.

THE foreword by G. Grant MacCurdy to the work under notice recalls that, after the discovery of a fragment of Neanderthaloid skull in Galilee (1925), and the International Archæological Congress at Jerusalem (1926), he had the pleasure in 1928 of following the excavations of Miss Garrod at Shukbah, Wady en-Natuf, 27 kilometres north-west of Jerusalem. He mentions Miss Garrod's fine excavations at Gibraltar a short time before, in which she had found a skull of Neanderthal type. Then came her successful expedition to Iraq (1928) and, finally, in 1929, her excavations, for the joint expedition mentioned in the title above, at Wady el-Mughara in the coastal zone near Haifa, where she was ably assisted by T. D. McCown.

No fewer than eighteen societies and institutions, six of which were British, contributed to the considerable expenses of the expedition, and the great quantity of archæological material obtained was distributed amongst forty museums or institutes. In 1932, for reasons of health, Miss Garrod had to hand over the direction of the excavations to Mr. T. D. McCown, who later gave all his time to the preparation of various Neanderthaloid skeletons found just then by him.

The palæontological classification was undertaken by Miss D. Bate, and the study of the anthropological remains still goes on at the Royal College of Surgeons and will be described in future volumes.

The excavations were prosecuted successively in three neighbouring caves, rich in deposits, in the hilly valley on the slopes of Mount Carmel, on the left of the "valley of the caves", Wady el-Mughara, just where it debouches on the coastal plain. Mughara-el-Wad was first excavated, then Mugharet-es-Skhūl and finally Et-Tabūn, in which deposits nearly 20 metres deep exceeded those of both the previous caves. In a series of chapters describing the stratigraphy and archæology of the sites, Miss D. Garrod, and, for Mugharet-es-Skhūl, Mr. McCown, tell of the results obtained. Needless to say that while congratulating the authors on their excellent and sober descriptions, we cannot give a detailed account of these, but pass immediately to their conclusions (chap. viii), where we learn that in the three sites, not counting superficial deposits of Bronze Age or more recent date, there are twelve archæological and palæontological levels graded in exact sequence, which can, if preferred, be reduced to ten. The oldest are found only at et-Tabūn, where the enormous deposits stretch from the Tayacian to the Upper Levalloiso-Mousterian, whilst Mugharet-es-Skhūl was only occupied from the Lower-Lavalloiso-Mousterian, and Mugharet-el-Wad begins in the Upper Levalloiso-Mousterian, but possesses three Aurignacian levels, one Atlitian and two Natufian.

Such an important sequence tells the whole human history of the Palestinian district and also agrees with the partial results obtained by other excavators, such as R. Neuville and M. Stekelis in the Judean desert. It also makes possible a comparative study of former excavations. Still this work does not classify the earlier industries, such as those in the open-air sites, like the Abbevillian of El Beka (Jerusalem) and others which are old Acheulean and primitive Levalloisian in the Beyrouth region. The lowest level contains a flake industry (Tabūn *G*) resembling the French Tayacian in its chipping technique of an oblique striking platform, and its position which underlies the final Acheulean, where there are no associated bones. This is confirmed by the discoveries of R. Neuville at Oum Qatafa.

Above (Tabūn *F* and *E*) there is a very fine Upper and Final Acheulean (Micoquian) already known at ez-Zuttiyeh (Galilee), where it was mixed with the Levalloiso-Mousterian, and at Oum Qatafa, etc. There are always a certain number of flakes with prepared striking platforms, more frequent near the top, and various types of scrapers, gravers with Audi or Châtelperron points, tools appearing at a later date in Europe.

Then the very long Levalloiso-Mousterian cycle begins, divided into levels *D*, *C*, *B*, at Tabūn, *F*2 and *G* at El Wad, *B* and *C* at es-Skhūl with slight morphological variations in this already evolved industry (such as the proportion of points and side-scrapers, the diminution from bottom to top in the number of axes, the presence of gravers and scrapers) all of too technical an interest for this short review, as is their comparison with those in the various excavations of R. Neuville, the ones at Shukba and those made by Zumoffen. In the course of development of this industry, important changes of fauna are noticeable—the disappearance of big pachyderms and the increase of Cervidæ. It was during this period that a tribe of Neanderthaloid men lived in the Wady-el-Mugharet. Of these, Miss Garrod has found one specimen at Tabūn in level *C*, and some fragments.

Mr. McCown found quite a cemetery of Neanderthaloid individuals. His account of their discovery in the narrow space of about 9 × 4 metres, of the measures taken for collecting them and determining their position, and the photographs and drawings which recorded these, form a deeply interesting whole, doing great honour to Miss Garrod's devoted fellow-worker.

At El-Wad, the lower Aurignacian rests on the Upper Levalloiso-Mousterian, with which it is mingled as at Mugharet-el-Emireh, but Neuville found it pure at Jebelqafseh. There are Châtelperron points and another type called El-Emireh, typical of that Palestinian level; it is a triangular point with base reduced by bi-facial trimming. The different types of gravers (angle, polyhedric, beaked, etc) exist, though there are not many; but blunt backed blades are abundant.

Then, towards El-Wad, there are two mid-Aurignacian levels. The yet lower level noted by Neuville at Irq-el-Ahmar and Jebelqafseh, distinguished by the presence of blunt backed points, nose scrapers and beaked gravers, and the absence of El-Emireh and Font-Yves points, is lacking here.

Most of the known Western types of flints are found, but, except that their working improves, especially in level *D*2 of El-Wad, where there are a good many fragments of blades with broad marginal trimming and more nose scrapers than there are lower down, there are fewer gravers, though of the same types—angle, ordinary, polyhedric, beaked, flat, etc. But points of Font-Yves type with a sharp point and nibbled edges are only found in lower levels. No bone industry is mentioned.

Similar industries at Nahr-el-Kelb and Antelias (Beyrouth) have long been known, and Neuville found them at Irq-el-Ahmar and El Khiam.

Level *C* of El-Wad, which follows, Miss Garrod calls Atlitian to avoid the question of connexions with the African industry, instead of Capsian as she first called it; it is also not definitely Upper Aurignacian. What characterizes this level is the great number of Châtelperron points and a mass of polyhedric gravers. For the first time here, we note two pierced shells. At El Khiam there is a related industry.

It only remains for me to discuss the very important Natoufian level crowning the Palæolithic series. A hiatus exists here at its base, filled up at El Kebarah by the special microlithic industry found there by Mr. Turville Petre under the lower Natoufian. This "Kebaran" is distinguished by long narrow microlithic blades, with blunted backs and sharp or obliquely chopped points, associated with small gravers and scrapers. At El Kebarah, the Lower Natoufian was rich in sculptured and worked bones (T. Petre), as in different sites of the Judean desert (R. Neuville). The latter divided the Natoufian into four levels of which I, II and IV are found more or less at El-Wad; IV is the level with notched arrowheads.

At El-Wad, level *B*2 (lower Natoufian) is extraordinarily rich in the geometric types of tool; lunates are distinctive of Helouan (Egypt) with triangles, rather rarer trapezes and a good many micro-gravers. There are blades with chopped ends and blunted backs meant to be hafted in series as sickle-blades, and many kinds of gravers and scrapers, thick rods or 'fabricators', and a kind of pick. Most of these types are also in the Upper Natoufian, but with the notched arrowheads of Helouan forming a link with the Mesolithic of Lower Egypt.

Natoufian bone tools, although less rich than the stock at El-Kebarah (T. Petre), include a good many bone points or awls, polishers, etc.; besides some fragments of very simple harpoons, the most important are sickle-hafted with a deep groove to insert sickle-blades, such as those at Helouan, some of which have been found fixed. A very pretty sculpture of a young deer-like animal was found in 1928 by Mr. Lambert in a sounding and is probably part of a sickle-handle. A second sculpture, a small human head in stone, is very rough.

It is perhaps the dawn of agricultural conditions, which is revealed in the Natoufian by the discovery of pieces of pestles and mortars in basalt and limestone, sometimes coloured with ochre, decorated with moulding, and ending sometimes in an animal's hoof. Still more remarkable is the terrace, suggestive of a place of primitive worship, quite clearly lower Natoufian in date, with a quantity of deeply hollowed basins on a ledge 1·5 metres × 2 metres, encircled with a rim, surrounded by remains of a flat stone kerb, and near a dry stone wall 8·5 metres long, the lower half made of single blocks 0·50–0·70 metre in diameter. This place, probably used for religious ceremonies, was also the centre of a great number of burials (forty); fourteen were in perfect preservation. Another group in the centre of the first room showed three layers of bodies, one on the other, stretched out and lying on their backs (ten in all). Those on the terrace differed by being flexed. Five of them had very elaborate personal ornaments, illustrated here by splendid photographs, crowns made of dentalium, cleverly arranged lengthwise, cross-wise and in fan-shapes. They had necklaces too, made of dentalium, alternating with 'twin' pendants, which seem to me to imitate the canines of deer, with distal segments cut from gazelle phalanges, or from the tarsian tibia of birds, sometimes notched.

I suppose the skeletons and their very remarkable personal decorations will be more extensively discussed, when the time comes for the detailed description of the bones.

The second part of the volume is devoted to the study, by Miss Bate, of the fauna; in spite of its great merit, it is too technical to be discussed at length. We must confine ourselves to confirming what this distinguished palæontologist says, namely, that the Upper Acheulean *F* level contains a good many extinct species, suggesting damp tropical conditions. Dry conditions prevail in Acheulean *E* and lower Levalloisian *D*, where *Hippopotamus* and *Rhinoceros hemitechus* are still found.

The rainy phase occurs at the end of *C* (mid-Levalloiso-Mousterian) in which the number of big bovines increase greatly. In *B* (Upper Levalloiso-Mousterian) we reach an extremely wet but not very warm phase, producing a very marked change of fauna, the big pachyderms definitely disappearing. During the Aurignacian, the climate grew warmer, but became—except for a slight increase in humidity in the middle—drier and drier until the end of the Natoufian; gazelles increase as the deer diminish. In the Natoufian, the domestic dog appears.

L. Picard considers that a minor damp period should be inserted just before the Bronze Age. In spite of the temptation felt to correlate the succession of wet and dry periods with the Western glacial stages of Riss and Würm, which seems to me fairly likely, Miss Garrod awaits discoveries in open-air sites, and especially those near the coast, before announcing her opinion.

Such are, much abbreviated, the fine results obtained by Miss D. Garrod and her fellow-workers during their six years work at Wady el-Mugharet. Thanks to her, and to the allied excavations of R. Neuville, Turville Petre, etc., the Palæolithic stage in the Palestinian caves is one of the best known in the world to-day, and for this we congratulate her.

H. BREUIL.

Science and Philosophy

Philosophy and the Physicists
By Prof. L. Susan Stebbing. Pp. xvi + 295. (London: Methuen & Co., Ltd., 1937.) 7*s.* 6*d.* net.

THE relations between science and philosophy have assumed a new aspect in this generation. The remarkable developments of physics, which have called for a reconsideration of certain fundamental concepts, have made it, if not impossible, at least highly undesirable, for these two departments of thought to maintain the attitude of superior indifference with which labourers in each have sought to conceal their incapacity for the work of the other. The physicist, if he is to avoid the slough of metaphysics which lies close to his new scene of operations, must learn to recognize its characteristics; and the philosopher, seeing his categories overrun by barbarians, is forced to fight the invaders with their own weapons, in the use of which he is unskilled. An interesting situation is thus created, which, it is to be hoped, will develop into better understanding and more friendly relations.

If we have succeeded in what may be the impossible task of taking an impartial view of the matter, we may say that the most essential fact is that modern physics has something vital to say to philosophy. It has brought to light principles of general philosophical import, by means of which a vast amount of apparently unrelated experience has been fused into a connected rational system with the power of extensive, if not unlimited, growth. Whatever their shortcomings may be, those physicists who have tried to interpret the new work in philosophical terms are aware of this. They behold the light, even if they are somewhat confused about whence it flows, and the vision splendid is to be seen by those who read between their lines. There is little evidence, however, that philosophers in general have caught a glimpse of it. The only philosophy (except, perhaps, that of Prof. Whitehead, which bears a relation to modern science that is still somewhat obscure) which takes explicit account of the principles animating modern physics seems to be logical positivism, which, in spite of certain merits, is a sorry enough creed. A few years ago, Mr. C. E. M. Joad published a book entitled "Philosophical Aspects of Modern Science" which, so far as it bore any relation to modern science, was concerned only with the unphilosophical aspects of modern physicists. Even Prof. Stebbing, fairest of critics, misses this primary fact of the situation. How otherwise can we account for the sweeping statement on p. 283—"Every scientist turned philosopher tends to find support in his special studies for the metaphysical theory which *on other grounds* he finds attractive"—when only four pages earlier she has said of her chief victim, "It is indeed clear that this is the change [the change in the status assigned to physical laws] that gave to Eddington's conception of the physical world that 'idealistic tinge' which was entirely different from the complexion of his earlier philosophical views"?

On the other hand, the philosopher may justly claim that physicists should present their findings in language which he can understand. It is unfair to expect him to become a physicist or to exchange logical habits of thought for cheap emotionalism. If the physicist claims to have found something important for philosophy and wishes philosophers to understand it, he should enter their courts as a guest, and honour the obligations appertaining to that dignity. Though he may not be prepared to make philosophy his pattern, he should be willing to live for a while in her mild and magnificent eye and learn her great language. It cannot be denied that physicists are not above reproach in this matter. When Sir James Jeans, for example, claims that on fundamental problems science must speak before philosophy, and assumes the role of spokesman with the comment that although not a philosopher either by training or by inclination, he has the better view of the game proverbially granted to the onlooker, he invites Prof. Stebbing's acid retort that the proverb applies only to those who know the rules observed by the players. There is certainly room for a better appreciation of philosophical problems, and a wider knowledge of the attempts already made to solve them, on the part of those physicists who cry the merits of their own particular nostrums.

It is this right of the philosopher (or, rather, of "the common reader", for it is as such that she somewhat too modestly claims to speak) that Prof. Stebbing asserts, and she supports her case by subjecting the works of Sir James Jeans and Sir Arthur Eddington to a minute analysis. Other writers receive occasional attention, and there is some independent discussion of abstract problems, but it is clear that Jeans and Eddington are "the physicists" and that the main purpose of the book is to show how far they are from being philosophers and how far removed from intelligibility are their writings. Jeans's work is too crowded with inconsistencies for any clear idea to emerge, and

Eddington not only is so anxious to write pure poetry that he forgets that some of his readers would like to know what he means, but also is so fascinated by the products of his imagination as to be unable to form a consistent philosophy for himself. These theses Prof. Stebbing seeks to establish in terms which, with respect to both purport and temper, are unexceptionable. She is severe but never spiteful, and she has the faculty of expressing cardinal points in a sentence. For example—"Jeans makes no effort to explain how it is that the Great Mathematician should have turned aside from his mathematical activities and condescended to create the world" ; and again—"The problem that confronts Eddington is to get as much uncertainty, or 'indeterminacy', as he can out of the miserably small amount represented by Planck's constant."

How far Prof. Stebbing establishes her case the reader must be left to judge. Two tempting but superficial criticisms may, however, be forestalled. The first is that in dissecting Eddington's parables and allegories she is revealing insensitivity to their character and producing something equivalent to a logical analysis of one of Blake's lyrics. This would be a fair criticism if the process were not necessitated by Eddington's own method. The attempt to find the flaw in his more closely reasoned passages leads inevitably to an idea first introduced playfully in an anecdote and thereafter treated as though it had been logically established. Consequently there is no alternative to breaking the butterfly on the wheel.

The second criticism that might be made is that the book is too much occupied with the splitting of hairs. It is true that some fine distinctions are made, though most of the 'hairs', alas, are only too rope-like. Hair-splitting, however, is a process quite properly indulged in by specialists in every field, and it appears pedantic only when practised by others. Physicists are more expert at the process than most. It was hair-splitting that discovered the noble gases, and no philosopher has yet split a hair so fine as that severed by the statement that the law of gravitation is not precisely that of the inverse square, yet the resulting strand has to bear the weight of all modern theories of the universe. When the fundamental problems of human existence are in question, therefore, it can scarcely be held superfluous to isolate the less than a hair that perchance divides the false and true.

The problems aroused by the book have more than academic importance. We have been told, for example, that more than 100,000 copies of "The Mysterious Universe" have been sold. The number that have been understood is precisely nil, if, as Prof. Stebbing suggests, the book is essentially unintelligible. What process, then, went on in the minds of many readers to produce an illusion of understanding and lead to the dissemination of its phrases from pulpit, press and platform ? The implications of that question call for serious consideration by those interested in the future of democracy.

H. D.

The Science of Radio Engineering

Radio Engineering

By Prof. Frederick Emmons Terman. Pp. xiii + 813. (New York and London : McGraw-Hill Book Co., Inc., 1937.) 30*s*.

A CERTAIN ruthlessness is inevitable in any text-book, and the permissible coefficient of ruthlessness is higher in engineering than in physics. Yet there is room for doubt whether a book on radio engineering which does not once mention the names of such founders as Clerk Maxwell, Popoff, Marconi, Jackson, Oliver Lodge, Larmor and Eccles does not fall below that level of piety which may fairly be demanded of even the 'toughest guy' in applied science. It is also to be doubted whether a book in which the first chapter, on the "Elements of a System of Radio Communication", is so ruthlessly shorn of qualifications, limitations and explicit cautions about implicit assumptions and simplifications is safe reading, even for engineers. The spiritual danger is obvious, but that there is much practical danger is well illustrated in such things as the misapplication of the "Rayleigh-Carson reciprocal theorem", a sharp-edged tool which is of great value in sufficiently subtle hands, but which produces strange shapes from the hand of the ruthless.

Despite such blemishes, the first edition of Terman's "Radio Engineering" established itself, rightly, in the first rank of guides to the transformation of radio engineering from an empirical and only roughly quantitative art into a logical and closely calculated science. The second edition, almost wholly re-written and very generously illustrated, will be of still greater value and will be welcomed by the great army of industrious 'Termanites' on both sides of the Atlantic—and of the Pacific.

, as the author's preface points out, o two parts. The first, dealing in 500 pages with fundamental properties, has chapters on circuit constants, properties of resonant circuits, vacuum tubes, vacuum-tube amplifiers, power amplifiers, vacuum-tube oscillators, modulation, vacuum-tube detectors and sources of power for operating vacuum tubes. The second part, devoting nearly 300 pages to more specialized radio topics, covers radio transmitters, radio receivers, propagation of waves, antennæ, radio aids to navigation, television, sound and sound equipment. It is far from adverse criticism to say that the whole forms a connected and reasoned guide to the last ten years' issues (up to a remarkably recent date) of the *Proceedings of the Institute of Radio Engineers*, to which the reader is, in copious and well-chosen footnotes, referred for fuller information. That air of intellectual nationalism which results from the natural tendency of an American teacher to refer American students mainly to American books and periodicals is not very offensively marked for the British reader, but the German, French and Dutch contributions to radio engineering are severely attenuated by the band-pass filter of an assumed unilingualism.

The first part of the book, on circuits and their components, is clearly the author's own territory, and is extremely good and comprehensive, with considerable tracts of original work which will be valuable to all radio engineers. The second part, and particularly the chapters on propagation of waves and on radio aids to navigation, are much less satisfactory, mainly because the light and shade of these subjects lend themselves badly to that sharp black and white treatment which so notably smooths the student's way through circuit work.

Prof. Terman's second edition will enhance the high reputation gained by his first, and should be at the right hand of every radio engineer. His half-tone blockmaker has invariably, and his line draughtsman not infrequently, served him ill, but the book is otherwise very pleasant to handle.

A New Guide to the Organic Molecular World

Dictionary of Organic Compounds: the Constitution and Physical and Chemical Properties of the Principal Carbon Compounds and their Derivatives, together with the Relevant Literature References. Edited by Prof. I. M. Heilbron and H. M. Bunbury. Vol. 3: Naphthacarbazole—Zygadenine. Pp. xii+943. (London: Eyre and Spottiswoode (Publishers) Ltd., 1937). £6 6*s*. net.

THE appearance of this volume completes the production of the first dictionary of organic compounds in the English language. The high standard of the first two volumes (NATURE, 134, 751, Nov. 17, 1934; 137, 342, Feb. 29, 1936) has been maintained, and the whole work has been published within a period of three years. This is a truly remarkable achievement, in which all concerned may take a pardonable pride. More than that, the publication of such a work by a team of British chemists speaks volumes for the wonderful progress which organic chemistry and biochemistry have made in Great Britain during the past twenty years.

Only those whose duties call for daily references to the vast and complicated literature of organic chemistry can realize to the full the great service which Prof. Heilbron and his collaborators have rendered to the *Fachgenossen*. Here is a work of some 2500 pages, printed in beautifully clear type, occupying less than 7½ inches of shelf-space, self-indexing, and affording thoroughly up-to-date information concerning the great majority of important organic compounds: a magic casement looking out upon that boundless organic molecular world "whose margin fades for ever and for ever when we move".

Even the unremitting expansion of this organic universe is to be followed, although not (we are glad to notice) by the issue of an indefinite succession of supplementary volumes. The editors propose to adopt a more practical and time-saving method for keeping a work of this nature up to date, by issuing revised volumes at regular intervals, beginning probably in 1939. Thus the three-volume format will be a recurring characteristic of the "Dictionary", which will also, of course, remain as a self-indexing entity.

Prof. Heilbron, Mr. Bunbury, their growing team of skilful and enthusiastic collaborators, and their publishers, deserve the thanks of all workers in organic chemistry and biochemistry for this elegant agent, which will catalyse so effectively the future labours of the fraternity.

JOHN READ.

Genetics and the Origin of Species

By Prof. Theodosius Dobzhansky. (Columbia Biological Series, No. 11.) Pp. xvi + 364. (New York: Columbia University Press; London: Oxford University Press, 1937.) 18*s*. net.

THIS well-designed and lucidly written book by one of the foremost younger geneticists is a thoughtful contribution to the problem of the origin of species. Not only does the author bring forward a clear and balanced statement of the genetical viewpoint, but he also supplies an exposition of recent genetical, cytological and statistical work in a form which is easily assimilated by the non-specialist.

The author divides his subject into (1) changes in the individual, (2) changes in the population, (3) fixation of these changes. Under the first heading are discussed gene and chromosome mutations, and the relation between evidence from the laboratory and that found in the wild. Under the second, a lucid description of the work of Wright, Fisher and Haldane leads to an estimation of the relative importance of selection, population size and variability in evolution. Under fixation of changes the author gives an extended account of polyploidy, hybrid sterility and other forms of isolation. The concluding chapter contains several pertinent remarks on the status of species.

The reassessment of old theories in the light of the experimental evidence is performed with a caution and soundness which will repel only those who are dogmatic upholders of tradition.

This is probably the best recent book for students who have an elementary knowledge of Mendelism, mitosis and meiosis, and who desire to understand the genetical evidence and viewpoints in biological questions. F. W. S.

Appendix to the Four Volumes of the "Mysore Tribes and Castes" (Index and Bibliography)

By Diwan Bahadur Dr. L. K. Ananthakrishna Iyer. Pp. iv + 70. (Mysore: Mysore University, 1936.)

AN ethnographical gazetteer loses half its value if it lacks an index; but the appendix which the late Dr. Ananthakrishna Iyer had added to the four volumes of his "Mysore Tribes and Castes" makes an even more generous provision for the needs of the student. In addition to index and bibliography, his supplementary volume includes a glossary of vernacular terms, and lists of endogamous groups and exogamous clans. Attention is directed to the evidence to be found in these lists of the tendency of endogamous groups to increase, notwithstanding attempts made to bring about union, and the disappearance of totems in favour of gotras of Puranic heroes.

The bibliography would be of much value to students if it were not for numerous errors and omissions of detail due to insufficient preparation and indifferent proof-reading, for which Dr. Ananthakrishna Iyer, who died in February 1937, is probably not responsible. As it stands, it is of little use to anyone who cannot identify many of the references from previous knowledge of anthropological literature.

Manual on Research and Reports: a Guidebook of Procedures helpful in [illegible] Investigations and presenting Reports on Su[illegible] the Fields of the Social Sciences.

By the Committee on Research of the Amos Tuck School of Administration and Finance, Dartmouth College. Pp. x + 140. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 7*s*. 6*d*.

THE steady stream of complaints, of which that by Dr. G. W. C. Kaye in his presidential address to Section A at the British Association meeting in Nottingham is only one of the most recent, regarding the deficiency of science graduates in writing reports and the ability to express themselves in concise and lucid English, has already called forth a number of books intended to correct this defect.

The present manual forms an admirable addition to this literature. It is concise and well written, and although designed primarily for those concerned with economic or social research, the chapters on preparing the manuscript and the anatomy of a report, as well as on guarding against error, and submission to a printer or publisher, can be read with profit by most scientific workers, whether engaged in academic or in industrial research. Many of the points may be seen to be matters largely of common sense, but experience suggests that the careful and thoughtful reading of the chapters on the collection of first-hand information, recording and organizing information, analysis and interpretation of data will well repay most recruits to scientific and industrial research.

Useful, however, as this manual is likely to prove, it is little credit to our educational system that such literature as this should still be meeting a definite need.

Einführung in die Physik

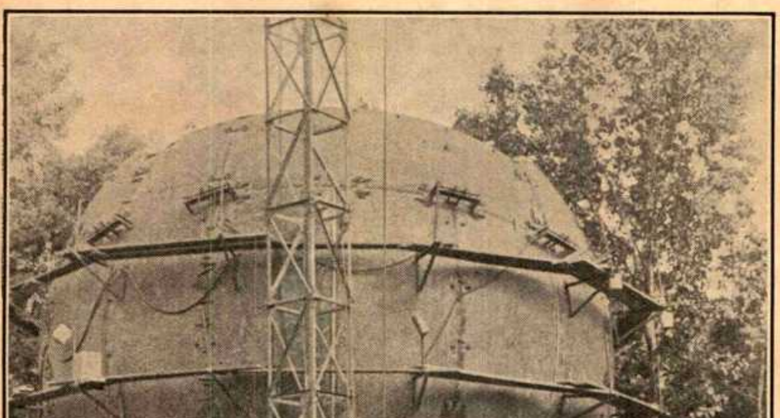
Von Dr. Otto Blüh. Pp. xvi + 582. (Berlin: Gebrüder Borntraeger, 1937.) 16 gold marks.

DR. BLUH has written an introduction to physical science which is a valuable contribution to the literature of the subject. His book represents roughly that part of the content of physics which may be assumed to be the property of a well-prepared student for a general honours degree or of a student revising the preliminary stages of his reading for special honours. No topics of serious importance are omitted and the main thesis is developed logically and clearly through some 500 pages, from the first section on "Masse und Messen" to the end of the concluding section of the second part on "Klassische Physik und Quantenphysik". A third part of the volume, some 30 pages in length, is devoted to the subject of the extent and significance of physical knowledge.

Descriptions of physical instruments are terse, clear and confined to essentials; the mathematical arguments are of an elementary kind, involving at most one or two simple differentiations and integrations, and the balance is well kept between the different main sections of physics.

The book will provide good practice for a student anxious to obtain fluency in reading German. A. F.

2. *The cyclotron.* The cyclotron of Lawrence accelerates light nuclei to very high speeds by multiple accelerations through a small potential of 20,000 volts or so. Two *D*-shaped electrodes, fed with high-frequency alternating current, are placed in a strong magnetic field which causes the particles to curve back repeatedly through the accelerating field. In this way protons and deuterons can attain speeds corresponding to 5 million volts and more. Using ion currents less than 100 microamperes, the cyclotron has furnished the most powerful neutron beams yet obtained, with which most of the biological work to date has been carried out. Its size is remarkably small for its performance; the whole apparatus, complete with high-frequency oscillator for supplying the electrodes, can be placed in a room of modest dimensions. The power consumption is heavy, about 30 kilowatts being required for the electromagnet and 70 kilowatts for the oscillator. The magnet may weigh as much as 100 tons. The cost is high, and a skilled staff is required to run it.



THE 5 MILLION VOLT ELECTROSTATIC GENERATOR OF THE CARNEGIE INSTITUTION, WASHINGTON, D.C., IN COURSE OF CONSTRUCTION (SEPTEMBER 1937). The charging belts and ion accelerating tube will be mounted vertically inside the pear-shaped tank 55 feet high by 37½ feet in diameter, and worked under an air pressure of 50 lb./sq. in. The target and observation room are underground for protection purposes. (By kind permission of the Director.)

The cyclotron is not, of course, suitable for accelerating electrons for X-ray production. There are about 25 cyclotrons being built in the world: two of them are in England (Cambridge and Liverpool), intended primarily for physics research.

3. *Electrostatic generator.* Through the efforts of numerous workers in the United States, the old-fashioned electrostatic generator of the Holtz type has been revived and developed into a formidable high-voltage generator. A well-insulated hollow conductor is charged by swiftly moving endless belts of silk or rubber on which electric charges have been sprayed by corona discharge from a set of points kept at a potential of 10,000–20,000 volts. The voltage attainable is limited only by the breakdown of the surrounding air or by sparking along the insulators, the current being proportional to the size, number and speed of the charging belts. A large generator of this kind has been installed at the Massachusetts Institute of Technology, developing 5 million volts (one terminal 2·5 million volts positive, the other 2·5 million volts negative, to earth) and a current of 2 milliamperes.

A great advance was made by Herb, Parkinson and Kerst, of Madison University, Wisconsin, who enclosed an electrostatic generator together with an ion accelerating tube in an earthed steel tank, and worked them under an air pressure of 100 lb./sq. in. By this means, the breakdown voltage was increased to nearly four times its value at atmospheric pressure and a steady voltage was obtained of 2·1 millions to earth in a tank 20 ft. long by 6 ft. in diameter. Naturally, in this form the apparatus is independent of the humidity of the external air.

Nuclear Physics and Medicine

Modern High-Voltage Equipment in the United States and on the Continent of Europe

By L. G. Grimmett, Radium Beam Therapy Research, London*

MANY interesting developments in radiology may be expected during the next few years, as a consequence of the discovery of the neutron and of artificial radioactivity.

The neutron has peculiar and novel properties which may make it of particular value in radiation therapy. To mention only two: it is more heavily absorbed in the hydrogenous tissues of the body than in the bones, and it ionizes by means of recoil protons which give densely ionized tracks, in striking contrast to the characteristics of X- and gamma-radiation, where absorption is roughly proportional to the density of the absorbing medium, and ionization proceeds by means of thinly ionized recoil electron tracks. For these reasons alone it might be anticipated that neutrons would produce different biological effects from X-rays. Indeed, the preliminary experiments of Lawrence and his collaborators on the effects of intense neutron beams on wheat seedlings, mouse tumours and other living organisms, indicate that neutrons are more effective biologically than X-rays, and what is perhaps more significant for therapeutical purposes, that they have a greater 'selective action' than X-rays; that is to say, they inflict relatively greater damage on malignant cells than on normal ones.

Artificial radio-elements have already proved their worth as chemical and biological indicators. Elements can be 'labelled' by mixing with them a small quantity of a radioactive isotope, and their subsequent history traced through the most complicated chemical actions by means of the associated radioactivity. In this way, for example, the metabolism of calcium and phosphorus in the body of the rat have been studied.

Now that it is becoming possible to produce short-lived radioactive isotopes of the common elements in large quantities, measurable in millicuries, we may hope to extend the scope of chemotherapy by the use of radioactive organic compounds, the therapeutic action of which would depend on their radioactivity rather than on their chemical properties.

The recent advances in pure physics are thus of considerable interest to medical science, and I was glad, therefore, to have had the opportunity, through the generosity of the Prophit Trust of the Royal College of Surgeons, of visiting many institutions abroad to see what progress had been made in this kind of work. My impressions are given below; it is only possible in this short article to summarize the chief points of interest.

Production of Intense Neutron Beams and of Radio-elements

The methods commonly employed for producing intense neutron beams are the bombardment of deuterium, beryllium or lithium by swift deuterons, the probable reactions being:

$$1.\quad {}^{2}_{1}\mathrm{D} + {}^{2}_{1}\mathrm{D} \rightarrow {}^{3}_{2}\mathrm{He} + {}^{1}_{0}n$$

$$2.\quad {}^{9}_{4}\mathrm{Be} + {}^{2}_{1}\mathrm{D} \rightarrow {}^{10}_{5}\mathrm{B} + {}^{1}_{0}n$$

$$3.\quad \begin{cases} {}^{7}_{3}\mathrm{Li} + {}^{2}_{1}\mathrm{D} \rightarrow {}^{8}_{4}\mathrm{Be} + {}^{1}_{0}n \\ {}^{7}_{3}\mathrm{Li} + {}^{2}_{1}\mathrm{D} \rightarrow 2\,{}^{4}_{2}\mathrm{He} + {}^{1}_{0}n \end{cases}$$

The efficiency of the last three reactions increases rapidly with the speed of the impinging deuterons.

Neutrons are also liberated in large numbers when beryllium is bombarded with gamma rays of energy greater than 1·4 million volts.

Radio-elements can be synthesized in a great variety of ways, by bombarding elements with neutrons, protons, deuterons or helium nuclei. Here again, the neutron method apart, the efficiency of most reactions increases rapidly with the energy of the bombarding particles. It is essential, therefore, to have means of accelerating light nuclei by potentials of the order 1–5 million volts.

The chief types of apparatus for producing high-energy particles are:

1. *Cascade transformer.* This was one of the earliest types of high-voltage generators, developed by Lauritsen at Pasadena in 1928 for X-ray production at 750 kilovolts, and extended later to 1 million volts. The greatest voltage which has been reached anywhere by this method is about 2 million. The apparatus is large and costly and requires a special building to house it. Currents up to 30 milliamperes can easily be obtained, but they are alternating, which is a disadvantage for many purposes. It is doubtful whether any more cascaded transformers will be built for nuclear physics, in view of the rapid developments of alternative methods.

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* Published by permission of the Executive Committee of the Radium Beam Therapy Research, London.

The design of this and other high-voltage machines is likely to be influenced by the discovery of the remarkable insulating properties of the gas CCl_2F_2, known commercially as a refrigerant under the name "freeon". The breakdown voltage of freeon is two to three times greater than air, and by using this gas under pressure it is possible to increase the breakdown voltage by a factor of 10.

Tuve, of the Carnegie Institution of Washington, D.C., is building a large electrostatic generator working in compressed air (see accompanying illustration). It is expected that voltages in excess of 5 millions will be obtained. The target of the ion tube is at earth potential and is underground, for protection purposes.

The electrostatic generator is relatively cheap, simple and robust. It is beginning to be adopted for hospital use; the Huntingdon Memorial Hospital, Boston, has installed one to work an X-ray tube at 1·2 million volts, 3 milliamperes.

4. *Resonance generator.* So far this ingenious apparatus, due to Sloan, has only been applied to X-ray production. Insulation difficulties are avoided by hanging a copper coil from one end in an evacuated earthed steel tank, about 4 ft. across, and making it resonate with a 100 kilowatt radio-frequency oscillator mounted above it, but not connected to it. High-frequency oscillations are induced in the coil, and an alternating potential of about 1 million volts is developed at the free end of the coil, which carries a target. The target faces a hot filament in the wall of the tank, which is biased so that electrons are accelerated only during the peak values of the alternating voltage. The apparatus is compact, but the power consumption is great (100 kilowatts). There is one of these generators in San Francisco, and another at Columbia University, New York.

5. *Cascade generators (voltage multipliers).* Greinacher, Cockcroft and Walton, and Bouwers, developed independently the cascade generator, an arrangement of condensers and rectifying valves by means of which an alternating potential of 200 kilovolts or so may be multiplied many times and rectified.

Bouwers has succeeded in getting 1·5 million volts constant potential to earth by this method at Philips' Laboratories, Eindhoven, and contemplates 2 million volts to earth in the near future.

The apparatus is on the large side and is expensive, but can be bought ready for use, and certainly has an impressive performance. It is independent of climatic conditions, has an ample reserve of power, and costs little to run.

At the moment, no ion tube is available at Eindhoven which will stand up to these voltages, but Bouwers, Heyn and Kuntke have constructed ion tubes to work at 300 and 600 kilovolts, yielding more than 1 milliampere of positive ion current, giving neutrons equivalent to 100 gm. of radium and beryllium. Even this, however, is a rather small neutron output for biological work, and some of the biological results obtained with it were criticized at the Fifth International Congress of Radiology (Chicago 1937), on these grounds.

Prof. P. Debye is installing a Siemens cascade generator in the new Kaiser Wilhelm Institute at Dahlem, for studying the materialization of gamma rays; it is in two halves, each giving 1·4 million volts to earth, with a total of 2·8 millions between the ends.

6. *Impulse generators.* Impulse generators working up to 2 million volts have been used for a long time in electrical engineering for the testing of transformers and insulators. The method consists of charging a number of condensers in parallel to 50,000 volts or so, and then discharging them in series, when a momentary voltage equal to the sum of voltages of the separate condensers is obtained. The apparatus is usually quite big and necessitates a special building, the output is under imperfect control, and is not suitable for exact physical experiments. Prof. F. Joliot, however, has turned it to good account in the manufacture of artificial radio-elements. At the Laboratoire Ampère, Paris, he has an impulse generator capable of giving 3 million volts, which is applied to an oil-immersed multi-sectioned X-ray tube of the Brasch and Lange type, about 1¼ metres long. The target of the tube is surrounded by beryllium. The heavy bursts of X-rays which occur at each impulse liberate photo-neutrons from the beryllium, which activate elements placed near by. Quantities of radio-elements approaching a millicurie have been obtained in this manner, and it is hoped to increase the yield by improving the tube design.

Incidentally, Prof. Joliot has solved the difficult problem of selecting the best apparatus for nuclear physics by installing one of each! His new Laboratory of Nuclear Physics, Paris, which is nearing completion, will have at its disposal a cyclotron, cascade generator, 2 million volt cascade transformer, 5 million volt electrostatic generator (recently a popular spectacle at the Palais de la Découverte of the Paris Exposition 1937) together with the impulse generator just mentioned. An extensive scheme of biological research is being planned in collaboration with the Radium Institute of Paris.

High-voltage X-ray equipment. X-ray apparatus for therapeutical purposes is still being developed towards higher and higher voltages, in the belief that the shorter wave-lengths are superior in their biological effects. There is a welcome tendency towards reducing the dimensions of the equipment. Bouwers described at the Congress of Radiology a million-volt installation, with sealed-off X-ray tube, measuring only 10 ft. × 8 ft. × 6 ft. high.

When the voltage has been pushed a little higher we shall be within sight of an efficient substitute for the natural gamma rays of radium (the radiation spectrum of which extends to about 2 million volts), at a price within the reach of the smaller hospitals, which cannot afford to buy large quantities of radium.

The main impression left by this tour is of the vigour with which the new physical knowledge is being followed up abroad, and applied to biology. One cannot but be struck with the absence of similar efforts in Great Britain, where, apart from a 400 kilovolt neutron generator which is being built at Mount Vernon Hospital, Middlesex, and the 1 million volt X-ray plant at St. Bartholomew's Hospital, London, no work of this kind is going on at all.

It is to be deplored that there is no institution in England where these important physico-medical problems can be attacked with the thoroughness they deserve.

Resonance and Mesomerism

By Prof. C. K. Ingold, F.R.S.

MESOMERISM is an extension of valency theory, and, like all valency theory, is founded in the quantum theory.

It may be recalled that in the quantum theory it is shown to be impossible accurately to specify the position and motion of an electron at each instant of time. What can be known about an electron, considered as a particle, is of a statistical nature, and is summarized in the behaviour of a wave. The frequency of the wave measures the energy of the electron ($E = h\nu$) and the amplitude measures the probability that the electron is in a given elementary volume (prob. = $|\psi|^2 dv$). The fundamental wave-property in the theory of the *atom* is *self-interference*—the self-interference of a confined wave; this annihilates all frequencies except those that can form standing waves, which are perpetuated and describe the quantum states. The fundamental wave-property in the theory of *valency* is *resonance*—the resonance of connected standing waves; their mutual perturbation replaces these waves by new standing waves, one of which usually corresponds to the creation or modification of some bond.

In order to appreciate the significance of resonance in the theory of valency, it is useful to recall the nature of resonance in vibrating mechanical systems. The simplest example is that of two like pendulums hung from the same stretched string. If one pendulum is given a displacement, its interaction with the string causes the vibratory motion gradually to become transferred to the second pendulum, after which it travels back to the first (Fig. 1). This motion is obviously not simple harmonic, but it can be shown to be a mixture of two simple harmonic motions. One of these occurs alone if we start the pendulums with equal amplitudes in phase; the frequency $\nu - \varepsilon$ is then a little less than the frequency ν of either uncoupled pendulum, because the two pendulums when swinging in phase deform the supporting string in mutually accommodating ways and this lowers the restoring forces. The other simple harmonic motion occurs when we start the pendulums with equal amplitudes in opposite phase; the frequency $\nu + \varepsilon$ is now a little greater than that of the uncoupled pendulums because of the opposing actions on the string. When we start the pendulums with any arbitrary amplitudes and phase difference, the two simple harmonic motions occur together, and the 'beats' arising from their differing frequencies give rise to the complicated motion described.

If ψ_1 and ψ_2 are the co-ordinates measuring the displacements of the two pendulums, then before coupling, each co-ordinate was associated with a definite frequency ν, but after coupling neither co-ordinate has any definite frequency. On the other hand, the linear combination $\psi_1 + \psi_2$ has the frequency $\nu - \varepsilon$, whilst the combination $\psi_1 - \psi_2$ has frequency $\nu + \varepsilon$. We may say that the mutual perturbation or 'resonance' has replaced the former co-ordinates of periodic motion (ψ_1 and ψ_2) by two independent linear combinations ($\psi_1 + \psi_2$ and $\psi_1 - \psi_2$), and has split the original coincident frequency (ν) into two frequencies, one greater and one less than the original.

In Fig. 1, (*A*) represents the uncoupled equivalent pendulums. Their displacement co-ordinates are ψ_1 and ψ_2, and their motion is periodic, each pendulum having the frequency ν. (*B*) and (*C*)

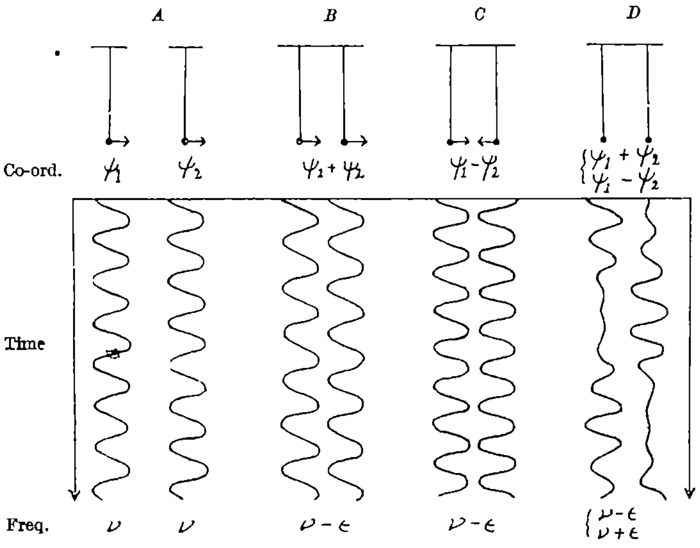


Fig. 1.

MECHANICAL RESONANCE: TIME-GRAPHS ILLUSTRATING THE BEHAVIOUR OF UNCOUPLED AND COUPLED PENDULUMS.

illustrate the only two sets of conditions in which the pendulums, when coupled, can undergo singly periodic motion. In mode (*B*) the pendulums are started with equal amplitudes in phase, and they then keep in phase; the displacement co-ordinate of the coupled system is thus $\psi_1 + \psi_2$. As the time-graph shows, the period is a little longer, and therefore the frequency, $\nu - \varepsilon$, is a little smaller, than for a single uncoupled pendulum. For mode (*C*) the pendulums must be started with equal amplitudes in opposite phase; they then remain in opposite phase, and accordingly the displacement co-ordinate is $\psi_1 - \psi_2$. As illustrated in the time-graph, the period is shorter, and the frequency, $\nu + \varepsilon$, greater, than for a single uncoupled pendulum. (*D*) represents the general result of coupling, the amplitudes and phase difference at the commencement of motion being arbitrary. Simple periodicity now disappears, but the motion can be represented as a superimposition of the periodic motions separately represented in (*B*) and (*C*). On account of the small frequency differences produced by the coupling, the superposition of these periodic motions causes the beat-like alterations of amplitude illustrated in the time-graph. Thus the general effect of the coupling is to replace two identical periodic motions by two other periodic motions, one of increased and one of decreased frequency.

If there are alternative ways in which we can supply electrons to a fixed system of atomic nuclei, and if the standing waves representing these alternatives can perturb each other, then there will be resonance. The simplest example is that of the hydrogen molecule-ion, H_2^+. There are obviously two ways of supplying an electron to a system of two hydrogen nuclei, which at first may be supposed to be fixed too far apart to admit of appreciable interaction (Fig. 2). If the electron is put near nucleus *A*, it will move in a manner represented by the standing wave ψ_A; if it is placed near nucleus *B*, it will move according to the standing wave ψ_B. The frequency of each wave corresponds to the energy of a hydrogen atom, and the form determines the probability, or charge-cloud, distribution. If now the nuclei are moved closer together so that the fringes of ψ_A and ψ_B overlap, each wave will perturb the other and neither will any longer be a standing wave of characteristic frequency. Two new standing waves will arise; one, the like-phase combination, $\psi_A + \psi_B$, which has a decreased frequency, and the other, the opposite-phase combination, $\psi_A - \psi_B$, which has an increased frequency. The former represents a system of reduced energy, a more 'stable' system, and corresponds to the formation of a bond.

Referring to Fig. 2, we have: (1) Separate ψ-waves, ψ_A and ψ_B, of identical frequency, ν, formed by supplying the electron to either of two well-separated, identical nuclei. (2) On moving the nuclei closer together the ψ-waves overlap and thus destroy each other's simple periodicity. This mutual interference, or 'coupling', gives rise to resonance, the periodic components

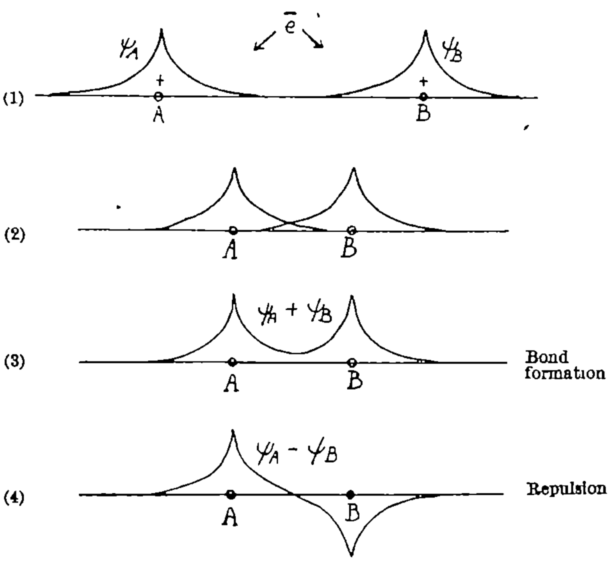


Fig. 2.

QUANTUM MECHANICAL RESONANCE: SCHEMATIC REPRESENTATION OF THE FORMATION OF A ONE-ELECTRON BOND.

of which are illustrated in (3) and (4). (3) This 'like-phase' periodic combination wave (displacement co-ordinate $\psi_A + \psi_B$) has a frequency, $\nu - \epsilon$, smaller than the frequency, ν, of the uncoupled waves ψ_A and ψ_B. The system represented thus has reduced energy: it is the molecule, which the atoms will therefore combine to form. (4) In this 'unlike-phase' combination (displacement co-ordinate $\psi_A - \psi_B$) the frequency, $\nu + \epsilon$, is greater than the frequency ν of ψ_A and ψ_B. This system has an increased energy, and represents a state from which the separated atoms will be regenerated. (In all the diagrams normalization is neglected, that is, the vertical scale is left arbitrary.)

This is the wave-picture: a particle-picture of the same phenomenon may be drawn as follows. It is a direct consequence of the uncertainty principle that all particles of which the motion is restricted have vibrational energy. The uncertainty principle may be written $\Delta q . \Delta p \approx$ Planck's constant h, where Δq represents the uncertainty in the position of the particle and Δp the uncertainty in its momentum; the momentum is, of course, closely related to the kinetic energy. A particle which is confined to a very small region of space ($\Delta q \rightarrow 0$) would vibrate with a correspondingly large energy ($\Delta p \rightarrow \infty$); and in proportion as the region is expanded the energy of the particle will be reduced. By moving nuclei A and B closer together we allowed an electron, originally imprisoned in the region of ψ_A, to escape into the region of ψ_B, and this expansion of domain, in accordance with the uncertainty principle, is accompanied by a decrease of electronic energy.

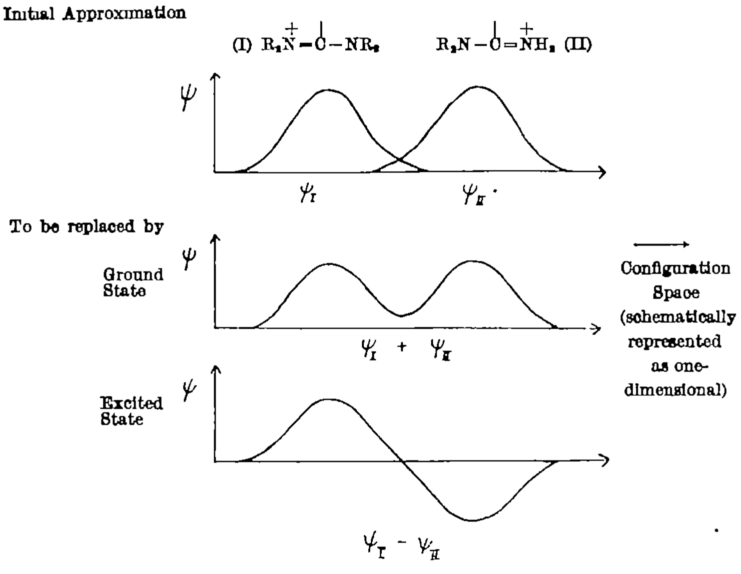

Initial Approximation
(I) $R_2\overset{+}{N}=\overset{|}{C}-NR_2$
$R_2N-\overset{|}{C}=\overset{+}{N}H_2$ (II)
ψ
ψ_I
ψ_{II}
To be replaced by
Ground State
ψ
$\psi_I + \psi_{II}$
Excited State
ψ
$\psi_I - \psi_{II}$
Configuration Space (schematically represented as one-dimensional)

Fig. 3.

QUANTUM MECHANICAL RESONANCE: SCHEMATIC REPRESENTATION OF MESOMERISM IN THE AMIDINIUM ION.

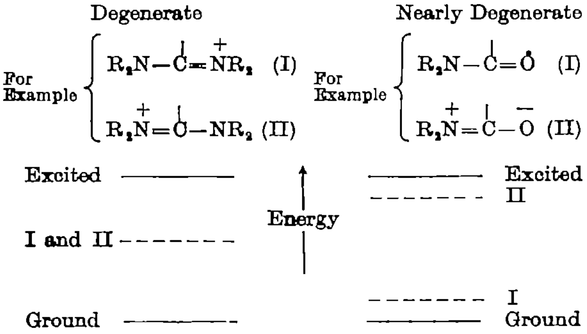

Degenerate
For Example
$R_2N-\overset{|}{C}=\overset{+}{N}R_2$ (I)
$R_2\overset{+}{N}=\overset{|}{C}-NR_2$ (II)
Excited
I and II
Energy
Ground
Nearly Degenerate
For Example
$R_2N-\overset{|}{C}=O$ (I)
$R_2\overset{+}{N}=\overset{|}{C}-\overset{-}{O}$ (II)
Excited
II
I
Ground

Fig. 4.

SPLITTING OF ENERGY LEVELS.

These are essentially the ideas which, variously elaborated and combined with the Pauli principle, are fundamental to all valency theory. The one-electron bond, the ordinary two-electron bond, the double bond, the triple bond, van der Waals' forces, steric repulsion—all involve resonance. It is true that wave-forms describing the statistics of poly-electronic systems are difficult to represent geometrically, but we can understand, through the analogy of the one-electron case, how resonance may lead to situations of increased stability. Leaving aside, however, all these intermediate chapters in the large subject of valency theory, we must here pass from the simple one-electron bond directly to that particular case of resonance which, on account of its special importance in organic chemistry, has received a special name, namely, mesomerism.

We can regard an ordinary structural formula as a symbol of the standing wave which has been derived by taking into account all the resonance involved in the bonds of the formula, and selecting from the final linear combinations of wave-functions that which has lowest energy. Mesomerism arises when, with nuclei in fixed positions, we can write several ordinary structural formulæ; for in this case the corresponding 'final' combination waves are not really final. They have to be linearly combined once more, with a further delocalization of the electrons, and a further gain in stability. It is essentially as a matter of convenience rather than principle that we separate this final stage of approximation to a true description from the previous stages, these being summarized in the classical structural ideas which the conception of mesomerism attempts to improve.

As an example we may consider the amidinium ion. The standing waves corresponding to the alternative formulæ are similar ; strictly expressed they are polydimensional, but are here represented (Fig. 3) schematically in one dimension. The final combination wave is a mixture of equal proportions of the two, and hence the charge-cloud distribution may be described as intermediate between those corresponding to the alternative formulæ. The identical energy levels represented by the alternative formulæ are, as usual, split into a ground level which lies lower, and an excited level which lies higher, than the original coincident levels (Fig. 4). We usually speak of the ground state as "the" mesomeric state, and the energy interval between this state and that of the structural formulæ as the energy of mesomerism.

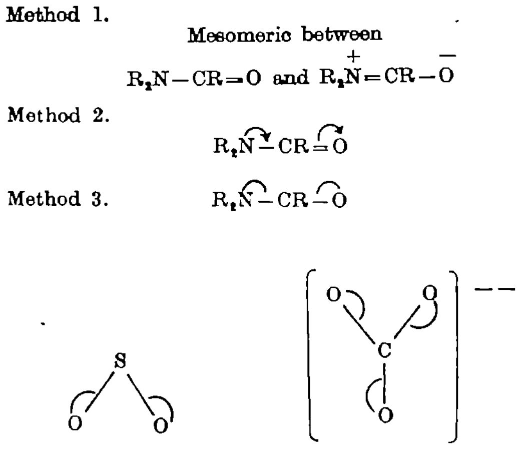


Fig. 5.
EXAMPLES OF NOTATION.

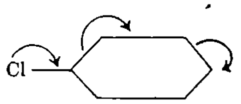
When the alternative formulæ are dissimilar, as in the amide group, there will be upper and lower initial energy levels, and the corresponding waves will not mix together in equal proportions. The combination wave of the ground state will contain an excess of the lower initial wave and that of the excited state an excess of the upper. But still the ground level will lie below the lower of the initial levels, and the charge-cloud will be intermediate between those of the initial structures.

There are several ways of expressing the intermediate character of the electron distribution in a mesomeric system. One way is to write down the various 'paper-formulæ' and to add a statement that the real formula is a mean between them (Fig. 5). A second is to write one paper-formula and attach curved arrows to it to show the direction in which it requires to be corrected. A third is to introduce a curved bond sign for each non-localized electron pair. The method chosen will depend on the example and the point which it is desired to emphasize. For example, the neatest method of expressing the trigonal symmetry of the carbonate ion is the third.

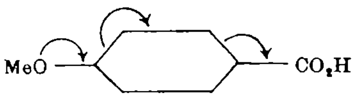
When mesomerism was first recognized (1926) as a general phenomenon in organic chemistry, it was appreciated as an electron displacement rather than as an energy disappearance : one might say that the mixing of the ψ's was perceived before the splitting of the ν's. This was because mesomerism was the electronic successor to Flurscheim's "quantitative effect", which, as he himself said, must represent a permanent redistribution of valency because it had to do with chemical equilibria, and therefore with the normal undisturbed states of molecular systems.

At that time very little was known about molecular dipole moments, but the dipole moment test for mesomeric electron displacement has since been carried out, chiefly by Sutton. He has shown that although Coulombic induction produces dipole moments in unsaturated compounds as in saturated, the former in general exhibit an extra moment, which is clearly due to mesomerism, since it always has the direction which could either have been anticipated from theory or deduced from the organic chemical observations*.

The energy disappearance characteristic of mesomerism, and its cause in electron-delocalization—the resonance of structures—was appreciated only after the fact of the polarization had been known for some years (1929). We have only to consider, however, that mesomeric polarizations, such as we can detect in chlorobenzene by dipole moments,



or in *p*-anisic acid by the acid-strengths,



in each case oppose the Coulombic induction of the substituent (Cl or MeO, both electron-attractors), in order to realize that the energy-drop which drives the polarization forward, and gives extra stability to the polarized system, must be large and independent of Coulombic energy ; therefore it must come from the only other possible source, namely, the resonance energy.

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* More exact evaluations of the extra moment have recently been made by Sugden.

Concerning the physical evidence of the energy disappearance, it is widely known that Pauling and Sherman collected together a large body of thermochemical data which showed that the resonance energy is always negative, and may vary from quite small values up to several electron volts. The most successful attempts to calculate the energy effect of mesomerism are those of Pauling and Wheland.

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Obituary Notices

Prof. G. H. F. Nuttall, F.R.S.

DR. GEORGE HENRY FALKINER NUTTALL, emeritus professor of biology in the University of Cambridge, died suddenly in London on December 16 at the age of seventy-five years.

Nuttall was born in San Francisco, where his father practised as a medical man; but later the family moved to Europe and Nuttall received his early education in England, France, Germany and Switzerland, and it was thus that he laid the foundations of his linguistic attainments. Later, Nuttall returned to the University of California, where he graduated M.D. in 1884. After a brief period at the Johns Hopkins University, he studied at Breslau and Gottingen, where he remained for four years and obtained the degree of Ph.D. At this time he became interested in botany and zoology, and these subjects led him on to the study of parasitology, to which he devoted the greater part of his life. On his return to Baltimore in 1890, he became assistant to the late Prof. Welch and later associate in hygiene at the Johns Hopkins University. In 1893 Nuttall returned to Germany and joined the Hygienic Institute of Berlin, acting as honorary assistant to Prof. Rubner. He married in 1895, Paula, daughter of Kammerherr von Oertzen-Kittendorf, Mecklenburg.

In 1899 Nuttall went to Cambridge to teach bacteriology and preventive medicine, and in the following year he was appointed University lecturer in these subjects, receiving the honorary M.A. degree. In 1906 he was appointed reader in hygiene, obtained the degree of Sc.D. and was elected a fellow of Christ's College. He held the office of reader for a few days only, being elected to the newly established Quick professorship of biology and to a professorial fellowship of Magdalene College. In 1907 the Quick Department moved into a large room on the ground floor of the east wing of the Medical School. Here in these uncomfortable quarters, which were divided up into alcoves by means of cupboards and screens, and which were known as the Quick Laboratory, Nuttall worked until 1920. In 1919, generous benefactions amounting to £30,000 from the late Mr. and Mrs. P. A. Molteno provided for the erection of the Molteno Institute for Research in Parasitology.

Nuttall received many honours; in 1904 he was elected a fellow of the Royal Society, at the same time as his friend Shipley. He also received honorary degrees from several universities. He was awarded the Belgian Order of Leopold II and the French distinction of Commandeur de la Légion d'Honneur.

Nuttall's research, incorporated in more than two hundred published papers and books, covers several branches of biology, including bacteriology, serology, hygiene, tropical medicine and parasitology. His outstanding achievement was the discovery that the blood and other body fluids possess bactericidal power, a discovery which laid the foundations of all work on serum antitoxins. In 1904 he published his classical monograph "Blood Immunity and Blood Relationship", incorporating the results of an extensive investigation of precipitin reactions carried out on some six hundred species of animal's blood. This investigation has clearly demonstrated the existence of a distinct similarity in chemical structure of the blood in animals which are related phylogenetically. It opened a new way of studying the phylogenetic relationships in the animal kingdom and provided also a new method for identification of the origin of minute traces of blood, a method which has had notable application in forensic medicine. In collaboration with Thierfelder (1895–97) he carried out the first successful experiment on life under aseptic conditions. In these investigations, guinea pigs delivered by Cæsarian section were kept alive and fed under bacteria-free conditions. These experiments solved one of the outstanding problems which preoccupied Pasteur and his pupils, and also demonstrated the origin of some organic substances in the gut and urine of animals. In collaboration with Welch (1892), he discovered and studied the first pathogenic gas-producing micro-organism causing the "gas-gangrene". This work, which came into prominence only during and after the Great War, opened a new chapter in bacteriology.

Nuttall's work on mosquitos comprises the first distribution map of *Anopheles maculipennis* in England and the discovery that this distribution coincides with the past and present distribution of malaria (ague) in England. This was followed by an important study of the biology and anatomy of *A. maculipennis*, carried out in collaboration with the late Sir Arthur Shipley. His study of canine piroplasmosis represents the first attempt of investigation in Europe of a disease imported by means of an infected vector—a tick—from South Africa. An important result of this investigation, which has great economic importance, was the discovery of the curative property of trypan blue for piroplasmosis in dogs, cattle and sheep. This study was followed by an extensive investigation of the anatomy, biology, life-history and systematics of ticks carried out in collaboration with Mr. C. Warburton, Dr. L. E. Robinson and others. Most of his time during and after the Great War was given to the study of lice (*Pediculus*), their life-history, biology and anatomy, and the problems connected with the methods of combating the spread of these parasites.

In 1901 Nuttall founded the *Journal of Hygiene* and in 1908 *Parasitology*, both of which he edited with great distinction, setting up a very high standard of publication in this field of biology. During his tenure of the Quick professorship, he raised £60,000, which was expended on building, endowment, and research, and received grants for research workers totalling nearly £12,000. On his retirement in 1932, he was presented by his colleagues and pupils with his portrait in oils painted by his friend, the late Philip de Laszló.

Nuttall had a charming manner and was a great conversationalist and excellent *raconteur*. One has a vivid recollection of him on a hot day last summer, distinguished, indefatigable and ever courteous, leading a number of French scientific investigators round the colleges and retailing in fluent French, anecdotes and stories from his apparently inexhaustible store of knowledge. He was always at ease in whatever company he found himself and had the knack of putting his companions at ease also. He was never at a loss for the right word or a courteous reply. At international gatherings he was always surrounded by numerous colleagues and was greatly helped in such company by his extensive travels and by his ability readily to speak so many languages. In spite of his multifarious activities, Nuttall found time to collect the photographs of many of the most famous parasitologists and biologists of the past, and this unique collection now adorns the walls of the corridors in the Molteno Institute. During his travels in the course of this long and active scientific career, Nuttall had exceptional opportunities of establishing contact, usually developing into friendship, with many distinguished workers of international reputation. He knew intimately several of them and had friendly scientific correspondence with others.

Nuttall's death deprives us of one of the last links with what may be described as the heroic periods in the history of bacteriology and tropical medicine. Nuttall died suddenly, as he always hoped to die, with his enthusiasm and energy little impaired and free from disabilities and sufferings often associated with old age. His wife died in 1922. He is survived by two sons and one daughter. D. K.

Capt. H. W. Seton-Karr

WE regret to record the death of Capt. H. W. Seton-Karr, archæologist, explorer and big-game hunter, who died on January 12 at the age of seventy-eight years.

Heywood Walter Seton-Karr, a member of an old Scottish family, was the son of George Berkeley Seton-Karr, resident commissioner of Baroda during the Indian Mutiny. Born in 1859, he was educated at Eton and went up to Oriel College, Oxford, afterwards entering the army. During the Egyptian campaign of the early 'eighties he served in the 92nd Regiment (afterwards the Gordon Highlanders), for which he received the medal, clasp and Khedive's star. He then travelled extensively in Egypt and Somaliland, making a large collection of palæolithic stone implements; these were among the first of extra-European origin to be recognized, and were afterwards described in the *Journal of the Anthropological Institute*. Later he made collections of similar stone implements in India. An assiduous collector, he is said to have presented collections of stone implements gathered on his travels to more than two hundred museums in various countries. In pursuit of big game he made no fewer than thirty-nine expeditions to Africa, India and Arctic Europe. He was an expert painter in water-colours and was commissioned to paint for the Imperial War Museum. His published works included "Shores and Alps of Alaska", "Ten Years' Wild Sport in Foreign Lands" and "Bear Hunting in the White Mountains".

WE regret to announce that the promising young Danish physicist Fritz Kalckar died suddenly from heart-failure a few weeks ago. Although only twenty-seven years of age, he was already one of the most brilliant collaborators of the Institute of Theoretical Physics, Copenhagen, and had written a number of interesting papers on various atomic problems. Only a few months before his death he published with Prof. Bohr, in the communications of the Copenhagen Academy, a paper on the recent development of the theory of nuclear reactions, which was intended as the first part of a series of papers on this subject.

WE regret to announce the following deaths:

Mr. H. L. Heath, formerly principal of the Mayo School of Arts and Crafts, and curator of the Lahore Museum, on February 10, aged sixty-six years.

Sir Truby King, director of child welfare, Dominion of New Zealand, 1921–27, and author of well-known standard works on the feeding and care of young children and on mothercraft, on February 9, aged seventy-nine years.

Dr. Charles Lallemand, formerly Inspecteur général des Mines, France, and president of the International Union of Geodesy and Geophysics in 1919–33, on February 1, aged eighty years.

Dr. John K. Small, director of research and curator of the New York Botanical Garden, known for his work on the flora of the United States, on January 20, aged sixty-eight years.

News and Views

Prof. Alexander McKenzie, F.R.S.

AT the end of the current session, Prof. Alexander McKenzie will retire from the chair of chemistry in University College, Dundee, which he has occupied with distinction for the past twenty-four years. After graduating in the University of St. Andrews, McKenzie began his chemical research work with Purdie at St. Andrews, and later took his degree of Ph.D. under Marckwald at Berlin. Before succeeding the late Prof. Hugh Marshall in his original university, in 1914, he held appointments as lecturer in chemistry in the University of Birmingham (1902–5) and head of the Chemistry Department at Birkbeck College, London (1905–13). In the University of St. Andrews, McKenzie has achieved a great reputation as a stimulating teacher and director of research, besides rendering valuable services over a long period as a member of Court and Senatus. McKenzie's researches in stereochemistry have earned him a well-merited international recognition as a leading authority in a branch of chemistry which has expanded so remarkably since he carried out his early researches in this field with Marckwald. He has maintained his original interest in the fundamental problems of asymmetric synthesis, and his name will always be associated with elegant work on these problems, as well as on the Walden inversion, and on the migration of organic radicals. His isolation (with Wren in 1908) of optically active benzoin may be cited as a particularly delicate stereochemical achievement, typical of his work in general. McKenzie is also known as a master in the application of the Grignard reagent and a pioneer in the vast field which was opened up by the addition of this invaluable new weapon to the armoury of organic chemistry. He will carry with him on the occasion of his retirement the cordial good wishes of his numerous circle of friends, both in Great Britain and abroad.

Sir Arthur Keith, F.R.S.

To commemorate his term of office as conservator of the Museum of the Royal College of Surgeons of England for twenty-five years, Sir Arthur Keith was presented on February 14 with a bronze bust of himself which had been made by Miss Kathleen Parbury. The bust was purchased by a large number of Sir Arthur Keith's friends and old pupils. Sir Cuthbert Wallace, in making the presentation, referred to the fundamental work of Sir Arthur Keith on the anatomy of the transmitting system of the heart and to his contributions to anthropological science during the past thirty-five years, and, in asking Sir Arthur to accept the bust, expressed the affection which all those who had subscribed, and many others, felt towards him. In his reply, Sir Arthur thanked his friends and old pupils for their generous gift, and asked the President of the College to accept the bust for safe keeping in the College Museum. After the presentation, Sir Arthur delivered a lecture on the prehistoric peoples of Palestine, the substance of which is published elsewhere in this issue.

Planning Scientific Research in Great Britain

To the January number of the *Nineteenth Century and After*, Prof. J. D. Bernal contributes an article entitled "A Policy for Scientific Research for Britain". The article is based on a memorandum on the same subject which was drawn up for the Parliamentary Science Committee by a joint committee of the British Science Guild and the Association of Scientific Workers. This memorandum was the subject of the leading article on research and finance published in NATURE of July 11, 1936. Some modifications have been made in the original memorandum, as the result of criticisms or suggestions by various individuals and scientific associations. Prof. Bernal makes an estimate of what he calls "the present budget of science in England". He arrives at a mean figure of £4,500,000, which represents only one tenth of one per cent of the national income—contrasting very unfavourably with the millions spent on advertising. In the United States the annual expenditure on scientific research is approximately £40,000,000, representing three tenths per cent of the national income or relatively three times as much as the British expenditure. Prof. Bernal puts the expenditure in the Soviet Union as only just under one per cent, and says that in Germany and in Japan it is probable that the proportional sum spent is between three and five times that of Great Britain.

IT is claimed that the present system of financing research in Great Britain does not meet the requirements of the situation and that a bolder and more comprehensive scheme is needed. The proposals of the Parliamentary Science Committee are, briefly, to form a permanent endowment fund for science, so as to ensure simultaneously: (1) adequate finance provided regularly; (2) a suitable rate of increase of income; (3) a comprehensive scheme of research covering all and not only part of the industries of the country; and (4) an organization co-ordinating the work of the different scientific departments and institutes. For these purposes, it is proposed to form a National Scientific Research Fund under the control of a Scientific Research Endowment Board, which would be an autonomous authority of the same type as the Electricity Board or the B.B.C. The Fund is to be provided jointly by the Government and industry, the Government contribution being by means of block grants from the Treasury over a number of years; and the contributions of the industrial firms might, it is suggested, take the shape of some kind of voluntary levy. One of the earliest tasks of the Board would be the planning of scientific research on a comprehensive scale. Research associations could be increased to cover all industries and might be grouped under research boards, following the example of the present Iron and Steel Research Board. In addition, it is suggested that a number of institutes for studying the fundamental aspects of applied research might be set up. It is not claimed that this proposed scheme for the endowment of science is more than a first draft, and the publication of the present proposals is intended in the first place to stimulate discussion, from which it may be hoped alternative, better balanced and more comprehensive schemes might emerge.

Drift of the Soviet Polar Station

During the last week, the drift of the Soviet Polar Station has become more rapid and on several days was as much as thirty miles. On February 11 the station was in lat. 71° 48′ N., long. 19° 52′ W., and within sight of the coast of East Greenland. *The Times* reports that the Danish authorities have sent instructions to Danes and Eskimos at the settlement at Scoresby Sound to arrange food depots along the coast in case the Russians decide that the only possible retreat is to cross the ice stream to the land. The men are now living in a snow hut, but so long as the ice stream remains compact they are in no immediate danger. Their greatest risk lies in the probability of the pack spreading and the floes being dispersed and destroyed farther south. Moreover, the southern part of East Greenland is very rugged and has no inhabitants or food depots south of Angmagsalite. If the men have to cross the ice stream to land, it is unlikely that they will be able to carry much with them. The icebreaker *Yermak* left Leningrad on February 11 and should be off the east coast about February 19. She has on board an autogyroplane, by which it is hoped a landing on a floe of restricted size will be possible. The last reports available were to the effect that the *Taimir* and the *Murman* are in constant telephonic communication with the men, but that a storm on February 14 had prevented an aerodrome being formed on the ice from which an aeroplane might start to rescue them.

Experimental Flights Across the Atlantic

The recent successful separation in the air of the seaplane *Mercury* from the flying boat *Maia* directs attention to the experimental work upon the matter of long-distance flights with commercial aircraft that is proceeding in readiness for the resumption of the Atlantic crossings during the coming summer. This combination, known as the Mayo Composite or "Pickaback" aircraft, built by Messrs. Short Bros. of Rochester, is an attempt to get a seaplane into the air with a wing loading that is prohibitively high for normal take-off, but is practicable for flight when once in the air at a safe height. The upper component is a heavily loaded seaplane that carries out the actual flight. This is carried on top of a comparatively lightly loaded flying boat capable of taking off and climbing easily and safely. When at about 5,000 feet the two separate, parting rapidly in a vertical plane, without risk of fouling or subsequent collision. Another method of attacking this problem is for the machine to start with a minimum of fuel, then sufficiently lightly loaded for safe take-off, and take on its full load of petrol from a tanker aircraft while in the air. Messrs. Imperial Airways, in co-operation with Sir Alan Cobham, have been using one of the large Empire class flying boats, the *Cambria*, for tests upon this method, with satisfactory results so far as they have gone.

A third method is to catapult the machine into the air, giving it the necessary minimum forward speed for flight by applying an impulse to it by some exterior mechanism, using hydraulic or explosive power. This, while possibly the simplest, is the least comfortable for the occupants of the aircraft. The R.A.F. have done considerable work on this, and it can be said to be successfully developed. In addition to these experiments, eight additional Empire type flying boats strengthened to carry 53,000 lb. instead of the normal 40,500 lb., have been ordered. These will have both greater fuel capacity and carry more useful load for such flights. Machines of the De Havilland "Albatross" class, a four-engined land machine specially designed for this work are also to be used.

R.A.F. High-Speed Flight

The flight by Squadron Leader J. W. Gillan, on February 10, using a Hawker "Hurricane", a R.A.F. high-speed fighter machine, directs attention to the development that has taken place, both in speeds of modern aircraft and in the methods of navigation. While this was not a properly observed speed record, in the sense that it was timed with great accuracy and afterwards reduced to a speed relative to still air, it was an ordinary flight undertaken under practical conditions upon a standard machine, and should be repeatable, under reasonable weather conditions, as circumstances demand. The flight was made in darkness, leaving Turnhouse Aerodrome, Edinburgh, at 5.5 p.m., arriving at Northolt Aerodrome, London, at 5.53 p.m. The distance was 327 miles, giving an average speed of 408·75 miles an hour, assuming the course to have been the shortest distance between the two points. This speed was helped by a high following wind of at least 50 miles an hour, although not exactly a tail wind on the line of flight. The course was flown entirely blind by the use of instruments. The "Hurricane" is fully equipped in this respect, carrying directional gyroscope, turn indicator, artificial horizon, rate of climb indicator, and a sensitive altimeter. Actually it was a real test of this method of flying, as much of the flight was made through or above cloud entirely obscuring even such landmarks as would have been visible after dark. Also the windscreen was coated with ice at certain stages of the flight, a further hindrance to vision. The machine was climbed slowly to 1 feet altitude, and maintained at that height until it was necessary to put it into a slow descent. This occurred over Bedford, one of the few towns that the pilot had been able to see through the clouds. He reported that he had been perfectly comfortable and warm, had had no occasion to use oxygen, and had no feeling of fatigue. The cockpit of this type of machine is entirely covered over with transparent cellulose material, and attention is paid to keeping the pilot warm.

Film illustrating Movement of a Fœtus

At the meeting of the Royal Society held on February 10, Sir Joseph Barcroft and D. H. Barron showed a film illustrating the development of movement in the fœtus of the sheep. The development of movement was depicted in respect of: (*a*) the types of movement which appear at different fœtal ages, and (*b*) the individuation of certain sorts of purposive movement from a general mass movement. The period of gestation is about 145 days. Up to about 35 days, the fœtus is immobile (type 1). At 35 days it commences to exhibit movements which are always 'jerky' (type 2). At 47–50 days it is almost incessant motion, which is 'sustained' (type 3). After 50 days the fœtus becomes quiescent (type 4). The following analysis may be made of these types: If the spinal cord be cut just below the brain at 60 days, without taking the fœtus out of the uterus, and the fœtus be allowed to continue growing until the cut fibres have degenerated, its body will exhibit jerky movements (type 2), whilst its head is quiescent (type 2). If the central nervous system is transected below the pons, the whole fœtus exhibits jerky movements (type 4). If the central nervous system is sectioned above the red nucleus the fœtus exhibits sustained movements (type 3). The mechanism for the integration of 'jerky' into 'sustained' movements is in the region of the red nucleus, and the mechanism for the inhibition of movement is preponderantly above that. Later parts of the film showed the development of respiratory movements (especially in relation to somatic movement), the development of progressive movement and the development of 'righting' movements.

Development of Calcutta

"The Second City of the Empire", compiled by Dr. P. C. Bagchi, has been published under the auspices of the Indian Science Congress Association as guide book and souvenir of its silver jubilee meeting recently held in Calcutta. The brochure, which is fully illustrated, gives a historical account of the rise and growth of this city and describes the development of its municipal administration, educational, industrial, public and social services. Calcutta came into existence towards the end of the seventeenth century, and largely owing to its geographical position rapidly grew into an important town. According to the 1935 census, its population now numbers more than a million. The city is mainly industrial and commercial, textiles and tea being two the chief commodities with which it is concerned. strides have been made in education during the last century, particularly since the foundation of the University in 1857. To illustrate the more modern developments on the medical side, mention may be made of the opening of the Pasteur Institute in 1924, and more recently still, the Institute of Hygiene and Public Health. The formation of the Vangiya Sahitya Parishad in 1894, for the cultivation and improvement of the Bengali language and literature, has done much to further the study of arts, while the Bose Research Institute, opened in 1917, is an example of the interest taken in pure scientific research.

The Volta Temple at Como

In *Engineering* of January 7 and 21 and February 4, Mr. F. Walker gives an account of the beautiful Volta Temple at Como, erected as a permanent memorial. The erection of the Temple was made possible by the generosity of Gr. Uff. ou Francesco Somaini, whose commission to the architect Signor Federico Frigerio placed no limits whatsoever on the class of work or expenditure involved. Standing in the public gardens near the edge of a lake in Como, the Temple is a white marble building in the Neo-Classical style, measuring approximately 25 m. in length, 20 m. in depth and 21 m. in height. The main building consists of a large circular hall surmounted by a dome, which is supported by four corner pilasters and eight marble columns. Above the capitals of the pillars is a cornice bearing in gold letters an inscription of dedication. A marble staircase leads to a mezzanuil gallery around the central rotunda, and on the parapet of the gallery are four sculptured panels illustrating incidents in Volta's life. One of these represents him demonstrating his pile to Napoleon at Paris. Though much of Volta's apparatus was destroyed in the fire at the Como Exhibition of 1899, his manuscripts and books were saved and replicas of his apparatus are shown in cases, together with many personal relics. The entire expense for the collection of apparatus has been borne by Signor Somaini, who has further endowed the Temple with a capital of 500,000 lire, the interest of which is to provide scholarships. Mr. Walker's article is accompanied with many photographs of what appears to be the most remarkable monument to any man of science.

Early Hittite Civilization in Cilicia

Results, which at first sight hold out great promise of additions to knowledge of the early stages in the extension of Hittite culture, have been obtained by the Neilson Expedition of the University of Liverpool under Prof. J. Garstang, now engaged in excavating an archæological site near Mersina on the Cilician coast of Asia Minor. A double-walled fortress has been discovered, which is thought to mark the site of a frontier post between the rival southern kingdom of Assawa and the allied State of Kizzuwadna (which seems to have included Tarsus) during the sixteenth or fifteenth century B.C., when the latter stage formed part of the realm of the Hatti, usually identified under the more familiar name of Hittites. According to a report of recent excavations (*The Times*, February 9), deep soundings on a considerable scale have disclosed no fewer than nineteen occupation-levels, belonging to a culture which, though differing, resembles that of the Hittites of the Anatolian plateau closely enough to be considered akin to it. These levels overlie a civilization which would seem to be linked culturally with predynastic Egypt and Sumer. This indicates the incoming of Hittite culture in the fourth millennium B.C., thus antedating considerably the period usually assigned to the foundation of the Hittite capital on the Anatolian plateau. Further soundings in deeper levels have disclosed an even more considerable antiquity, in which this region was evidently a centre of no little cultural activity. Although the succession of painted pottery wares and stylized patterns reflect relationship with the oldest Mesopotamian styles, there is also evidence of local development lasting over a long period. In the lowest level a rich neolithic stratum has been found, similar to that of Sakje Geuzi, in which the most characteristic features are the use of obsidian, for weapons and tools, instead of flint, and a black pottery which is thin and highly finished.

Viking Relic in the British Museum (Bloomsbury)

THE acquisition of a remarkable example of Viking art—it is, in fact, considered to be the most remarkable Viking relic now in existence outside Scandinavia—was reported at the February meeting of the Trustees of the British Museum (Bloomsbury). It is a carving in oak of the head and neck of some beaked creature which formed either the figurehead or the stern-post of a Viking ship. Its precise purpose is at present uncertain. The animal motif, usually highly conventionalized, is one of the most familiar in the decorative art of the north European peoples in the first millennium of the Christian era; but of the zoomorphs, or animal-headed figures, which are known to have adorned the Viking ships, this is believed to be the only surviving example. It is almost four feet nine inches long, and is in the form of a rounded head on a long slender neck. The head curves smoothly into a parrot-like beak, which is open and shows teeth along the edge of the mandibles. The head is well poised on the slender neck, which is covered with a deeply carved lattice pattern, presumably representing feathers or scales. The history of its rediscovery is almost as remarkable as its character. It was found some two years ago during dredging operations in the River Scheldt. Other ship's timbers were brought up at the same time, but unfortunately were not preserved. The importance of the relic was so little appreciated that it was used for some time as a garden ornament. As it is known that the Island of Walcheren at the mouth of the Scheldt was long held by Danish Vikings at the beginning of the ninth century, this zoomorph is attributed to a Danish origin.

Yorkshire 'Bygones'

A COLLECTION illustrating the past cultural history of Yorkshire in the life of both country and town has been presented to the Corporation of York and housed in the old Female Prison, which has been converted into a museum for this purpose. The donor of the collection is Dr. Kirk of Pickering. The collection includes horse brasses, horseshoes, over one hundred insurance plates, and police truncheons, some of which were used in the Chartist and Bread riots. To these have been added fireplaces of various periods, weights and measures of all kinds and periods, and a collection illustrating the history of house lighting; all these exhibits are derived from the past custom of Yorkshire. One of the most instructive is the reconstruction of a Tudor street, some one hundred feet in length, in which are doorways, mounting blocks, shops and other features collected from various parts of the county. Parts of the Female Prison, which was built at the end of the eighteenth century, have been preserved in the original state. The Museum is not yet open to the public, but a private view for subscribers was held on February 5. Among the subscribers are the Carnegie United Kingdom Trust and the Joseph Rowntree Social Trust, Ltd., from each of which the sum of £500 has been received. The historical and geographical position of York makes it a peculiarly appropriate centre for a collection of this kind. The past cultural history of a county embodies much of interest to the student of archæology and ethnology, while custom illustrating its social history survived in a primitive form down to quite recent times, of which it is still possible to find traces in the remoter districts. In these matters, it is true, Yorkshire does not stand quite alone; and although the scheme for a national folk-museum for England seems for the time being to make little progress, it is none the less gratifying to note that local collections are being made before the material has entirely disappeared, as has been shown by recent correspondence in *The Times*.

Hooke's Experiments on Combustion

IN the issue of *Ambix* of December 1937, Dr. D. J. Lysaght publishes an interesting account of Robert Hooke's theory of combustion, which he outlined in "Micrographia" (1665) and amplified in his "Lampas" (1677) and "Cutlerian Lectures" (1679). Hooke's failure to impress his views upon the members of the Royal Society is attributed to his lowly social position, the simplicity of his conceptions, and the innate conservatism of the seventeenth-century mind. Hooke wrote only a scanty account of the experiments upon which he based his ideas, and Dr. Lysaght has done a useful service to historical chemistry by giving a critical discussion of these experiments, as transcribed in Birch's "History of the Royal Society" (1756–57) from the Royal Society's "Journal Book" (1661–87). Hooke's "many luciferous experiments" sufficed to demonstrate all the important facts bearing upon the problem of combustion. "The consumption of a selected portion of the air, the necessity for a continuous supply of this fluid, the formation of heat and light by the 'composition', the existence of solids with the essential constituent of the air 'fixed' in them and available for combustion, and the increase of weight on calcination must be admitted to be almost all the evidence required for the modern theory. These phenomena were linked up with those relating to respiration. The one fact that was not understood seems to be the part played by the air in calcination . . . and this deficiency prevented the complete synthesis that appears to have been so near at hand." Dr. Lysaght concludes that Hooke's work had the effect of postponing for a considerable time the adoption of the phlogiston theory of combustion.

Unemployment in Colorado

A SURVEY of the Colorado labour market and its "relation to unemployment compensation", by E. R. Livernash of the Massachusetts Institute of Technology, has been issued in the University of Colorado Studies (24, Nos. 3 and 4; 1937). The survey was undertaken in the summer of 1936, and indicates that outside the provisions of the Act there are 45,000 agricultural labourers unemployed and 21,000 domestic servants, as well as a considerable number of those working in trading establishments employing less than eight persons. Unemployment of long duration is regarded as inadequately compensated, this type of unemployment being particularly heavy in the steel, coal and constructional industries and in declining industries such as the southern coal field. The problem of exhausted-benefit unemployment may be of major importance. The recurrent drain of seasonal unemployment, however, may be unwise, as annual earnings are often adjusted on a competitive basis. Much cyclical unemployment appears as seasonal employment, and this may mean a considerable volume of ineligible unemployment in a bad depression. The difficulty seems to be that in future depressions unemployed individuals most in need of relief will find themselves in the exhausted-benefit and ineligible classes. The law may be putting a premium on short-time recurrent unemployment. Mr. E. R. Livernash suggests that experience under the Act, enabling us to classify types of unemployment, may ultimately permit compensation being related more upon the incidence of unemployment, both in occurrence and duration.

A Nature Reserve of Fossil Plants

PROF. G. R. WIELAND made an eloquent plea (*Science*, March 19, 1937), that will be endorsed by the botanists of all countries, for the creation of a national monument on the Black Hills, U.S.A., in which specimens of the remarkable cycadeoid fossils will be exposed *in situ* for study among their natural surroundings. The magnificent photographs of these specimens previously published by Prof. Wieland are evidence how effective such a display would be. His present arguments, indicating the striking parallelisms between these plants and the types discovered in the Carpathians and the Isle of Wight and Isle of Portland and elsewhere, and directing attention to their increased significance in view of the wide vistas on floral morphology in the Gymnosperms opened by the discovery of the marvellous petrified Araucarian forest of the Cerro Cuadrado in central Patagonia, reinforce very powerfully the case for expenditure of time and money in achieving an appropriate display of these unique fossils. The locality is described as very accessible; the horizon is perfectly defined and the quarrying necessary not extensive. It is very much to be hoped that Prof. Wieland's object will be attained and the United States thus obtain a national monument that would be quite unique in its character and clear evidence that that great nation appreciates the value of some of its most remarkable scientific possessions.

London Teachers' Association

AT its annual conference held on February 12, the London Teachers' Association was addressed by its new president, Mr. S. Vanderhook, of Holden Street School, Battersea, on "Current Issues in Education" including, as "the most vital", reduction in the size of classes. The L.C.C. programme for 1938–41 contemplates a reduction of classes in junior schools to 42 and in infants' schools to 44, the standard for senior schools remaining at 40. As it is now twenty-five years since the L.C.C. initiated a scheme for reducing the size of infants' classes to 48 and senior classes to 40 Mr. Vanderhook may well call the new scheme a "small" step forward. A large part of the address has reference to the measures which are to come into operation next year for raising the permissible school-leaving age to 15. The Board of Education's Circular 1457 on this subject is discussed on the lines of the National Union of Teachers' memo. of December 1937. Mr. Vanderhook would, himself, use a short way in dealing with applications for exemption from further school attendance in order to accept "beneficial employment". He would reject them all; for he holds that there is no employment which is beneficial for young persons of fourteen years of age.

Destruction of Sea-Birds by Oil

A LIVELY and informative discussion regarding the destruction of sea-birds by oil waste took place at University College, London, in May last, under the auspices of the University of London Animal Welfare Society, and the report of the meeting has just been published (ULAWS Monographs and Reports, No. 2*a*). Prof. N. K. Adam opened the discussion. A summary of Prof. Adam's special report has already appeared in NATURE of July 17, 1937, p. 100. Many representatives of oil and shipping interests and naturalists took part in the subsequent discussion, the general tenor of which indicated that, in spite of legislation and a 50-mile limit for the discharge of oil, the amount of destruction was still very great, Prof. Adam putting the estimated death-roll of sea-birds at from 10,000 to 200,000 a year. Only international action is likely to be effective in bringing this destruction to an end, and since the maritime nations are almost entirely opposed to the compulsory fitting of oil separators to vessels, efforts are being made to prohibit the discharge of waste oil in certain areas where the effect is likely to be greatest. Mr. Sanford D. Cole described the Wheeler system by which the cleaning out of oil tanks, double bottoms and bilges is carried out mechanically and much more efficiently than by hand, and suggested that the installation at various ports of separator barges fitted with this American contrivance might go far to diminish the evil of oil pollution.

Sea Shells from Victoria

THE Field Naturalists' Club of Victoria is designing a series of handbooks to foster interest in the State's fauna and flora. The second of the series is by C. J. Gabriel, honorary conchologist, National Museum, Melbourne; it is entitled "Victorian Sea Shells, a Handbook for Collectors and Students", and has been published by the Field Naturalists' Club of Victoria (price 1*s.* 6*d.*). It is well illustrated by Joyce K. Allan, assistant conchologist, Australian Museum, Sydney, with a coloured and several uncoloured plates. Descriptions are given of most of the common sea shells around the coast of Victoria. From a collector's point of view, this little work is extremely useful and will help many to name their specimens. It does not, however, attempt to teach anything about the animals themselves beyond their various habitats. A popular name is given to each shell, in most cases a translation of the specific name. Thus we have the "impoverished Nassarius" and the "sordid sand snail", but there is the banded periwinkle, also known as the "Austral wink", and the black nerite, also known as the "crow". There are a dictionary of terms and diagrams showing the different parts of the shell.

World Congress of Faiths

THE World Congress of Faiths, of which Sir Francis Younghusband is chairman, is arranging a week-end Congress to be held at Cambridge on June 24–28, with residence for men at St. John's College and for women at Newnham College. The subject for deliberation will be "The Renaissance of Religion". Distinguished speakers, representing religions, philosophy and science, will deliver addresses to be followed by discussion. The object for which the World Congress of Faiths is organized is to promote a spirit of fellowship among mankind through religion. The Congress seeks to awaken and develop a world-loyalty, whilst allowing full play for the diversity of men, nations and faiths. Further particulars may be obtained from the secretary, World Congress of Faiths, 36 Victoria Street, London, S.W.1.

Announcements

THE Most Reverend Cardinal Arthur Hinsley, Archbishop of Westminster; Prof. J. Chadwick, professor of physics in the University of Liverpool; and Sir Richard Livingstone, president of Corpus Christi College, Oxford, since 1933 and Vice-Chancellor of the Queen's University, Belfast, in 1924–1933, have been elected members of the Athenæum under the provisions of the rule of the club which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for their public services.

H.M. THE KING has approved the award of the Royal gold medal of the Royal Institute of British Architects to Mr. Ivar Tengbom (Sweden), hon. corresponding member, in recognition of the merit of his work as an architect. The medal will be presented to Mr. Tengbom at a general meeting of the Institute on April 4.

THE following officers of the Royal Astronomical Society were elected at the anniversary meeting of the Society on February 11: *President*, Dr. H. Spencer Jones, Astronomer Royal; *Vice-Presidents*, Prof. S. Chapman, Prof. H. Dingle, Sir Frank Dyson and Prof. F. J. M. Stratton; *Treasurer*, Mr. J. H. Reynolds; *Secretaries*, Prof. W. M. H. Greaves, Prof. H. H. Plaskett; *Foreign Secretary*, Sir Arthur Eddington.

IN connexion with the movement for the preservation of the fauna and flora of the Empire, attention has been directed to the imperfection of our knowledge of the fauna and flora of Fiji and the Western Pacific High Commission Territories. These Governments have recently expressed the hope that the subject will attract more attention in future. Adequately qualified naturalists desirous of devoting a few months to such studies in these territories under favourable conditions should consult the Under Secretary of State, Colonial Office, Downing Street, S.W.1.

PROF. GÜNTHER ENDERLEIN, the well-known Berlin entomologist and bacteriologist, has recently retired on reaching the age limit.

PROF. HANS BURGER, director of the psychiatric and neurological clinic at the University of Jena, has been nominated a member of the Kaiser Leopold Caroline German Academy of Natural Science in Halle.

THE Gillson scholarship in pathology has been awarded by the Society of Apothecaries of London to Dr. R. H. S. Thompson of the Rockefeller Institute.

THE following appointments and promotions have recently been made in the Colonial Service: Agricultural officers—G. D. Badger, Uganda; T. W. Brown, Malaya; F. E. J. Buller, Nigeria; P. V. Ormiston, Malaya; W. N. Scott, Malaya; A. K. Briant (agricultural superintendent, St. Vincent), Zanzibar; R. P. Davidson (agricultural officer, Uganda), Malaya; H. P. Smart (agricultural officer, British Honduras), senior agricultural officer, Tanganyika. Other appointments—P. Coryndon, inspector of produce, Nigeria; F. E. Harnett, sleeping sickness control officer, Nigeria; J. R. O. Humphries, inspector of plants and produce, Gold Coast; D. W. Le Mare, assistant to the director of fisheries, Str Settlements.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 334.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nuclear Photo-effects

THE beautiful experiments of Bothe and Gentner[1] on the ejection of neutrons from heavier nuclei by means of γ-rays with energy of about 17 M.v. resulting from impact of protons on lithium, have revealed a remarkable selectivity of these nuclear photo-effects. Thus a few elements, apparently irregularly distributed, were found to possess cross-sections for such effects of the order 10^{-26} cm.^{2}, while for the large majority of the elements investigated no measurable effects could so far be detected. At first sight this selectivity might, as pointed out from various sides, seem difficult to reconcile with the views on the mechanism of nuclear reactions to which one has been led through the study of the effects initiated by neutron impacts[2]. In fact, the distribution of the energy levels of the compound nucleus formed in such collisions must for all heavier elements be expected to be practically continuous for excitation energies above 10 M.v., while the nuclear photo-effects obviously demand a special sensitivity for much higher excitations confined within well-separated energy regions.

This apparent contradiction disappears, however, if we realize that the level distribution of the compound nuclei, which form the intermediate stage in nuclear transformations initiated by collisions, represents the ensemble of stationary states corresponding to the more or less coupled modes of vibration of the nucleus, while the response to the photo-effects is primarily conditioned by certain special vibratory motions with singular radiation properties. Thus, in nuclear transformations initiated by high-frequency radiation, we have not to do with a simple competition of the disintegration and radiation probabilities of a well-defined intermediate state, but rather with the balance between the radiative processes and the effect of the coupling of the corresponding specific vibrations of the nucleus and the other possible modes of nuclear vibrations. This coupling will tend to the rapid extinguishment of any special features of the initial type of excitation and to its replacement by a more stable state of the excited nucleus, where the energy is distributed among all modes of vibration in a way analogous to the heat motions of a solid body at low temperature. As soon as such a state of nuclear excitation is established, the course of the photo-effect is practically determined. In fact, the radiative properties of the nucleus in this state will resemble that of a black body with a temperature of a few million volts, and the probability that the whole energy is emitted in a single radiation quantum of 17 M.v. will accordingly be negligibly small. Moreover, for the high excitations concerned, the total probability of the radiative processes of the nucleus will be very much smaller than the probability of its tegration, which increases exponentially with the ture like in a usual evaporation process.

This argument implies that the cross-section for nuclear photo-effects in the energy region concerned will be given by a formula of the type well known from the theory of optical selective absorption:

$$\sigma = \frac{\lambda^2}{4\pi} \sum_i \frac{\Gamma_R \Gamma_C}{(\nu - \nu_i)^2 + \frac{1}{4}(\Gamma_R + \Gamma_C)^2}$$

where λ and ν are the wave-length and frequency of the γ-rays respectively, and ν_i one of the sequence of such frequencies corresponding to maximum resonance. Further, Γ_R and Γ_C are the probabilities in unit time, respectively, for the re-emission of a quantum $h\nu$ from the initial special state of excitation of the nucleus and for the conversion of this transitory state to the ordinary state of nuclear excitation with the same energy. This latter process will be seen to correspond closely to the effect of collisions in diminishing the resonance in absorption of light in gases at high pressures.

Present experimental evidence does not directly disclose for any given element the variation of the cross-section of the selective photo-effect with the frequency of the γ-rays. Still, from the way in which this cross-section varies among the elements for rays with $h\nu = 17$ M.v., it would appear that the distance between the resonance maxima in this energy region is probably some million volts and that the breadth of each of these maxima is roughly comparable with the variation of $h\nu$ in the incident γ-rays due to natural width of the line and the Doppler effect in the proton-lithium collision which amounts to about 50,000 volts. If, further, the largest cross-sections observed are assumed to correspond to maximum resonance, we get from the above formula values for Γ_R and Γ_C of the order of magnitude 10^{15} sec.$^{-1}$ and 10^{19} sec.$^{-1}$ respectively. Both these values appear quite reasonable. In fact, on account of the high frequency of the γ-rays concerned, we should expect Γ_R to be several times as large as the probability of emission of ordinary γ-rays in nuclear transmutations, estimated from neutron captures to be about 10^{14} sec.$^{-1}$. Further, the value for Γ_C is much smaller than the frequency 10^{21} sec.$^{-1}$ of the initiating γ-rays, while it is much larger than the probability of disintegration of the excited nucleus, estimated by the evaporation analogy to be of the order 10^{16} sec.$^{-1}$ for energies of about 17 M.v.

The proportion between the duration of the initial transitory state and the whole lifetime of the excited nucleus, which for 17 M.v. is thus probably of the order 10^{-3}, should for lower energies be still smaller, since the coupling between the different modes of vibration will presumably decrease much more slowly than the probability of neutron escape. At the same time the ratio between the chances of re-emission of a quantum $h\nu$ from the initial state of excitation and from the more stable state of the excited nucleus will rapidly decrease. Still this ratio, which for 17 M.v. is extremely large, will scarcely approach unity before we have come well within the energy region of discrete nuclear levels. Even in the upper part of this region, we must therefore be prepared to find a selectivity of the nuclear photo-effect similar to that found in the continuous energy region, but in experiments with sufficient monochromatic γ-rays each resonance maximum will here resolve itself into a fine band of sharp absorption lines corresponding to the separate levels. With the vanishing predominance of the initial state of excitation with regard to the radiation processes, this kind of selectivity, however, will soon disappear and be replaced by a line absorption spectrum of the usual type, which of course will be accompanied by a nuclear photo-effect only so long as $h\nu$ is large enough to cause a disintegration of the nucleus.

In the discussion of these problems, of which a more detailed account will be given in a forthcoming paper in the communications of the Copenhagen Academy of Sciences, I am indebted to my collaborators of the Institute of Theoretical Physics for valuable help, especially to Mr. Fritz Kalckar, whose sudden death a few weeks ago means a most regrettable loss to us all*.

N. BOHR.

Universitetets Institut
for Teoretisk Fysik,
Copenhagen, ø
Jan. 31.

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* Cf. p. 319 of this issue.

[1] Bothe, W., and Gentner, W., *Z. Phys.*, **106**, 236 (1937).

[2] Cf. Bohr, N., NATURE, **137**, 344 (1936); and also Bohr, N. and Kalckar, F., *Math. Phys. Comm.*, Copenhagen Acad. Sci., **14**, 10 (1937).

Relativity and Quantum Theory

IT is well known that the transformation theory of quantum mechanics corresponds to the property of the classical equations of motion of being invariant with respect to contact transformations. These are simultaneous transformations of co-ordinates x^k (including time) and momenta p_k (including energy), such that the difference of $p_k dx^k$ in the old and in the new variables is a total differential. The point transformations in the x-space are only a special case; but there exists another case of the same simplicity which can be described as a point transformation in the p-space.

General relativity, on the other hand, is concerned only with point transformations in the x-space; it can easily be seen that the transformation of the p_k induced by the contact condition mentioned above is exactly equivalent to the tensor calculus of relativity. It has struck me that the point transformations in the p-space might be considered in the same way. Thus one is led to a kind of inverted relativity formalism in the p-space in which everywhere space-time and momentum-energy are interchanged. The principle laws of quantum mechanics, such as the commutation laws, the relations of indeterminacy, etc., are symmetrical in x^k and p_k.

These facts suggest very strongly the formulation of a 'principle of reciprocity', according to which each general law in the x-space has an 'inverse image' in the p-space, in the first instance the laws of relativity. The foundation of this idea is too involved to be explained here; it is developed in a paper which has been submitted to the Royal Society. I wish only to press the point that this theory attempts to explain the ultimate particles on relativity considerations without connecting them with the whole universe (x-space)—an idea[1] which seems to me unacceptable for reasons of physical common-sense.

I shall now indicate some simple consequences and numerical results. The principle of reciprocity leads to the introduction of a metric tensor γ_{kl} in the p-space, the coefficients of which are not given numbers but functions in this space which satisfy differential equations in exact analogy to Einstein's gravitational equations for the g_{kl}. The most general form of these contains a 'cosmological term' due to which the x-world is closed and has a finite radius a. The corresponding property of the p-space is this: an energetically closed system corresponds to a closed momentum space, with a radius b, which represents the maximum momentum possible. There are several attempts in the literature[2] to introduce such a maximum momentum, with the purpose of eliminating the disturbing 'infinities' in quantum mechanics; but they had to be rejected since they contradicted relativity. This difficulty is avoided with help of the new principle.

Between the g_{kl} (multiplied by a proper constant A) and the γ_{kl} (divided by A) there will be a relation which is the quantum equivalent of contact transformation, of the form

$$Ag(x) = h^{-3/2} \iiint \frac{1}{A}\gamma(p)\sqrt{-|\gamma|}\, dp_x dp_y dp_z,$$

where $|\gamma|$ is the determinant of the γ_{kl}. In order that g_{kl} and γ_{kl} be dimensionless numbers, one has

$$A^2 = (b/\sqrt{h})^3.$$

The chief consequence of the closed p-space is a change of the expression for the number of quantum cells of a given phase element. This new formula has a great number of applications. The following quantities which are infinite in the accepted theories become finite: The number n of quantum states of radiation in the x-volume V, the zero energy ε of the radiation in V, the self-energy $e^2/r_0 = mc^2$ of the electron; taking the empirical values for c, e, m, one has numerically

$$n = n_0 V, \qquad \varepsilon = \varepsilon_0 n = \varepsilon_0 n_0 V,$$
$$n_0 = 2{\cdot}90 \times 10^{37} \text{ cm.}^{-3}, \qquad \varepsilon_0 = 59{\cdot}7 \text{ M.e.v.}$$

Between the natural units of length and momentum, r_0 and b, and the quantum constants h and A (defined above), there are the symmetrical relations

$$h = (\pi r_0)b, \quad A^{4/3} = \frac{b}{\pi r_0} = 0{\cdot}0085 \text{ gm./sec.}$$

Coulomb's law is modified by a factor $\int_0^{2r/r_0} J_0(x)dx$, where $J_0(x)$ is the Bessel function. This implies a change of Rutherford's law of scattering, to which is added a factor

$$\left(1 - \frac{E}{E_0}\sin^2\theta/2\right)^{-1}.$$

where E is the energy of the incident particle, and E_0 a constant energy which equals 19·200 M.e.v. for the proton-electron collision; for the proton-proton collision where the formula has to be modified (exchange effect) the characteristic energy is 10·4 M.e.v. in good agreement with experimental results[3].

There are further deviations from Planck's and Stephan-Boltzmann's laws; the latter resembles for high temperatures the formula for the heat content of a crystal, with the characteristic temperature

$$\Theta_0 = 1{\cdot}63 \times 10^{12} \text{ degree.}$$

These deviations are connected with the fact that the pressure of radiation is not equal to $\frac{1}{3}$ of the energy density; Maxwell's equations do not hold in these domains.

The laws of the kinetic theory of gases undergo also an alteration, which for a gas of molecular weight μ begins at a characteristic temperature

$$\Theta = \frac{137}{1845}\,\frac{\Theta_0}{\mu} = \frac{1{\cdot}21 \times 10^{11}}{\mu} \text{ degree.}$$

The equation of state is unchanged, but the specific heat goes to zero for $T \rightarrow \infty$.

The application of the new principle to the structure of nuclei leads to interesting results. A nucleus of mass number A is considered as the densest packing of A particles of mass number 1 (protons, neutrons). Then the radius R of the nucleus is connected with the electronic radius r_0 by

$$R = r_0\sqrt[3]{\tfrac{3}{8}A} = 2{\cdot}02 \times 10^{-13}\sqrt[3]{A} \text{ cm.,}$$

in excellent agreement with Bethe's[4] estimate $(2{\cdot}05 \times 10^{-13})$. The mean kinetic energy $\bar{\varepsilon}$ per nuclear particle (proton or neutron) and the maximum energy ε_0 are given by

$$\varepsilon_0 = \tfrac{5}{3}\,\bar{\varepsilon} = 10{\cdot}4 \text{ M.e.v.}$$

The application of the Fermi distribution law together with Bethe's empirical value for the radius leads to $\varepsilon_2 = 10$ M.e.v.

These confirmations show that we have to do with more than a mere formalism. Though we are at present far from having a consistent theory, the new principle provides an attractive programme of investigation.

MAX BORN.

Department of Natural Philosophy,
University,
Edinburgh. Jan. 14.

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[1] Eddington, A. S., "Relativity theory of Protons and Electrons". (Camb. Univ. Press, 1936.)

[2] Born, M., and Rumer, G., *Z. Phys.*, **69**, 141 (1931). Wataghin, G., *Z. Phys.*, **88**, 92 (1934). March, A., *Z. Phys.*, **104**, 93, 161 (1937); **105**, 620 (1937); **106**, 49, 291, 532 (1937); **108**, 128 (1937).

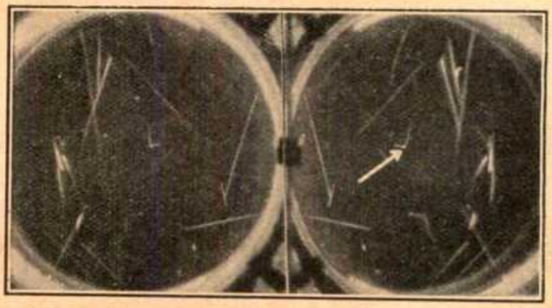
[3] Tuve, M. A., Heÿdenburg, N. P., and Hafstad, L. R., *Phys. Rev.*, **50**, 806 (1936); Breit, G., Condon, E. U., and Present, R. D., *Phys. Rev.*, **50**, 825 (1936).

[4] Bethe, H. A., "Nuclear Physics". *Rev. Mod. Phys.* Part A (with R. F. Bacher), **8**, 82; Part B, **9**, 71; Part C (with M. S. Livingston), **9**, 245. See especially Part B, formula (598), p. 166.

Wilson Chamber Photograph of the Neutro-Electric Effect

AMONG the possible interpretations of the neutro-electric effect, recently discovered by Kikuchi, Aoki and Husimi[1], the disintegration of the neutron into an electron and a proton must be discarded, since Gilbert, Smith and Fremlin[2] could find no corresponding track in the Wilson chamber. (Their estimation that about thirty proton-electron pairs should appear per expansion is no doubt too large; but our present result is also in contradiction to the view of disintegration.) The most reasonable explanation would be to assume the expulsion of the orbital electron or the electron in a negative state due to some still unknown interaction between the electron and heavy particles. In this process, as the neutron loses its energy, the atom with which collision has occurred should gain the corresponding momentum. Therefore, the electron track starting in the Wilson chamber should always be accompanied by a track of a heavy particle.

We searched for such kind of tracks in a Wilson chamber placed near the D–D neutron source filled with methane mixed with alcohol vapour. According to our previous result, the cross-section of the proton for the process is $0{\cdot}6 \times 10^{-26}$ cm.^{2}. Assuming the cross-section for the elastic scattering to be $2{\cdot}0 \times 10^{-24}$ cm.^{2}, 1 in 300 recoil proton tracks should appear in pair with an electron track. From the atomic concentration of the carbon atoms in the chamber and the known cross-section, the ratio of the number of carbon-electron pairs to that of single proton tracks in the same photographs should be about 1 in 200.



WILSON CHAMBER PHOTOGRAPH OF THE NEUTRO-ELECTRIC EFFECT. THE NEUTRON TRAVELS UPWARDS.

We examined about 900 pairs of photographs and obtained 3,060 proton tracks starting from the illuminated portion of the chamber. Of these, six appeared with the electron track. The accompanying illustration shows one of the photographs obtained. The number of the tracks which should be attributed to the carbon-electron pair was 12. These figures are in good agreement with our expectation. For various reasons it is impossible to consider that all the pairs we have observed are due to accidental coincidence of two independent tracks.

There now seems to be no doubt about the reality of the new effect. Its importance in connexion with the theory of the elementary particles can scarcely be over-estimated.

SEISHI KIKUCHI.
HIROO AOKI.

Physical Institute,
Osaka Imperial University.
Dec. 20.

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[1] *Proc. Phys.-Math. Soc. Japan*, **18**, 727 (1936); **19**, 734 (1937).

[2] NATURE, **139**, 796 (1937).

A Non-radiating Motion of a Spinning Electron

MATHISSON[1] recently deduced the equations of motion of a spinning electron from the General Theory of Relativity. According to those equations such a particle, when free, instead of following a geodesic, performs some sort of screw motion around it. In the special case when the 'gravitational background' is the space time of the Special Theory of Relativity and the velocity is small compared to the velocity of light, this movement consists of a uniform translation in any direction and a uniform circular motion in a plane perpendicular to the angular momentum $\mathbf{J}$ of the particle, the frequency ν being proportional to $\mathbf{J}$. The radius remains indeterminate. Assuming $\mathbf{J} = h/4\pi$ we get $\nu = 2m_0c^2/h$.

If this particle had the mass m_0 and the charge $-e$ of an electron, the radiation damping of its circular motion would be so great as to stop it almost immediately. Mathisson's attempts to establish a connexion between the Theory of Relativity and quantum mechanics would then obviously encounter unsurmountable difficulties. In the course of a private discussion, Dr. Mathisson expressed, therefore, the view that not only the mass, charge and spin of the particle but also its magnetic moment should be taken into account. It is to be expected, then, that the electronic constants might be chosen in such a way that a free electron would not emit any radiation when moving in the above-mentioned manner. Mathisson is now completing his theory on these lines.

It is possible to show in a very simple 'classical' way that in some particular cases the superimposed action of a magnetic dipole can annihilate the radiation of an electric charge in motion. It is well known that when a magnetic dipole with a moment **q** moves with a velocity **v**, an electric moment

$$\mathbf{p} = \frac{1}{c}\left[\mathbf{vq}\right] \qquad (1)$$

appears. Suppose such a magnetic dipole carrying also an electric charge $-e$ moves uniformly around a circular orbit of radius r, the frequency being ν and the dipole axis remaining perpendicular to the plane of the circle, the electric moment (1) will then be directed along the radius vector of the particle. If we put

$$p = er \qquad (2)$$

and assume that the sense of motion is such as to produce a magnetic moment opposite to **q**, the action of the resulting electric moment will be equivalent, at sufficiently distant points, to that of a charge $-e$ in the centre of the circle and a charge $+e$ on the particle. The moving electron charge will be compensated and there will remain only a charge $-e$ at rest in the centre of the circle. At distances large enough there will remain thus only an electrostatic field and the radiation will disappear. Putting $\mathbf{q} = \frac{h}{4\pi}\frac{e}{m_0 c}$ and $\mathbf{v} = 2\pi\nu r$, we get from (1) and (2)

$$\nu = 2m_0c^2/h.$$

Curiously enough, this is also the frequency of Schrödinger's *Zitterbewegung* for a Dirac electron in slow motion.

The above considerations seem to me suggestive, though—or rather because—they are based on such crude 'classical' notions.

J. W. WEYSSENHOFF.

Institute of Theoretical Physics,
Jagellonian University,
Cracow. Jan. 15.

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[1] *Acta physica Polonica*, **6**, 163 (1937) and **6**, 218 (1937).

Coupling between the Orbital and the Spin Angular Momenta of Paramagnetic Ions from Magnetic Measurements

IN a salt of the iron group, though the spin angular momentum of the paramagnetic ion is not directly affected by the crystalline electric fields acting on the ion, yet indirectly it is, owing to its coupling with the orbital angular momentum of the ion, which is easily affected by these fields. The magnetic anisotropy of the crystal, and the deviations of the temperature dependence of its principal susceptibilities from the Curie law, are the results of such an indirect influence of the crystal fields on the spin angular momentum exerted through the spin-orbit coupling[1], and should be the greater the stronger the coupling. Conversely, from the observed anisotropy or the deviations from the Curie law, it should be possible to calculate the strength of the spin-orbit coupling in the ion.

Such a calculation is simple for a nickel salt, and the necessary theoretical expressions have been worked out by Penney and Schlapp[2]. The magnetic anisotropy $\Delta\chi$ for any given plane in the crystal, that is, the difference between the maximum and the minimum susceptibilities in the plane, per gram molecule, is given by the relation

$$\Delta\chi = \frac{8N\beta^2}{3kT}\left(8\lambda - \frac{2\lambda^2}{kT} - 3kT\right) . \Delta\alpha,$$

where λ is the constant of spin-orbit coupling, β is the Bohr magneton, and N, k and T have their usual significance. The factor $\Delta\alpha$ depends on the crystal fields acting on the Ni^{++} ions, and on the orientation of the selected plane in the crystal. Because of the small coefficient of thermal expansion of the crystal, $\Delta\alpha$ will be almost independent of temperature. From measurements on $\Delta\chi$ at two different temperatures it should therefore be possible to eliminate $\Delta\alpha$ and determine λ.

Using the method described by us in some recent papers[3], we have measured the magnetic anisotropies of the tetragonal crystals $NiSO_4.6H_2O$ and $NiSeO_4.6H_2O$, at the temperature of liquid oxygen and at room temperature. For both the crystals the anisotropy at $-183°$ C. is found to be about $4{\cdot}8_0$ times that at 23° C. From this ratio we obtain for the constant of spin-orbit coupling in Ni^{++} the value $\lambda = -331$ cm.$^{-1}$, which agrees well with the value -335 cm.$^{-1}$ obtained from spectroscopic data[4].

K. S. KRISHNAN.
A. BOSE.

210 Bowbazar Street,
Calcutta.
Jan. 12.

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[1] Van Vleck, J. H., *Phys. Rev.*, **41**, 208 (1932).

[2] *Phys. Rev.*, **42**, 666 (1932).

[3] Krishnan, K. S., and Banerjee, S., *Phil. Trans. Roy. Soc.*, A (1933–36).

[4] Laporte, O., *Z. Phys.*, **47**, 761 (1928).

Diffraction Gratings ruled in Metallic Films

PROF. R. W. WOOD, of Johns Hopkins University, has recently reported[1] on the successful preparation of diffraction gratings by ruling on 'aluminized' surfaces, and predicts a bright future for this type of dispersive instrument. One of the most interesting aspects of this technique, however, is not included in his letter. Inasmuch as I participated in the conception and development of the general method of preparing and ruling evaporated films at Cornell University early in 1934, which method Prof. Wood was induced to adopt about a year later, I feel that I am in a position to offer some comments of interest.

Diffraction gratings are not ruled upon 'aluminized' mirrors but rather upon mirrors the surfaces of which are coated with a discrete film of aluminium deposited over a film of chromium. It was found in the early attempts to rule gratings in evaporated films of pure aluminium that the aluminium film was stripped in patches from the glass by the diamond point, while films of pure chromium were so hard that a diamond loaded heavily enough to rule the chromium also disfigured the surface of the glass underneath. Hence it was rightly concluded that a double film might serve, since the diamond could be caused to rule through the soft aluminium without being loaded heavily enough to affect the under-coating of chromium. At the same time the aluminium-chromium bond would not be disturbed, for the tenacity of an aluminium film for one of chromium is far greater than that of an aluminium film for glass. It is of interest to note here that this search for a proper film for ruling diffraction gratings has led to the development of a type of film, called 'chroluminum', now extensively used for coating large astronomical mirrors.

The double film has ideal properties for the ruling of diffraction gratings in that the glass surface is not touched by the diamond point, and in that the depth of the rulings can be controlled accurately by controlling the thickness of the aluminium film. The first property allows the same figured and polished mirror blank to be used over again in case the first ruling is a failure, since the chroluminum surface can be removed easily from the glass and a new one deposited for another try at ruling. The second property allows rulings of any desired depth to be obtained with comparative ease, and thus allows most of the light of the reflected spectra to be concentrated in a desired colour of a desired order. The thickness of the aluminium film through which the diamond point is to rule is computed in advance, and is controlled during the process of deposition of the aluminium. The thickness of the underlying chromium film is of little importance, and is usually made slightly less than that necessary to give opacity.

ROBLEY C. WILLIAMS.

Observatory of the University of Michigan,
Ann Arbor, Michigan.
Jan. 17.

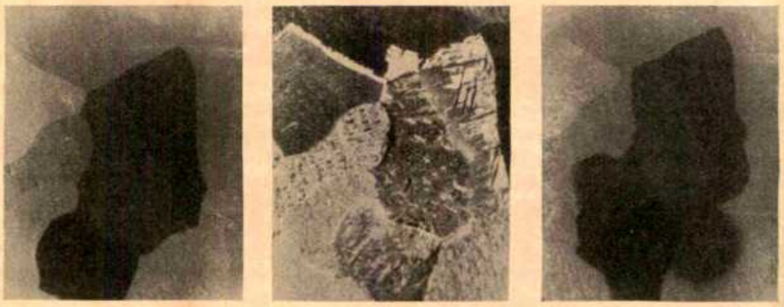
[1] NATURE, 140, 723 (1937).

Electron-Optical Observation of the Transition of α- into β-Zirconium

THE investigation of the transformation process of the hexagonal α- into the cubic β-modification of zirconium by means of X-rays[1] led to the conclusion that this process is brought about by a homogeneous transformation (shearing combined with dilation) of coherent lattice regions parallel to definite crystallographic planes and directions, the 'shearing motion' being opposed in successive α → β and β → α transitions, the whole process thus resembling closely the way martensite needles are formed in steel.

In such cases it is generally observed that the transformation into the new phase cannot be described as a growth of nuclei steadily increasing in size, but that it consists of the formation of parallel and intersecting systems of more or less needle-shaped lamellæ, which, as transformation progresses, do not increase in size but merely in number, the resulting pattern showing the type of lamellar structure met with in martensitic steels and known as *Widmannstätten* texture in meteorites and many alloys[2].

The investigation of the emission pattern of zirconium in an 'electron microscope' of the type described elsewhere[3], showed that the same texture is exhibited by α-crystallites formed from the β-phase. This is clearly shown by the accompanying photographs corresponding to cathode temperatures of 1100° C., that is, well above the transition point, (865° C.) and 600° C., a temperature well below this point. It is interesting to see that the regions, originally occupied by the β-crystallites, can still be discriminated in the α-pattern by the difference in 'direction' of the lamellæ in the adjoining regions (needles of the α-modification of zirconium have already been observed in etched test pieces after suitable cooling from the β-state[4]).


β-Zr (1100° C.) α-Zr (600° C.) β-Zr (1150° C.)

EMISSION PATTERNS OF ZIRCONIUM ABOVE AND BELOW THE TRANSITION POINT (865° C.).*

On retransformation into the β-state, the original crystallites reappeared, as is evident from the photograph at 1150° C., which (apart from the left-hand side, where crystal growth has already started: see below) is practically identical with that at 1100° C. This behaviour, which is totally different from the phenomenon of crystal growth observed on transition of α into γ iron[5], seems to confirm the conclusion deduced from the X-ray investigation mentioned above.

It seems worth mentioning that at a cathode temperature above 1150° C. the β-crystallites showed phenomena of growth, whereby the capacity for growth of the individual crystallites could be influenced by the insertion of a temporary transition into the α-modification.

A detailed account of these observations will be published in *Physica*.

W. G. BURGERS.

J. J. A. PLOOS VAN AMSTEL.

Natuurkundig Laboratorium,
N. V. Philips' Gloeilampenfabrieken,
Eindhoven.
Jan. 7.

* The striation visible in the β-Zr patterns has the same direction over the whole cathode and is due to the polishing of its surface.

[1] Burgers, W. G., and Jacobs, F. M., *Physica*, **1**, 561 (1934); Pap. Disc. Intern. Conf. Physics, London, 1934, vol. 2, p. 158.

[2] See Sachs, G., "Praktische Metallkunde", **3**, 20 (Berlin, 1935); further papers by Mehl, R. F., and collaborators in *Trans. A.I.M.E.* from 1931 onwards.

[3] Burgers, W. G., and Ploos van Amstel, J. J. A., *Physica*, **4**, 5 (1937).

[4] See Vogel, R., and Tonn, W., *Z. anorg. allg. Chem.*, **202**, 292 (1931), Burgers, W. G., and Jacobs, F. M., *Physica*, **1**, 561 (1934).

[5] Burgers, W. G., and Ploos van Amstel, J. J. A., NATURE, **136** 721 (1935); *Physica*, **4**, 15 (1937).

A Modified Phase Rule Equation

It is well known that the Gibbs Phase Rule as applied' to equilibrated macro-systems subject to changes of temperature, pressure and concentration may be written in the form

$$P + F = C + 2,$$

where P is the number of phases, F the number of degrees of freedom and C the number of components. In applying the equation to physical and chemical equilibrium, the number of components C is taken as the *minimum* number of independently variable constituents in terms of which the equilibrium may be expressed in the form of a chemical equation. The term 'number of components' has thus to bear the brunt of the matter and assume a responsibility not shouldered by the equation itself. In fact, it is frequently necessary to write out a properly balanced chemical equation in order to decide upon the number of components in the system. Moreover, the equation cannot be applied without making allowance for certain restrictions when the phases approach identity, as in critical phenomena, or when one of the substances is kept in a definite weight-ratio to some other substance in the system, as in dissociation phenomena.

In view of these difficulties it is perhaps desirable to state the Phase Rule in terms more readily comprehended by the ordinary chemist and metallurgist. If we retain the original definitions of phases and degrees of freedom and let C be the *total* number of chemical constituents (that is, actual chemical substances) present in the system we may write

$$P + F + R = C + 2 - r,$$

where R is the number of reversible chemical reactions occurring in the system, and r, the restriction term, is equal to the number of pairs of phases having the same concentration or composition. This equation may then be applied without reference to stoichiometric chemical equations and without recourse to any process of choosing components.

Thus in the thermal dissociation of calcium carbonate:

$$CaCO_3 \rightleftarrows CaO + CO_2,$$

we have three constituents and one reversible chemical reaction so that

$$3 + F + 1 = 3 + 2 - 0; \text{ that is, } F = 1.$$

Again, in the dissociation of ammonium chloride

$$NH_4Cl \rightleftarrows NH_3 + HCl,$$

we have a reversible chemical reaction and also one pair of phases (the solid phase and the gas phase) with identical composition, so that

$$2 + F + 1 = 3 + 2 - 1; \text{ that is, } F = 1.$$

The equation also leads to a clear differentiation between physical and chemical change in transition processes. We know, for example, that the system

$$Na_2SO_4 \cdot 10\,H_2O \rightleftarrows Na_2SO_4 + \text{liquid}$$

containing three substances (decahydrate, anhydrous salt and water) is invariant (that is, $F = 0$). Accordingly,

$$4 + 0 + R = 3 + 2 - 0 \text{ and } R = 1.$$

The point is thus an incongruent melting point arising from the rupture or formation of chemical linkages. A similar behaviour is exhibited by an intermetallic compound with a submerged maximum, as, for example,

$$AuSn_4 \rightleftarrows AuSn_2 + \text{liquid};$$

but in this case the linkages involved are metallic. These transition processes are conveniently termed *meritectic* reactions (from *meros*, part; *tectic*, melting) to distinguish them from the ordinary peritectic reactions of solid solutions. Applying the equation to a binary system of two solid solutions undergoing peritectic reaction,

$$\alpha \rightleftarrows \beta + \text{liquid},$$

we have

$$4 + 0 + R = 2 + 2 - 0; \text{ and } R = 0.$$

It is clear, therefore, that the peritectic transformation of solid solutions does not involve the rupture of chemical or metallic linkages.

The modified equation, while removing the bugbear of the term component, is also of utility in other directions and in my opinion is much more easy to apply than the customary equation.

S. T. Bowden.

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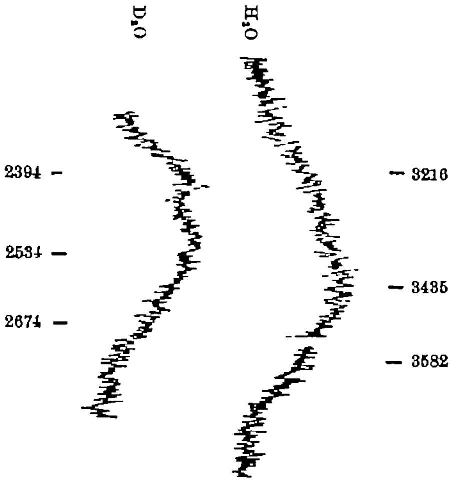
Jan. 17.

Constitution of Heavy Water

On lines similar to the investigation by one of us on ordinary water[1,2], we have studied the Raman band of heavy water (99·6 per cent D_2O) at different temperatures ranging from 6° to 100° C. Within this range, the principal band for this substance is very broad and diffuse, extending in its Raman frequencies from 2,254 to 2,784 cm⁻¹. It shows a structure similar to that of ordinary water, having at 30° C. three components merging into one another with their maxima at 2,394, 2,534 and 2,674 cm^{-1}. The one important characteristic of this band, as compared to that of ordinary water, which earlier workers with this substance[3,4,5] failed to record, is the difference in the relative intensities of the three components. The accompanying microphotometric curves of the bands for the two types of water were taken at 30° C. It is clear from the curves that for



heavy water, the marked components are better resolved, the first component with Raman frequency 2,394 being nearly of the same intensity as the second, whereas for ordinary water, the first component is not only not well resolved from the second, but is also less intense.

With the view of ascertaining the cause of this difference, the changes with temperature in the relative intensities of the three components for heavy water were investigated. The results revealed, in general, a similarity in the changes for the two kinds of water, but the structure of the band for heavy water at any temperature is analogous to that for ordinary water at a lower temperature. Owing to the extreme diffuseness of the bands, it is difficult to determine the exact values of the corresponding temperatures.

If these components are attributed to different polymers, namely, single, double and triple molecules[1], the difference in the relative intensities of the components for the two types of water at the same temperature indicates a difference in the relative proportions of their polymers. The similarity in the structure of the band for heavy water at any temperature to that of ordinary water at a lower temperature leads to the conclusion that characteristic temperatures for heavy water should be higher than for its isotopic analogue. This observation is confirmed from experiment, the temperatures of freezing, maximum density and boiling being 3·8°, 11·6° and 101·4° C. respectively.

For heavy water, the component with the smallest frequency at 2,394 cm^{-1}, which we attribute to $(D_2O)_3$, diminishes in intensity with increasing temperature, whereas the third component (2,674 cm^{-1}) increases correspondingly, the central component attributed to $(D_2O)_2$ remaining almost unaltered. These results indicate that the equilibrium between the polymers changes with temperature as for ordinary water.

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Waltair.
Dec. 23.

[1] NATURE, 132, 480 (1933).
[2] *Proc. Roy. Soc.*, A, **145**, 489 (1934).
[3] Wood, R. W., *Phys. Rev.*, **45**, 392 (1934).
[4] Ananthakrishnan, R., *Proc. Ind. Acad. Sci.*, **2**, 291 (1935).
[5] Bauer and Magat, *C.R.*, **201**, 667 (1934).

Ethnographical Museums

RECENTLY, there has been a certain correspondence in the Press about the India Museum, and now the question has been ventilated in NATURE of January 29 (pp. 177, 193). Though, unfortunately, I have only the usual superficial knowledge of things Indian, may I discuss the wider point of view of archæology and ethnology in general ? These are, of course, one and the same, the latter being only the former in the present tense. This point is indeed made in the remark regretting "the present divorce of antiquity from historic times".

A museum is, or should be, a centre of teaching and study, where everyone should have facilities for acquiring knowledge and broadening his interests in mankind according to his ability. This, of course, means teaching for the serious student, and general information for the vaguely interested public.

Coming back to the particular case in point, we may notice that the purpose of the Victoria and Albert Museum, of which the India Museum is a section, is "to promote the application of art to manufactures". Yet I have noticed that it is Indian 'art' that is so much mentioned in the recent correspondence. Is all the emphasis once again to be laid on 'art' to the detriment of 'industry' ?

Alas, after literature, art has formed the greatest obstacle with which the new study of man's accomplishment has had to contend. All the world over, whether in ancient Egypt, in China, in the Muslim world, or in Europe, the approach to the past has always been primarily through an appreciation of the written word. Later has come an appreciation of the beautiful works of the past. It is only within the last fifty years or more that the new study of archæology and ethnology has grown up. That is a study of all the phenomena of any given civilization—not only of the things beautiful, but also of those that never aspired to beauty or sank into ugliness, but were merely made for everyday use.

The studies of literature and of art have been firmly entrenched in man's mind for many hundreds of years, and have produced their own splendid results. Hence, many find difficulty in discerning the new science. Then, if it begins to dawn upon them, they are liable to look upon it merely as an aberration of those who are not good enough to scale the heights of the others. It should, however, stand forth clearly as the independent line of study which it is, with its own methods and leading to its own results, just as do the other two.

Neither art nor literature is the whole of man's activities, but each is a part of them, just as much as the industries of flint-working, potting, weaving, carpentry, mechanics or any other.

Hence a museum should not be, as it used to be, a collection of things quaint or curious, or even of a few superlatively beautiful ones. It should, on the contrary, give a comprehensive view of a people's complete activities, good, bad and indifferent. These activities cannot be studied properly without reference to those of surrounding countries. Fortunately, an understanding of this has been growing recently. It is now many years since Sir Flinders Petrie began clamouring for a central institution which would cater for this sort of thing, and only last year a prize was offered for an essay treating of Egyptian archæology on these lines.

Finally, it may be remarked that an attractive display of objects will always appeal to people, whereas a learned treatise will only repel the majority.

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Solubility of Cellulose in Water

PURE cellulose is generally regarded as being perfectly insoluble in water, but experiments recently carried out in this laboratory indicate that pure cellulose is slightly soluble in pure water.

High-grade bleached commercial grades of cellulose contain water-soluble impurities (both organic and inorganic), usually less than 1 per cent. This water-soluble extract is determined by digesting a weighed sample of the cellulose for 2 hours on a water-bath with twenty times its own weight of water and filtering off the extract. This operation is repeated another three times and the combined four filtrates are evaporated to dryness on the water-bath, the residue being weighed and calculated as the water-soluble content of the cellulose.

My own experiments show, however, that when this method of extraction is continued on the same sample, after the above determination of water soluble content, approximately constant weights of residue may be recovered from subsequent extracts in a long series of extractions.

Hydrolysis was suspected at this temperature of extraction (95–100° C.), and a further series of experiments were conducted with very pure distilled water at ordinary temperatures (15–18° C.) in carefully selected apparatus, when it was found that the extracts again gave a lower but still approximately constant residue after repeated extractions.

In one case a sample of cellulose, weighing 10 gm., after removal of water-soluble impurities, was digested and washed in the cold with 20 litres of distilled water, corresponding to fifty extractions, without diminution of the residue obtained from the last extract. Micro-biological attack of the cellulose was considered as a possible explanation, but after consideration of microscopical and other evidence, was discarded. The following are typical of the results obtained when using 20 gm. samples stirred in 800 c.c. water for 2 hours at 15–18° C.:

	Cellulose	Average Water-soluble Residue in Extracts
A.	Bleached spruce wood .. .. (sulphite process)	18·6 mgm. per litre
B.	„ „	21·0 „ „ „
C.	Alpha-Cellulose from B . ..	13·6 „ „ „
D.	Bleached cotton wool . .	20·6 „ „ „

The residue obtained from the extracts after evaporation, when final drying is done in a desiccator over phosphoric acid, appears as a white film, having a uniform granular appearance. Under the microscope, it is largely colloidal and isotropic but contains some scattered crystallites. The residue, if not charred during drying, is soluble in water and the solution shows a reducing action equivalent to about 15 per cent calculated as glucose. Whether this hydrolysis has taken place during extraction or evaporation of the extracts remains to be determined. Evaporation of a concentrated solution of the residue yielded a transparent brittle gum-like substance giving negative reactions for the presence of crystalline cellulose or of dextrin.

One fact appears certain, namely, that pure cellulose is slightly soluble in pure water at ordinary temperatures to the extent of 1·4 to 2·1 parts per 100,000, forming a perfectly clear sol. This dispersion of cellulose in water is probably accompanied by some breakdown in the cellulose molecule, but the nature of the reaction will take some time to determine.

This slight solubility of cellulose in water obviously sheds light on numerous scientific and technical problems involving the physical and chemical reactions of cellulose, from its origin in the cell-wall to its resolution by bacteria.

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'Convergent' Sunbeams

THE phenomenon of 'divergent' beams of sunlight is known to everyone. The illusion of divergence of the beams is so good that one has forcibly to remind himself that they are really parallel.

One day last summer, I observed 'convergent' beams and this observation was corroborated by others with me. It was late afternoon in a flat country. Clouds hid the sun, which, perhaps, was nearly eclipsed by the horizon. It had been raining in the surrounding country and cumulus clouds were still prominent in the west. The rays of the setting sun gave the familiar fan-like pattern in the west, passed almost invisibly overhead and then 'converged' in the east as if they emanated from a sun on the eastern horizon. These rays were of lower intensity than those in the west but were plainly visible.

The explanation of the phenomenon is obvious; one is under the parallel beams, and looking along them in opposite directions. The spectacle was new to me.

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Origin of Stellar Energy

IT is well known that matter consists of nuclei and electrons. Nevertheless it can be shown that in bodies of very large mass, this usual 'electronic' state of matter can become unstable. The reason for this lies in the fact that the 'electronic' state of matter does not lead to extremely great densities, because at such densities electrons form a Fermi gas having an immense pressure. On the other hand, it is easy to see that matter can go into another state which is much more compressible—the state where all the nuclei and electrons have combined to form neutrons.[1] Even if we assume that neutrons repel each other, this repulsion can become appreciable only at densities of the order of magnitude of nuclear densities, that is, 10^{14} gm./cm.^{3}, and the pressure of a Fermi gas consisting of neutrons is much less than that of an electronic gas of the same density, because of the greater mass of the neutrons.

Therefore, in spite of the fact that the 'neutronic' state of matter is, in usual conditions, energetically less favourable, since the reaction of neutron formation is strongly endothermic, this state must nevertheless become stable when the mass of the body is large enough. In this case, the gravitational energy gained in going over to the neutronic state with its greater density, compensates for the losses of internal energy.

It is easy to compute the critical mass of the body for which the 'neutronic' state begins to be more stable than the 'electronic' state. First of all we must calculate the energy necessary to form one neutron. For example, in the reaction ${}^{16}_{8}O + 8\epsilon^- = 16\,{}^{1}_{0}n$, we find from the mass defects that to form one neutron the energy required is 0·008 mass units or $1{\cdot}2\,10^{-5}$ ergs (7·5 Mv.). To transform one gram of matter into neutrons we thus need 7×10^{18} erg./gm.

Now we must calculate the gain in gravitational energy. The gravitational energy of the much less dense 'electronic' state can, of course, be neglected. Let us assume first of all that the neutronic state has a constant density, 10^{14} gm./cm.^{3}. The gravitational energy of a homogeneous sphere of mass M is then $3 \times 10^{-3}M^{5/3}$ ergs. For the stability of the neutronic phase we must then have $3\times10^{-3}M^{5/3} > 7\times10^{18}M$, or, $M>10^{32}$ gm.$=0{\cdot}05 \bigcirc$, where $\bigcirc$ is the mass of the sun. On the other hand, if we assume that the neutrons behave like a Fermi gas, we find for the energy $7\times10^{-22}M^{7/3}$ ergs and hence

$$M > 1{\cdot}5\times10^{30} = 10^{-3} \bigcirc$$

which critical value is even less than on the first assumption.

When the mass of the body is greater than the critical mass, then in the formation of the 'neutronic' phase an enormous amount of energy is liberated, and we see that the conception of a 'neutronic' state of matter gives an immediate answer to the question of the sources of stellar energy. The sun during its probable time of radiation (about 2×10^9 years according to general relativity theory) must have emitted something of the order of magnitude of 3×10^{50} ergs. The liberation of this amount of energy requires the transition of only about 2 per cent of the mass of the sun (with the assumption of constant density) or even only $3 \times 10^{-3} \bigcirc$ (with the Fermi gas model) to the 'neutronic' phase. Even for such a bright star as β Orionis, we find for the mass of the neutronic core only about $0{\cdot}1 \bigcirc$ (with the Fermi gas model).

Thus we can regard a star as a body which has a neutronic core the steady growth of which liberates the energy which maintains the star at its high temperature; the condition at the boundary between the two phases is as usual the equality of chemical potentials. The detailed investigation of such a model should make possible the construction of a consistent theory of stars.

As regards the question of how the initial core is formed, I have already shown[2] that the formation of a core must certainly take place in a body with a mass greater than $1{\cdot}5 \odot$. In stars with smaller mass the conditions which make the formation of the initial core possible have yet to be made clear.

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[1] Cf. Hund, F., *Erg. d. exakten Natwis.* **15**, 189 (1936).

[2] Landau, L., *Sov. Phys.*, **1**, 285 (1932).

Points from Foregoing Letters

CONTRARY to expectations, γ-rays of 17 million volts energy eject neutrons from the nuclei of some of the heavier elements only. Prof. Niels Bohr suggests that this selective behaviour is conditioned by "certain special vibratory motions with singular radiation properties" and these, together with other possible modes of vibration, lead to an energy distribution analogous to that of the heat motions in a solid body at a low temperature. The radiative properties of the nucleus in this state will resemble that of a black body with a temperature of several million volts. Based on this analogy Prof. Bohr gives a formula of selective absorption, relating the cross-section for nuclear photo-effects with the frequency of the incident γ-rays and the probabilities for the re-emission of a quantum.

Prof. Max Born proposes a 'principle of reciprocity' according to which each general law in x-space (space-time dimensions) has an 'inverse image' in the p-space (of momenta and energy). He indicates some of the consequences and numerical results: An energetically closed system would correspond to a closed momentum-space, with a radius c representing the maximum possible momentum. A number of quantities which are infinite in accepted theories become finite. Coulomb's law is modified, which implies a change in Rutherford's law of scattering so that for head-on collisions there is an absolute limit for the distance of closest approach. Plank's and Stephan-Boltzmann's laws and the laws of the kinetic theory of gases are altered. Applied to the theory of nuclear structure, the new principle yields, for the mean kinetic energy per nuclear particle and for the ratio between the nuclear and electronic radii, values in excellent agreement with Bethe's estimates.

Wilson chamber photographs showing the emission of the electron from atoms when they interact with neutrons are submitted by S. Kikuchi and H. Aoki. The authors assume the expulsion of an orbital electron or an electron in a negative state, due to some unknown interaction between the electron and heavy particle.

According to Dr. J. W. Weyssenhoff, from the simple classical theory it follows that, in particular cases, the superimposed action of a magnetic dipole can annihilate the radiation of an electric charge in motion. This may remove the difficulty in connexion with Mathisson's theory of the spinning electron since the moving electron charge will be compensated so that there is no radiation.

In a paramagnetic salt it should be possible, according to Prof. K. S. Krishnan and A. Bose, from measurements on the magnetic anisotropy of the crystal at different temperatures, to calculate the coupling between the orbital and the spin angular momenta of the paramagnetic ion. The value of the coupling in Ni^{++} calculated in this manner agrees well with the spectroscopic value.

Photographs of electron-emission patterns of α-zirconium (at 600° C., cathode temperature) and of β-zirconium (at 1100° C.) submitted by Dr. W. G. Burgers and J. J. A. Ploos van Amstel show that, as in the case of martensite, a *Widmannstätten* texture is exhibited by α-crystallites formed from the β-phase. On retransformation into the β-state, the original crystallites reappear, showing phenomena of growth.

The difficulties associated with the application of the Gibbs Phase Rule equation arise from the special significance which is attached to the term component. A modified equation proposed by Dr. S. T. Bowden avoids the use of this term and leads to a clear differentiation between the phase transformations of compounds and solid solutions.

Pure cellulose is generally regarded as being perfectly insoluble in water, but from investigations described by James Strachan, it appears that high-grade cellulose from wood and from cotton is slightly soluble in pure water at 15–18° C. to the extent of 1·4 to 2·1 parts per 100,000, and that this dispersion of cellulose in water is probably accompanied by some breakdown in the cellulose molecule.

Research Items

Ancient Man in Devon

THE implementiferous gravels at Broome, Dorset (the gravels in question are actually over the county boundary in Devon), have long been famous. Chert implements were discovered there in 1877–78. Mr. Reid Moir has now investigated these gravels and the contained implements in the light of the knowledge of quaternary deposits and 'palæolithic' implements which has accrued since the gravels and implements were originally described (*Devon Archæol. Exploration Soc.*, 2; 1937). The gravels were regarded in earlier investigations as laid down by normal river action; but it cannot be questioned that, during the Ice Age, Devon, so near the main terrain of the glaciers, must have been affected by the tremendous happenings of the period. The deposits must therefore be regarded as laid down by an abnormal flow due to the melting ice. It would appear that some twenty feet of the deposit was laid down as a result of the passing away of glacial conditions. Then comes about four feet of comparative quiescence, in which palæolithic hunters may have lived on the river bank. Another period of very active deposition follows in which the uppermost thirty feet of gravels was laid down. This is only vaguely stratified, or 'tumbled'. The archæological evidence fits in with this hypothesis. The specimens from these deposits can be classified as (*a*) primitive, possibly eolithic, implements, much rolled and abraded; (*b*) one or two early Acheulean hand-axes showing signs of transport; (*c*) Late Acheulean hand-axes, fine and unabraded; (*d*) Clacton III material unabraded; (*e*) some Levallois flakes, but not a definite Levallois industry. There can be no doubt that the middle layer was laid down in Late Acheulean and Clacton III (High Lodge) times. The Broome deposits fall in line with the 100-ft. terrace of the Lower Thames Valley, Derby Rd., Ipswich, and Hoxne, Suffolk. The lower deposit of Broome, therefore, is connected with the glaciation of the Kimmeridge Chalky Boulder Clay and the uppermost with the Upper Chalky Boulder Clay; while there is strong evidence for correlating the upper gravels with the deposit of 'clay with flints' of East Devon on the Bere–Seaton Road, a site which Mr. Reid Moir also discusses.

Mesolithic Flints from West Hartlepool

Finds of worked flints from the submerged forest at West Hartlepool, which have the appearance of an early stage of the Maglemose culture, or possibly even more primitive and suggestive of that of Duvense, Lubeck, have been recorded by Dr. C. T. Trechmann, Mr. A. S. Kennard adding a note on the Mollusca (*Proc. Prehist. Soc.*, July–Dec. 1936). The submerged forest is situated between Hartlepool and West Hartlepool and along the coast southward to Seaton Carew. The main portion occupies a depression between two outcrops of magnesian limestone. A mammoth tusk, antlers of red deer and Irish elk, and other mammalian remains have been found beneath the deposit. A rough but well-chipped pick-like flint implement, now in the Sunderland Museum, was found "on the turf of the buried forest" at Seaton Carew in 1860. In 1934–35, flint flakes and chippings and a fresh shell of *Littorina littorea* were found at West Hartlepool near the base of the peat, while a patch six feet long and three feet wide yielded a quantity of very sharp implements and chippings of very black flint with white chalky patches and streaks. These appear to be the work of one person thrown down together. The fifty specimens, all found at the junction of the underlying blue clay with the peat, included a number of elongated micro flakes, a microlith blunted down one edge, a micro-burin and a broken, asymmetrically notched flake, probably a microlith in process of manufacture. In the peat itself are found indefinitely chipped flints of an elongated shape, not easy to comprehend, but in certain characters recalling the pick in the Sunderland Museum. It seems possible that two periods are represented, one at the base and the other higher up in the peat. The peat is very compressed and contains birch, hazel, *Equisetum*, iris, etc. Permeation by drain refuse makes pollen analysis unsatisfactory. The period is early Littorina or Atlantic. The worked flints are of Maglemose type, and a comparison with other sites of the submerged forest regions of the Yorkshire, Durham and Northumberland coasts suggests that the worked flints found at Skipsea are of like appearance.

Inactivation of Adenosine by Blood

ALL tissues of the body contain in greater or less amounts adenosine or allied compounds, substances which, when they enter the blood-stream, have far-reaching physiological effects. The existence of enzyme systems in the tissues capable of inactivating these substances has been known for some time, but up to the present no such enzymes in the blood have been described. Drury, Lutwak-Mann and Solandt (*Quart. J. Exp. Physiol.*, 27, 215; 1938) have now demonstrated the presence in the blood plasma of the ordinary laboratory animals and of man of an enzyme inactivating adenosine, probably by deaminating it to form the biologically inert substance inosine. Cat's plasma is by far the most active, 0·1 mgm. of adenosine being destroyed in so short a time as 2 min. by 1 c.cm. of plasma. This very high degree of activity is, however, exceptional and is only reached on account of the remarkable fact that the activity of the plasma of anæsthetized animals gradually increases during an experiment, until 5–6 hours after the beginning of an experiment it may be 12 times the normal value. Although this increase appears to be accelerated by a fall of blood pressure, the authors are unable to correlate it directly with this, and it appears to be unconnected with the presence of any particular organ. The authors suggest that the increase in enzyme activity may be due to the formation of more enzyme from inactive plasma protein.

Larvæ and Pupæ of Aquatic Diptera

MEMOIR 205 (1937) of the Cornell University Agricultural Station is written by Prof. O. A. Johannsen and forms Part 3 of a series entitled "Aquatic Diptera". In the present case, the single family Chironomidæ is dealt with and, in particular, four out of five of its sub-families. The Chironominæ are the family left out to be dealt with in a subsequent memoir. While this work deals primarily with North American genera and species, the keys include European forms in some cases where it is considered desirable to direct attention to differential characters. The work is illustrated by eight plates containing more than 270 line figures. Since practically all the European genera are figured, the work will prove a valuable aid to the identification of forms found on both sides of the Atlantic Ocean. The material which forms the basis of the study was collected and reared by the author and some of it a number of years ago. Parts IV and V, which conclude the series, it is mentioned, have been completed and will appear as another memoir within a short time. When completed, the work will form an admirable and up-to-date guide to the study of the many forms of Diptera found in aquatic habitats.

Crustacea of the Philippines

A CHECK list of Philippine Island decapods is given by P. Estampador Eulogio (*Philippine J. Sci.*, 62, No. 4; 1937), but there are many additions to the fauna recently described from Woltereck's Wallacea Expedition to the Philippine and adjacent islands. The contributions already published are summarized by Dr. Woltereck in Band 34, Heft 3/5 of the Internationale Revue der gesamten Hydrobiologie und Hydrographie, 1937. This number is devoted to the Wallacea Expedition, and includes original contributions, especially on the freshwater Crustacea, by H. Balss (Potamonid crabs), V. Brehm (Diaptomids), W. L. Tressler (Ostracods) and E. Woltereck (freshwater Caridea). The Potamonid crabs are common in this region, living much on land and having no free-swimming larvæ. Dr. Woltereck has two important and extensive papers, the first dealing with races and species of the genus *Caridina* present in the islands, the second with their systematics and geographical distribution. The latter includes a list of all known species and a comparison with other Atyidæ.

Researches on Copepods

DR. C. H. EDMONDSON has studied copepods in Hawaii, Fiji and Tahiti (Quantitative Studies of Copepods in Hawaii with Brief Surveys in Fiji and Tahiti; Occasional Papers of Bernice P. Bishop Museum, Honolulu, Hawaii, 13, No. 12, 1937). The semi-enclosed bodies of water are shown to support a much larger number of copepods than do the open reefs and a large number of animals feed upon the copepods. The author describes the feeding habits of *Eleutheria*, or creeping medusa, abundant among *Ulva* and other seaweeds on the shores of Oahu. "These minute medusæ may be seen ingesting copepods as large as themselves, becoming greatly distorted in the process, and at the same time holding two or three other copepods within the grasp of their tentacles." It is found that shoal water copepods are more resistant to falling than to rising temperatures. A large proportion survive 5° C. for 17 hours, but all die in 16½ hours at 35° C. Dilute sea water in the proportion of 1 part sea water to 3 parts fresh water has no detrimental effect on copepods during a period of 48 hours. Many copepods survive a reduction in pH from 8·6 to 5·8 for 24 hours, a few for 48 hours, none for 72 hours. Adult specimens are more sensitive than larval forms to altered ecological conditions.

Lichens from Greenland

THE lichens collected by Prof. Theodor M. Fries (largely crustaceous) in 1871, supplemented by the collections of Dr. Johannes Grøntved (mainly macro Lichenes) and others have been examined and collected into one volume by B. Lynge of Oslo. This volume must represent a very comprehensive survey of present-day knowledge of Greenland lichens, especially of the region of and around the Island of Disko. This region was visited primarily by the 1871 expedition to bring to Sweden some blocks of iron, detected the previous year by A. E. Nordenskiöld; these were formerly thought to be of meteoric origin, but were later proved to be telluric. (Meddelelser om Grønland. Bd. 118. No. 8. 1937.) The collections of Fries, gathered under the forced conditions of an Arctic expedition, were found to be in remarkably good preservation, though some difficulties were experienced with regard to dates and exact localities. Many of the lichens were difficult to photograph, and a method, new to lichenology, was used to throw the surface details into sharper relief. The lichen is suffused with the vapours of a white and very fine-grained ammonium salt. Temporarily the colour contrasts of disk and thallus are masked, but afterwards the covering salt evaporates and no damage is done to the plant. Use was also made of Prof. Asahina's new reagent paraphenylenediamin, which in many genera was found to be of great value for specific distinctions.

Peculiar Cystoliths in the Cucurbitaceæ

DR. H. L. CHAKRAVARTY's paper upon the physiological anatomy of the leaves of Cucurbitaceæ (*Philippine J. Sci.*, 63, No. 4, August 1937) seems to require a revision of the accepted ideas of those peculiar aggregates of calcium carbonate known usually as cystoliths. In the genus *Momordica*, and particularly in *M. cochinchinensis*, such irregular deposits of calcium carbonate are very common in enormously enlarged epidermal cells. In *M. charantia* the cellulose peg upon which the deposits are formed is very short, but in *M. cochinchinensis* the cystoliths have no definite structure. They are very irregularly branched, and the calcium carbonate strongly impregnates a stratified, branched cellulose skeleton. Their frequency is remarkable—in a square centimetre of leaf 1,000–1,600; in an entire leaf there may be as many as 100,000; so that enormous quantities of calcium carbonate must be accumulated in a single plant. The author directs attention to the fact that Zimmerman has described a similar type of cystolith in *M. rostrata* Zimmerman.

Endophytic Fungi of Rye-Grass

A FUNGUS which has hitherto defied identification is commonly distributed freely throughout most tissues of rye-grass, *Lolium perenne*. It has sometimes been regarded as a stage in the life-history of *Epichloe typhina*, but Miss Kathleen Sampson shows, in a recent paper (*Trans. Brit. Mycol. Soc.*, 21, Pts. 1 and 2, 84, Oct. 1937), that it has few characters in common with this fungus. The endophyte has been isolated upon egg medium, and cultured afterwards upon agar media, but no further clue to its identity has thereby been revealed. A second fungus has been isolated, which grows readily upon many kinds of media, and which is no less systemic than the first. It produces spiral hyphæ and microconidia, but provides no reliable diagnostic features.

Crustal Deformations around Lake Biwa

LAKE BIWA is the largest lake in Japan, its length from north to south being thirty-seven miles, and its average width nine miles. Along its shoreline are distributed no fewer than thirty-six water-gauges, and, from their records, Prof. C. Tsuboi (*Earthq. Res. Inst. Bull.*, 15, 935–942; 1937) has calculated the mean annual height of the surface at each station from 1887 until 1929. While there are many fluctuations in level, due probably to variations of rainfall, the mean annual height at all the stations shows that the level is falling at the rate of 5 ft. per century, and it is interesting to note that well-developed terraces occur at a height of about 650 ft. above the present surface. At one of the stations at the south end of the lake, the curve of mean annual height indicates a fall in level of about 6 in. during the years mentioned; while at another at the north end there was a rise of about the same amount. This suggests that the crust around the lake has been tilted towards the north by about 0·7 second of arc, and repeated series of levels along both sides of the lake agree nearly with this estimate.

Effects of Intensive Drying

SINCE H. B. Baker from 1912 reported rises in boiling point, surface tension and freezing point in the case of liquids intensively dried by phosphorus pentoxide, the problem has been investigated by others, who have mostly either failed to observe any change in physical properties or have explained the effects as due to superheating. D. A. Lacoss and A. W. C. Menzies (*J. Amer. Chem. Soc.*, 59, 2676; 1937) now find that when purified benzene is desiccated with purified phosphorus pentoxide with precautions to exclude or destroy dust, its vapour pressure, near 80°, is lowered markedly if the drying process is carried on at room temperature, but raised slightly if the drying is carried on at 90° or 105°. Without opening the sealed apparatus, the vapour pressure could be caused to revert to the normal value by heating the liquid out of contact with the phosphorus pentoxide, provided the desiccation had not been too vigorous. On allowing access of normal air, vapour pressures likewise reverted to the normal value. No change in vapour pressure was found in the case of benzene if the materials used were not both purified and also dust-free, nor when barium oxide or magnesium perchlorate were used as desiccants. Carbon tetrachloride, normal heptane and cyclohexane failed to show any change of vapour pressure upon desiccation under the same conditions as had given positive results with benzene.

Raman Effect and Analysis

AN interesting review of the application of the Raman effect to the analysis of organic mixtures by J. Goubeau appears in a recent issue of *Angewandte Chemie* (51, 11; 1938). The author points out the suitability of the method for the analysis of substances with non-polar linkages, and most organic substances fall into this class. The spectrum being determined by the actual structure of the molecule is capable of distinguishing between all types of structural isomerides. Optical isomerides and their racemates give the same spectrum. The application of the Raman spectrum to qualitative analysis is discussed, and the sensitivity of the method is considered. The applications of the method to typical analytical problems are then mentioned. The process has been used to detect impurities in substances, for example, the presence of secondary butyl alcohol in fermentation propyl alcohol, methyl bromide in ethyl bromide, and methyl alcohol in ethyl alcohol. The identification of substances by this method has the advantage over the determination of melting point or boiling point that the substance is not affected by the process. The existence of characteristic lines for different groups of atoms (C : C, C ⋮ C, C : O, etc.) makes it possible to classify a substance. The use of the method when dealing with mixtures of substances difficult to identify in other ways is described, the work of Dupont on the terpenes being mentioned. *Cis*- and *trans*-isoeugenol have been detected in the presence of each other. Mixtures of hydrocarbons have also been investigated. Quantitative analysis is also possible by determining the intensities of characteristic lines of the substance.

Reduction of Occultations for Faint Stars

In a recently published paper (*J. Brit. Astro. Assoc.*, 48, 3, January 1938) by Dr. M. Davidson an entirely new method is developed for the reduction of occultations. Instead of using the ordinary Besselian geometry, Dr. Davidson employs rectangular equatorial co-ordinates and shows how very accurate results are attainable. The method is applicable to stars of all magnitudes, but as the Nautical Almanac Office has computed certain constants for occultation stars brighter than magnitude 7·5, it is not suggested that the method should be used for these. The author hints at the possibility of taking into consideration the inequalities of the limb of the moon, thus greatly enhancing the value of a single occultation, and shows how this might be done, but admits the great difficulties in the practical application.

Interpretation of ε Aurigæ

THE paper on ε Aurigæ by Kuiper, Struve, and Strömgren, referred to in NATURE of January 22, p. 154, is now published (*Astrophys. J.*, 86, 570), giving full details of the latest theory regarding this most interesting binary star. The following is a short summary of the system as postulated by the authors: The principal component, the so-called 'infra-red star' (*I* star), has a temperature of only 1,200°–1,400° and contributes no appreciable light in the spectral region covered by the observations. It has a very great diameter (about one third of the major diameter of the orbit) so that the outer layers of its atmosphere are as near to the second component as to the centre of the *I* star itself, and are subject to greater influence from this source. This second component, an *F2* star of much smaller diameter, is the source of the observed spectrum as well as of the visible light from the system, and by photoelectric action of its ultra-violet radiation produces a shell of highly ionized material in the outermost layers of the *I* star. This shell is semi-transparent, and during the eclipse of the *F2* star (which is of 'grazing' character, not central) absorbs about half the light of the latter in a non-selective manner, thus explaining the observed constant minimum of the light curve and the similarity of the spectrum throughout. In the words of one of the authors, we are presented with "a new astronomical phenomenon, an eclipse by a stellar Heaviside layer".

Science in India*

PROGRESS OF ZOOLOGY

Zoology and its advancement in India were chosen by Prof. G. Matthai as the subject of his presidential address before the Section of Zoology. The address dealt with the progress of zoology since the foundation of the Indian Science Congress in 1914, and more particularly with advances made since 1921.

Oceanographical investigation of the Indian Ocean has been conducted, since the first meeting of the Indian Science Congress, mainly by R.I.M.S. *Investigator* (until 1926) and the John Murray Expedition (1933–34), under the direction of Lieut.-Colonel Seymour Sewell. Previously the *Sealark* Expedition, under the leadership of Prof. J. Stanley Gardiner, had surveyed the western Indian Ocean south of the Maldives, more particularly the islands of the Chagos Archipelago and the Mascarene region (during 1905–6 and 1908–9). The work of the *Sealark* Expedition was mainly on problems relating to coral reefs and atolls and their biology, and was a continuation of a previous study of the Maldives and Laccadives. The R.I.M.S. *Investigator* concentrated its work in the Andaman Sea and the Bay of Bengal. The recent work of the John Murray Expedition was in the region of the Arabian Sea not covered by the *Sealark* Expedition. The study of the deep-sea biology of this region was assisted by physical, chemical, hydrographic and topographic investigations. The Survey of India collaborated with the John Murray Expedition in the cruise down the Maldives for making pendulum observations with the view of determining the nature of the foundations on which the Maldives and Laccadives are situated.

The work of the R.I.M.S. *Investigator* has extended our knowledge in regard to variation in the air temperature over the open waters of the Indian seas, in the wind force, in the amount of rainfall and in the relationship between the temperature of the sea surface and that of the air. There is always a vertical circulation of the layers of water caused largely by differences in temperature and salinity. A reversal of seasons is noticeable in the Indian seas at a depth of about 100 fathoms, comparable to the phenomenon that takes place in the temperate seas.

The 'Murray Ridge' discovered by the John Murray Expedition appears to be ultimately connected with the Carlsberg Ridge. The latter ridge divides the western region of the Indian Ocean into north-eastern and south-western halves. 'King Fuad Bank' is probably a submerged atoll with a distinct rim about 40 ft. high and a level floor 130 fathoms deep.

Regarding the reefs of the Western Indian Ocean, Prof. J. Stanley Gardiner recently pointed out that the Mascarene Region differs from the Chagos Archipelago in regard to conditions of reef-growth, changes adverse to reef-growth taking place at a much higher rate than in the latter. The regression of coral reefs in the Mascarene region does not appear to be due to any biological reason such as sedentary organisms that cause destruction by boring into the reefs, since the activity of such organisms is decreased at the depths at which reefs of this region are situated, or by sediment, which cannot settle on the seaward sides of reefs and banks, or by precipitation of calcium carbonate (for such precipitation is not visible on coral polyps on the seaward sides), or by currents the action of which is less on the sides facing the sea, or by temperature, which at 50 fathoms is not lower than 61·9° F., or by any decrease in the amount of plankton that serve as food material to coral polyps, for it is not liable to much quantitative variation in the Indian Ocean; nor does the chemical composition of the surface water in the Indian seas show any appreciable difference. The comparative poverty of the deep sea fauna in the Chagos and Mascarene regions is perhaps due to the hardness of the sea floor and to the fact that the quantity of plankton which serves as food material to the larger organisms is less in the Indian seas than in the temperate regions. In spite of the "shallow and fierce conditions" of life on the reefs of these regions, it is interesting to observe that the animals do not exhibit any special structural features that may be regarded as adaptations to the peculiar environmental conditions.

The madreporarian corals collected by Prof. J. Stanley Gardiner in his several expeditions to the Indian Ocean, particularly of the astraeid corals, provided material for a comparative study, of the morphological organization of their hard and soft parts, with the view of determining, if possible, the limits of species and genera, most previous taxonomic studies on corals having been based on characters taken solely from the hard parts that are liable to considerable variation. The same material, along with others, formed the basis for a study of colony-formation in astraeid corals.

The Zoological Survey of India has been engaged mainly in faunistic investigation, more especially of the brackish water of the Chilka Lake and its island (Barkuda), the estuarine fauna of Goa, the fauna of the Mutlah River, of the Inle Lake, the Indian freshwater molluscs and their trematode parasites, the aquatic and terrestrial fauna of the Punjab Salt Range, the cave fauna of the Siju Cave in Assam. Particular attention has been paid to the study of the fishes of hill streams in various parts of India and their structural and other adaptations to this peculiar environment. Fisheries research, especially on *Trochus*, has been conducted in the Andamans.

The address ends with a brief account of the research work carried out in the various zoology departments in India.

ENTOMOLOGY IN INDIA

The past, present and future of entomology in India formed the subject of Mr. M. Afzal Husain's presidential address to the Section of Entomology.

Linnæus (1758) included in his "Systema Naturæ" twelve species of Indian insects, and thirty years later Fabricius (1792–98) included in his "Entomologia systematica" one thousand Indian species, collected mostly by the Christian missionaries. During the last hundred and fifty years insects have received much attention. The number of the existing species of insects in India cannot be less than 2·5 millions, but only one in sixty is known. The

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* *Continued from page* 297.

condition of Indian insect collections is also very unsatisfactory. It is distressing to find that most of the 'types' of Indian insects have gone out of the country. In the museums there is scarcely one 'type' for every hundred species described.

The Indian Museum laid the foundation of agricultural entomology in 1884 and the Imperial Institute of Agricultural Research at Pusa and the Agricultural Departments in the provinces and some Indian States have carried on the work. The Indian Central Cotton Committee, the Imperial Council of Agricultural Research, the Indian Tea Association and the Indian Lac Association have fostered the study of the insects of agricultural importance. Similarly, the small band of workers in forest entomology have achieved much success.

Ronald Ross and the workers who followed him made most valuable contributions to medical entomology, which have been of utmost utility to humanity. The Indian Research Fund Association has financed much research on insects of medical importance. Veterinary entomology has been greatly ignored, and it is only lately that an entomologist has been appointed to study insect pests of domesticated animals. In education, entomology has long been the Cinderella among sciences. Even in agricultural colleges it is only within the last few years that entomological teaching has received some attention. In most medical and veterinary colleges, entomology has no place in the curricula.

India is equally behind in entomological literature. There is no literature on insects in any of the vernaculars of India. The "Fauna of British India" is not developing as fast as one would wish it to develop. There are few catalogues of insect groups.

According to Sir Thomas Holland, among the sciences of economic value entomology perhaps ranks first in importance to India. Sir Mirza Ismail has drawn a very gloomy picture of the conditions in India. More than one hundred million people suffer from malaria every year and more than one million succumb to its effects. "The debility, poverty and apathy caused by this disease are factors of magnitude in retarding the national, social and economic progress of the country". *Anopheles* brought about the decay of the Greek and Roman civilizations, and is to-day one of the major obstacles to progress in India. According to Fletcher, the sugar-cane pests alone cause an annual loss of 300,000,000 rupees. The hide industry of India suffers a yearly loss of 1·5 crores of rupees from one insect—ox warble fly. At a very modest computation, the annual loss caused to India by insects has been put at 200 crores of rupees, and a loss of more than a million and a half of human lives. It is a truism that insects have been responsible for more destruction of property and loss of life than that caused by all the wars, floods, earthquakes, fires and famines in human history, and the losses caused by them are on the increase. Advancing civilization is producing conditions most suitable for insect multiplication and spread.

The tribute of Rs. 200 crores which India pays to the demons *Satpada* is a heavy drain, which should not be permitted to continue. An effective defence against these enemies will reduce this enormous wastage, and India will have enough money for her national development. To effect this, an army of workers must be produced to study insect life in all its aspects, and an army well equipped with knowledge and machinery to fight these demons. The public must be made to appreciate the importance of insect study. Entomology must take its place in the schools and universities, agricultural, medical and veterinary colleges. Funds should be provided to develop pure and applied entomology. India has depended far too long on the generous assistance of foreign workers and institutions for the progress of Indian entomology, but the time has come when she must shoulder her own burden. In every province and every State, insect surveys should be conducted, museums for insect collections and insect study established, Indian universities should come forward to take their full share in entomological development. An Entomological Society of India and an entomological journal are also needed.

RACIAL COMPOSITION OF THE HINDUKUSH TRIBES

DR. B. S. Guha in his presidential address to the Anthropological Section discussed the racial composition of the Hindukush tribes.

The region south of the Hindukush and Karakorum Mountains occupies a strategic position in the racial geography of India, for in these difficult, high mountainous valleys are still sheltered some of the remnants of the northern steppe folk who invaded India in the second millennium B.C.

Linguistically the tribes living in this area can be classified under two heads, namely, Dardic and Burushaski, with Kaffiri occupying an intermediate position between Iranian and Indian. Burushaski is unrelated to any known language; but Morgenstierne's investigations have shown the essentially Indian character of the Dardic and even the Kaffiri languages.

The earliest investigations on the somatic characters of these interesting tribes were those of Ujfalvy, followed by Stein, Dainelli and B. S. Guha, who, as a member of the scientific expedition sent by the Government of India, visited Kaffristan and Chitral in 1929.

From a careful consideration of physical characters, it appears that the basic racial type in the entire region is a short, dark dolichocephalic strain with prominent long nose, often aquiline, which might be regarded as a variant of Eugen Fischer's *Oriental race* and the most characteristic type of the region.

Besides this principal type, there is the southern extension of a broad-headed race closely allied to what is known as the *Dinaric race* of eastern Europe. In its strongest form it is found among the Khos of the Chitral valley and the Burushos of Hunza Nagir, though it occurs throughout the Dardic tribes in varying degrees. The skin colour in this race is prevailingly of a rosy white tint, but the eyes are more often hazel and green, and the colour of the hair is brown.

The third main racial strain is a tall dolichocephalic type with long and straight nose. It forms a very important layer among the Kaffir and the upper stratum of the Burusho and the Dardic tribes. The distribution of the cephalic index in this type follows the same trend as found by Ariens Kappers in the races of the Aral Caspian regions and very similar to that which forms the dominant element in the northern European population, from whom its chief distinction lies in the integumentary colours. Whereas in Sweden the blond type represents 49 per cent of the population, among the Kaffirs it does not exceed 15 per cent. Blondness, as is well known, is due to a deficiency mutation which suppresses the appearance of pigment. It is certain that this deficiency mutation has occurred in this and at least in another, namely, the *East-Baltic race*, at some time or other. It is probable that the mutations for skin, hair and eye colours have taken place separately. In the Baltic tribes, the high rate of the deficiency mutation might probably account for the larger percentage of the blond as compared to the Hindukush tribes, among whom the activators are perhaps dominant over suppression, causing the general persistence of the more pigmented people.

Lastly, an intruding Mongoloid element must also be responsible for the yellowish tint in the skin colour and broad flat nose found among many individuals.

The proportions of these strains vary in different parts. The Dinaric and the Proto-Nordic elements are stronger in the western valleys, whereas the basic Oriental and the Mongoloid elements are more conspicuous in the eastern valleys of the Upper Indus.

Breeding Investigations in the Sugar-Cane

Hybridization in and with the genus *Saccharum* formed the topic of Rao Bahadur T. S. Venkatraman's presidential address to the Section of Agriculture. Hybridization in the sugar-cane at the Imperial Sugar-cane Station at Coimbatore represents the first attempt to improve the subtropical types of canes. This genetical work, which has been going on at the Station for more than twenty-five years, has involved six species of *Saccharum* and four genera. There appear to be two distinct groups of wild species of *Saccharum*, both of which are confined to south-east Asia. Some of the wild species show wide variations. For example, a survey of the Indian wild species, *S. spontaneum*, showed a variation in sugar content of the juice from 0·5 per cent to 17·0 per cent, the latter figure being higher than that of certain cultivated Indian canes.

The Indian canes belonging to the species *S. barberi* are cultivated in subtropical India, though some are found farther south. Certain Indian canes cannot be ascribed to the genus *Saccharum*, the most important being the Mungo group of Dr. Barber.

A wide range of forms is known to arise from sugar-cane seed. This is explained by the heterozygous nature of the parents and the fact that most sugar-canes in cultivation are polyploid; for example, *S. offinarum* is octoploid.

Very little in-breeding has taken place in the sugar-cane, but much work has been done on inter-varietal, inter-specific and even inter-generic hybridization. Inter-varietal hybridization has been confined mostly to *S. officinarum*. At Coimbatore, economically important inter-specific hybrids have been obtained from *S. officinarum* × *S. spontaneum*. In Australia and Hawaii, *S. robustum* is being used for producing hardier seedlings for tropical regions.

At Coimbatore, inter-generic hybridization has been carried out, using such genera as *Sorghum* and *Bambusa*. The *Sorghum* cross was introduced to produce a shorter life-cycle which in the sugar-cane is from twelve to even twenty-four months. Hybrids producing a crop in seven months have been produced, and these have had high quality juices. Growth vigour in these, however, has proved disappointing. Crossing with the bamboo (*Bambusa*) has been introduced in order to obtain greater vigour, but experimental work has not proceeded far enough yet to justify definite conclusions, from the economic point of view.

The previously mentioned inter-generic hybrids have shown some interesting phenomena with regard to the manner in which the characters are shown in the F_1 generation and transmitted in further back-crosses with either parent. In both the *Sorghum* and *Bambusa* hybrids with sugar-cane, the one fact that stands out prominently is the general dominance of *Saccharum* characters in the F_1 generation.

In the case of *Saccharum* × *Sorghum* hybrids, the general dominance of *Saccharum* characters was found to persist even after twice back-crossing the hybrids with their *Sorghum* parent. Certain of the *Sorghum* hybrids exhibited morphological characters not found in either parent. Most of these hybrids were infertile in their first generation. On further vegetative propagation, however, some of them are showing an increasing fertility in the sexual organs with the result that, whereas in the earlier years no seeds could be obtained from these, it has since been possible to raise seedlings in large numbers from some of them and also to back-cross them with the two parents.

[*To be continued.*]

The Prehistoric People of Palestine*

By Sir Arthur Keith, F.R.S.

THE fossil remains of the earliest inhabitants of Palestine were discovered in caves of Mount Carmel by an expedition led by Miss Dorothy Garrod, and financed by two societies—the British School of Archæology in Jerusalem and the American School of Prehistoric Research. The early Palestinians were quite unlike any people now living, but are of profound interest, because, if not our actual ancestors, they are certainly near akin to the human stock which in the course of time gave the world its Caucasian or white inhabitants. Hitherto our search for the fossil ancestor of the white man has been in vain. Everyone is familiar with the place held by Palestine in our conception of human life at the dawn of history; the excavations made at Mount Carmel by Miss Garrod are destined to give that small country in the East an equally important place in our picture of man's prehistoric world.

What the expedition found was this. Man began to inhabit the caves of Mount Carmel long before the onset of the last glaciation of Europe. One cave from an archæologist's point of view is the richest ever opened; it was filled with fossiliferous earth tramped down by the feet of prehistoric man, until an accumulation more than 80 feet in depth had been formed. From bottom to top the strata were pregnant with man's stone tools, with the fossil bones of animals—many of them of extinct species, and with the bones of the men and women who fashioned and used the tools. It is no exaggeration to say that these deposits record the history of man in Palestine for a period of at least 100,000 years; the period may be longer; the future is not likely to prove that it was shorter. The strata begin while man is still in an early stage of stone culture; they leave off about the time of Abraham. There is no need to tell how each stratum has been made a page of history; the story is told by Miss Dorothy Garrod and Miss Dorothea Bate in a volume just issued by the Oxford University Press [see p. 304 of this issue].

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* Substance of a lecture given by Sir Arthur Keith at the Royal College of Surgeons on February 14.

Hitherto we have had to build our knowledge of prehistoric man out of fossil scraps. At Mount Carmel complete skeletons were found; one small cave, excavated by Mr. T. D. McCown of the American School, proved to be a veritable cemetery; fossil remains of ten individuals were found in it—three of them complete skeletons—the others were disturbed burials. Altogether we know thirteen of the fossil Carmelites by name or number. We have become familiar with all of them. Four are children, all the adults are less than fifty years of age, save one. Only one had turned fifty at the time of death. The expectation of life was not good among these early inhabitants of Palestine.

We owe so complete a representation of this prehistoric community to certain circumstances: (1) the careful way in which the dead had been buried; (2) to the fact that Mount Carmel is composed of limestone, and limestone tends to the preservation of bones better than any other rock. If the limestone helped to preserve the Carmelite bones, it also made their extraction a matter of extreme difficulty. Mr. McCown, realizing the impossibility of removing the bones piecemeal in the cave, cut out the bone-containing breccia—hard as cement—in blocks weighing a ton or more, and had them conveyed from the slopes of Mount Carmel to the Museum of the Royal College of Surgeons in Lincoln's Inn Fields, London. The rougher work of extraction was done at the Museum but the finer work, including restoration, examination, comparison, drawing and photography of the various bones were done, by permission of the President and Council of the College of Surgeons, at the Buckston Browne Research Farm, Downe, where, within sight of Darwin's old home, Mr. McCown and I restored the old Palestinians to life—or as near to their living state as is now possible. Mr. McCown and I began our task in the autumn of 1933; the final account of what we had done and seen was drawn up for publication at the end of 1937. Thanks to Dr. J. Beattie, conservator of the Museum of the Royal College of Surgeons, our task was made easy.

What kind of people were those early dwellers on Mount Carmel? The Bible records in the book of Genesis that before the flood "there were giants in the land". The fossil people we are now dealing with are almost worthy of such a name. The men were tall; four of them range in height from 5 ft. 8 in. to 5 ft. 11 in. The women, on the other hand, were of short stature, varying from 5 ft. to 5 ft. 4 in. We have been able to study every bone of the feet, hands and limbs of this ancient people; they had straight and strong limbs, walking and running as we do, and yet every bone differs in detail from our bones. Their chests were ample; we infer they were runners and long-winded. We have studied their spinal columns; their vertebræ still retain certain simian details in their conformation. It is so with the bones of their hands and arms; in certain points they are peculiar. We have been able to measure their heads and in some cases to take casts of their skull cavities and thus obtain a crude picture of the conformation of their brains. Although the fossil men of Mount Carmel are separated from us in time by the space of a whole glacial epoch, yet in point of size they had already brains which were equal to ours, although as regards convolutionary pattern, theirs were the simpler. The muscles of their tongues were attached to their lower jaws as ours are; all the parts of the brain which indicate a capacity for speech were present.

In their anatomy they still retained many primitive marks. Their eyebrow ridges, like those of the gorilla, form great bars of bone above the orbits; their jaws are massive; their mouth cavities were very much more capacious than ours. Their necks were thick and exceedingly strong.

Nowhere in the world of to-day could there be found a local group of people showing the wide range of structural variation of our fossil Palestinians. Chins were at every stage of evolution—from a chinless stage comparable to that of the chimpanzee, to chins of moderate development. One of the most distinctive of human features is the nose; in nose-form, the Palestinians were not uniform; in one the size of the bridge and general prominence might well be the prototype of the Roman nose; in another, an opposite condition—almost negroid—prevailed. We found it possible to arrange the individuals of the group in a series; at one end, a woman had her closest affinities to the very primitive Neanderthal type of Europe; at the other end of the series, a man known to us as Skhūl IV might be a crude form of an early European. We seem to be dealing at Mount Carmel with a plastic folk in the throes of evolutionary change.

To fit the fossil Palestinians into their place in our picture of ancient humanity we have to think geographically. We now know that before the last glacial epoch set in, Europe was inhabited solely by peoples of the Neanderthal type; their fossil remains have been found as far west as the Island of Jersey and as far East as the Crimea. As we go eastwards, the type approximates somewhat to that which we have now found in Palestine. In Mount Carmel we have a people whose date is earlier, not later than that of the Neanderthalians of Europe. Our Mount Carmel people have many points of resemblance to the Neanderthalians of Europe, and yet in many they differ. In those points wherein the Palestinians differ from the Neanderthalians, they are Caucasian or modern.

Have we, then, reached the homeland of Europeans in Palestine—the Eden in which Neanderthal man evolved into man of the modern type? That is not the inference Mr. McCown and I are inclined to draw; we believe that, as research is carried further into Western Asia, we shall find the fossil remains of men who have still less of the Neanderthalians in them and more of us moderns than is the case at Mount Carmel.

The first glimpse we have in Europe of the early Caucasians or 'whites' is obtained when the crisis of the last glaciation was passing. They then appear in South Europe as Cromagnons and in central Europe as Predmostians. Hitherto we did not know whence these early representatives of our type had come. The discovery at Mount Carmel suggests that we shall find their homeland in Western Asia. Our tall men of Mount Carmel have many structural points in common with the tall Cromagnon. History, it is said, repeats itself; the Cromagnons blazed the trail from Asia to Europe; the ancient Palestinians may not be the ancestors of the Cromagnons but only distant relatives; at a much later date, Western Asia gave Europe its forms of speech and also, we presume, the primitive speakers of the Aryan tongue.

The most surprising result of the excavation of the caves of Mount Carmel is the light thrown on the mentality of early stone-age mankind. Care of the dead is one of the hall-marks of humanity. The Mount Carmel people had a care for their dead. The youngest child was placed in its grave in a sitting position with limbs flexed under the trunk and arms folded. The tallest of the men had in his embrace the fossil jaw of a boar; we do not suppose it was in a fossil state when placed in his dead arms; we suppose it carried with it a meal of which he had been fond—a pig's tongue. We must also suppose that those who placed the supply of food in the grave beside him believed that death was not the end of life. Even thus early man seems to have softened the blow of death with a hope of immortality.

Another very unexpected discovery was this. When the hip joint of one of the men was cleared of limestone breccia, it was found to be shivered. On closer examination a perforation was found at the centre of the injury, filled in with cave earth. When the earth was removed from the perforation of femur and pelvis and a cast taken of it, we had before us the image of a four-side spear-head. We did not know that such weapons had been invented at so early a date; we believed that the only fighting weapons possessed by men then were stone clubs. A spear to penetrate the whole thickness of the hip joint of a large-framed man and to enter the pelvis as this weapon did must have been finely tempered and driven with exceeding force.

Science News a Century Ago

Solidification of Carbonic Acid

QUOTING from the *Scotsman*, the *Mechanics' Magazine* of February 24, 1838, said: "Mr. Kemp, of Edinburgh, who has been so successful in his experiments upon the liquefaction of the gases, has succeeded in reducing carbonic acid gas to the solid state. This experiment, which had been previously shown in Dr. Hope's class-room, Mr. Kemp exhibited before the Wernerian Society at their last meeting, in the presence of Professors Jameson, Forbes, Graham, Trail, Welsh, Pillans, Dr. Neill, and a number of other scientific gentlemen. The gas requires a pressure of thirty-six atmospheres to reduce it to the liquid form. When the pressure was removed by opening a small stopcock on the condensing apparatus, the cold, produced by the rapid evaporation of the liquid, was so great, that the whole mass was almost instantly reduced to the solid state; and in this condition, although the temperature could not have been less than 180 degrees below zero Fahrenheit, it was handled and tasted by many of the gentlemen present. . . . This is the first time that the solidification of carbonic acid has been accomplished in Great Britain. Many important results may be expected to accrue from it . . . there can be no doubt, that any liquid may be frozen by it, and it will be a powerful agent in producing the condensation of those gases which have hitherto resisted all attempts to reduce them to their liquid form."

Kenneth Kemp, who for some years assisted the professor of chemistry, Thomas Charles Hope (1766–1844), died in 1843 at the early age of thirty-six years.

Reform of the Patent Law

IN the issue of *The Railway Magazine and Annals of Science* of February 1838, is a contribution by Mr. J. Hacket entitled "Suggestions on a New System of Granting Patents for Inventions". After a brief review of the Patent Law at that time and the disabilities inventors suffered from and the loss to society through the discouraging effects of the system which then prevailed, the writer went on to say that nothing short of a new system based upon a new principle was required. "The only measure that I can conceive," he said, "calculated to produce the beneficial effects so much required, is a national institution, in which are a number of suitable apartments, with models, plans and specifications of the most useful machines, manufactures, etc., now in use, patented and unpatented, classed in proper order—over each department in the proposed national establishment, persons suitably qualified should be appointed to arrange in order, protect from injury, and be accountable for every model, plan and specification committed to their charge." Individuals desirous of obtaining a patent were to send notice to the secretary of the institution and, on the receipt of the plans and specifications and a fee of £1, protection was to be obtained for one year. At the expiration of this year, or the patent being put into operation, £5 annually was to be paid.

Wind Measurements at Birmingham

IN a letter published in the *Athenæum* of February 24, 1838, Mr. William Ick, the curator of the Birmingham Philosophical Institution, gave some observations made with a self-recording anemometer and a rain gauge. In a violent gale on December 18, 1837, he said, which continued without intermission for 14 hours, the anemometer registered the highest force of the wind as 16½ pounds on the square foot. This gale was exceeded on December 20 when the highest pressure recorded was 21¼ pounds. Other records were taken on January 2 and February 9, 12 and 15 of 1838. "I shall offer no comments on these facts," he added. "The British Association have voted a sum for the erection of an anemometer at Plymouth, and Mr. Osler has very nearly completed the instrument. If another were erected in the northern part of the island, and several others in distant stations judiciously chosen, in the continents of Europe and America, a comparison of the results might in a few years furnish important information respecting the laws which regulate the force and direction of aerial currents and their influence on temperature, humidity, etc."

The inventor of the anemometer to which Mr. Ick referred was Abraham Follet Osler, who was born in Birmingham on March 22, 1808, and succeeded to the glass-making business of his father, which he carried on until 1876. His self-registering meteorological instruments were installed at Greenwich and elsewhere. He was elected fellow of the Royal Society in 1855 and died at Edgbaston on April 26, 1903.

Societies and Academies

Edinburgh

Royal Society, January 10.

A. B. Wildman and J. Manby: The hairs of the Monotremata, with special reference to their cuticular scale pattern. An improved technique for the examination of cuticular scale margins is described and the sequences of scale form along the fibres are discussed and demonstrated photographically. The sequence on the shield-hair of *Ornithorhynchus* is unique and in this, as in other characteristics, the shield possesses a marked bilateral symmetry. Those tail fibres, which possess no shaft portion, correspond to the shields of the more typical shield-fibres. Support is given to the view that the shields constitute a remnant of a more primitive spinous coat. The authors indicate that changes in scale-form along the fibre are innate and are not caused by attrition.

A. Graham: The structure and function of the alimentary canal of æolid molluscs, with a discussion on their nematocysts. The anatomy, histology and physiology of the alimentary tract of four species of æolid molluscs are described. The digestive gland secretes enzymes, digestion occurs in its ducts and in the stomach. Soluble food is absorbed in these positions and in the gland where particles of food are also ingested. Mucus from buccal and pedal glands secreted over the food appears to prevent the discharge of nematocysts; those stored in the cerata are exploded by mechanical means.

Mary G. Calder: Some undescribed species from the Lower Carboniferous flora of Berwickshire; together with a note on the genus *Stenomyelon* Kidston. Two new species of petrified seeds are described: *Calymmatotheca kidstoni* is a radiospermic, cupulate seed, and *Samaropsis scotica* is a platyspermic, winged seed. *Kalymma tuediana* n.sp., a petiole probably allied to *Calamopitys*, is also described. The species *Stenomyelon tripartitum* Kidston is shown to be synonymous with *S. tuedianum* Kidston. The descriptions are based upon material from the Calciferous Sandstone Series (Cementstone Group) at various localities in Berwickshire; the material is now in the Kidston Collection in the Botany Department of the University of Glasgow.

H. Merton: Studies on reproduction in the albino mouse. (1) The period of gestation and the time of parturition. With the help of a self-recording balance, constructed after the principle of a letter-scale and connected with a kymograph, the hour of parturition can be fairly accurately determined. Two-thirds of the births took place between 4 p.m. and 4 a.m. Of 90 females, 84 were fertilized within 4 days after being placed with a male: they therefore showed a very regular cycle of 4–5 days. The methods are described which can be used to predict the day of birth. The average size of 504 recorded litters during the year was 7·0, the largest (8·3) occurring in August.

Paris

Academy of Sciences, December 27 (*C.R.*, 205, 1333–1476)*.

Mme. Léone Walter-Lévy: Neutral magnesium chlorocarbonate.

Alexandre Travers and Hamid Zahabi: The preparation of the hexahydrate of tricalcium aluminate.

Mme. Pauline Ramart-Lucas: The structure and absorption of colouring matters. Isomeric forms of fluoresceine.

Marc Tiffeneau and Bianca Tchoubar: The removal of halogen by silver from the iodhydrines of the α-cyclanediols.

Mme. Yvonne Khouvine and Yoshinobi Tomoda: The total acetylation and methylation of α-d-tagatose.

Henry Gault and Jean Burkhard: A partial synthesis of methyl-cyclopentenolone from wood tar.

Daniel Bodroux and René Thomassin: Syntheses effected with p-cyclohexylbenzyl chloride.

Louis Royer: The orientation of certain alkaline halides by calcite.

Jean Gubler: The structural and palæogeographical unities between Fez and Le Sebou (Northern Morocco).

Georges Choubert: The Lias of the eastern Haut-Atlas and of the Hauts-Plateaux.

Jean Sagatzky: The Tarkwaïen system in Ex-Haute-Volta.

Raymond Jouaust, Robert Bureau and Louis Eblé: The sudden disappearance of radio-electric waves, their relations with magnetic and solar phenomena. From a study of a year's data, it is concluded that chromospheric eruptions cause sudden disappearance of radio-electric waves and, at the same time, small local magnetic disturbances are produced, the latter differing from magnetic storms.

Pierre Dangeard: The presence of pyrenoids in some species of *Vaucheria*.

Jacques Rabaté and Jean Dussy: A new holodiglucoside extracted from sophoraflavonoloside.

Victor Plouvier: The presence of amygdonitril-glucoside in the genus *Cotoneaster* and some other Rosaceæ.

Emile Miège: The baking qualities of *Triticum*, of *Ægilops* and of their hybrids.

Joseph Lefèvre: Some effects observed as the result of the treatment of seeds and cuttings with various substances and especially with heteroauxin.

André Hollande: Amœbæ of the limax type, in their relations with flagellates.

Pierre Drach: The origin of the limestone in the tegumentary skeleton of the crustacean Decapods.

Daniel Auger: The stimulation of an internode of *Nitella* by the current of action of a contiguous inter-node, latent addition.

Marius Piéry, Jean Enselme and Mlle. Simone Pettel: Researches concerning the influence of mineral waters on tissue respiration. The constitution of a system of research by means of Warburg's technique.

Raymond-Hamet: The physiological activity of pure gelsemine.

Mlle. Marie Thérèse Regnier: The action of the sexual hormones on the inversion of sex in *Xiphophorus helleri*.

Albert Raynaud: The histological study of the genital tract of female mice transformed experimentally into free-martins.

Jaques Monod: Maintenance ration and growth ration in bacterial populations.

René Catala: The influence of thermal agents on the nymphosis of the larvæ of *Chrysiridia madagascariensis*.

Mme. Nadine Dobrovolskaia-Zavadskaia: The appearance of a new *culbute* mutation in two different strains of mice.

François Artigas: The absorption by thin screens of the radiation of potassium sulphate and of plant ashes.

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* *Continued from p.* 300.

Georges Brooks: The determination of the fluorescence spectra of ash isolated from the tissues of *Rana esculenta*.

Lazare Silberstein: The action of chloropicrin on the vitamin B_1 contained in wheat. Chloropicrin is increasingly used for the destruction of insects in cereals: experiments on pigeons show that vitamin B_1 in wheat is unaffected by this chemical.

Mme. Yvonne Jérôme-Lévy: The acetic fermentation in the presence of charcoal. In the presence of charcoal the production of acetic acid is accelerated, and the quantity produced is also higher.

Auguste Cuénod and Roger Nataf: The polymorphism of *Rickettsies* of the trachome.

Arthur Vernes, Robert Bricq and Mlle. Andrée Gager: New considerations on the pallidine of syphilitic sera.

Calcutta

National Institute of Sciences of India, January 9.

Symposium on River Physics in India.

D. N. Wadia: Changes in the courses of Indian rivers during the latest geological epoch.

Sunder Lal Hora: Changes in the drainage of India, as evidenced by the distribution of freshwater fishes.

C. C. Inglis: The use of models for elucidating flow problems based on experience gained in carrying out model experiments at the Hydrodynamic Research Station, Poona.

Gerald Lacey: The flow of water in alluvial channels.

Kanwar Sain: The effects of the construction of weirs and weir-controlled canals on the regimes of the Punjab rivers.

A. N. Khosla: Design of weirs on permeable foundations.

N. K. Bose: River physics laboratories of Europe and America.

S. C. Majumdar: River problems in Bengal.

P. C. Mahalanobis: River floods in Orissa.

Cracow

Polish Academy of Science and Letters, December 6.

Mlle. L. Stankiewicz: The arithmetical operations in the numerical solution of a system of linear equations according to the methods of Banachiewicz.

W. Swietoslawski, L. Keffler and J. Salcewicz: Contribution to the study of the quantity of heat evolved in the internal transformation of a block of lead produced by the action of its own weight. The authors prove the existence of a thermal effect of the order of $0 \cdot 4 \times 10^{-4}$ to $0 \cdot 2 \times 10^{-4}$ calories per gram per hour. When massive blocks of lead are used for measuring the heat given off by radioactive elements, this phenomenon must be taken into account.

J. Moszew: Syntheses of compounds of the type 2′-phenyl-3′, 4′, 2, 3-quinolinoquinoline.

St. Kreutz: The metamorphosis of the amphibolite rocks of the Tatra.

L. Chrobak: Pegmatites and granites containing molybdenite of the western Tatra.

J. Wojciechowski and Mlle. L. Skrobinska: The action of the hydrogen ion concentration on the chemotropism produced by phosphates.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Monday, February 21

Imperial College of Science (Chemistry Lecture Theatre), at 5.15.—Prof. W. P. Jorissen: "Reactions in Gaseous and Solid Mixtures".*

Royal Geographical Society, at 8.30.—A. Stephenson and the Rev. Lancelot Fleming: "King George the Sixth Sound".

Wednesday, February 23

Society for the Study of Alchemy and Early Chemistry, at 8.—R. B. Pilcher: "Alchemists' Apparatus in Art".

Royal Society of Arts, at 8.15.—Oscar Borer: "Reclamation of Tidal Lands".

Friday, February 25

Royal Institution, at 9.—Prof. D. M. S. Watson, F.R.S.: "Pterodactyls Past and Present".

Association of Technical Institutions, February 25–26.—Annual General Meeting to be held in the Haberdashers Hall, Gresham Street, London, E.C.2.

February 25, at 11 a.m.—Sir Robert Pickard, F.R.S.: Presidential Address.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Lecturer in Engineering in the East London Technical College, South Africa—The High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (March 4).

University Demonstrator in Engineering—The Secretary of the Appointments Committee, Engineering Laboratory, Cambridge (March 9).

Lecturer in Anatomy in the University of Belfast—The Secretary.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Report of the Little Owl Food Inquiry, 1936–37. Organised by the British Trust for Ornithology. By Alice Hibbert-Ware. Pp. 74+8 plates. (London: H. F. and G. Witherby, Ltd.) 3*s*. 6*d*. net. [201

Leeds University. Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing during the Session 1936–37. Pp. 24. (Leeds: The University.) [201

University College of Wales, Aberystwyth. Leaflet Series S, No. 4: New Varieties and Strains from the Welsh Plant Breeding Station—Two New Varieties of Oats. S84, Spring Oats for Soils of High Productive Capacity; S175, Spring Oats for Soils of Medium Productive Capacity; and Notes relative to the Cultivation of Ceirch Llwyd Cwta (S171) and relative to the Selection of Varieties. Pp. 23+8 plates. (Aberystwyth: Welsh Plant Breeding Station.) 1*s*. [211

University of London: Institute of Education. The Teaching of Mathematics: a Bibliography. By Max Black. Pp. 14. (London: Christophers) 6*d*. [251

Other Countries

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 17, 1935. vi. Aerologiska Iakttagelser i Sverige, 1934–1935. Pp. 10. 3.00 kr. Meddelanden, Serien Uppsatser. No. 16: Luminous Efficiency of Solar Radiation. By T. E. Aurén. Pp. 24. 1.50 kr. Nr. 20: Några aktinometrars egenskaper med hänsyn til mätning av artificiell strålning i samband med vaxtodling. Av Gosta Köhler. Pp. 98. 3.00 kr. No. 21: Hydrologisk bibliografi åren 1935 och 1936, Sverige, årgångar 2 och 3. Pp. 14. 1.00 kr. No. 23: Actinometric Measurements near Stockholm, 1930–1936. By Anders Ångstrom. Pp. 28. 2.00 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [211

Science and Reality. Pp. 28. (Calcutta: Science and Reality.) [251

Mitteilungen der Prähistorischen Kommission der Akademie der Wissenschaften. Band 3, Nr. 1–3: Untersuchungen im Bergbaugebiete Kelchalpe bei Kitzbuhel, Tirol. Von Ernst Preuschen und Richard Pittioni. Pp. 160+39 plates. (Wien: Holder-Pichler-Rempsky A G.) [251

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The Scientific Value of Expeditions

THE rescue of the Soviet scientific workers from their drifting ice-floe by the use of two ice-breakers brings to an end one of the most striking polar expeditions of recent years, and one that it is confidently believed will be of considerable scientific value. Any sensational character that this venture may have had was due not to an attempt to accomplish a difficult and hazardous feat as an exhibition of mere physical prowess but to the necessity of adopting a dangerous mode of investigation where no other was available. The inner Arctic regions, which may be taken to embrace all that area of the Arctic Ocean north of the continental shelves of the surrounding continents, has for long defied penetration. Until near the end of the nineteenth century, many attempts had been made to force ships northwards into the pack-ice; but all failed. Other attempts had taken the shape of sledging northwards over the ice from a base as far north as sea access allowed. These attempts were equally fruitless. While such attempts were laudable in an age when the outlines of the distribution of land in high latitudes were unknown, they were nearly always devoid of real scientific inspiration. The nineteenth century tended to measure the worth of exploration by the hardship and danger encountered rather than by additions to knowledge. Thus it substituted for the earlier centuries' motives of commercial gain an aim that was less material but not of higher benefit to man.

It was Nansen who in 1893 realized that to battle with the drifting pack was to play a losing game and that the only sensible course to pursue was to take advantage of its drift—not to move or try to move against the ice but with it. Thus he conceived and carried out his expedition in the *Fram*. On the results of this expedition are based by far the greater part of our knowledge of inner polar regions. Since then, no explorer has emulated Nansen. It is true that several explorers both by sledge and by air have reached or crossed the North Pole, but not one of them has made any considerable additions to our knowledge of high northern latitudes. Hurried journeys, especially at the speed of air travel, have not proved very valuable in scientific investigation. Even broad outlines of the lie of land may give an erroneous impression from the air, as the recent British Graham Land expedition has shown in correcting the aerial surveys of Sir H. Wilkins in the Antarctic. Ground work and sea work remain essential to serious exploration.

The Soviet authorities, in planning this recent expedition, followed Nansen's idea of using the drift of the ice, but by using air transport they were able to begin at the Pole instead of attempting to drift there. The Pole itself had no particular value as a starting-point, but some objective was necessary, and the Pole has a certain lure. The four members of the expedition had few duties to perform outside their scientific work: no energy was dissipated in difficult travelling. All their time was devoted to observation, and as a result we can look forward to a series of meteorological observations taken in high latitudes throughout some nine months. This in itself will be an invaluable contribution to the study of Arctic air currents and all that depends on them. In addition, the observers took regular soundings of the ocean, which will throw light on the position and extent of the submarine ridge which appears to connect Spitsbergen with northern Greenland and probably marks the line of Caledonian folds.

There should also be important observations in the winter phases of plankton and on the physics of the ocean water below the ice, such as the charting of the intermediate warm layer of Atlantic water and its relation to ice formation and wastage The movements of the Soviet floe show a current from Siberia to Greenland, as indicated by the drift of the *Fram*, but as there was no tendency for the floe to be swept towards the north coast of Greenland the drift seems to lack the circulatory motion with which it was often associated. The rate of movement of the floe will determine the rate of the current and the rate of overflow of Arctic water to the Atlantic All these and other observations, not to omit those on magnetism, will amplify the records of the *Fram*, which alone of previous expeditions threw light on these and cognate problems.

Men of science owe a debt of gratitude to these daring Soviet observers and also to the enterprise and sound organization of their rescuers. The Soviet Union has certainly shown extraordinary enterprise and insight in their exploration of Soviet and adjoining polar regions in recent years, and it is much to be hoped that the observations of the drifting station as well as those of the many Soviet observations on land in high latitudes will be readily and soon available to science.

Such a scale of investigation may be beyond the resources or perhaps one should say outside the conception of countries organized on different economic systems. Private enterprise in Great Britain has rarely shown great devotion to exploration without news value and has certainly been diffident about the publication of scientific results. One would like to note a greater tendency to appoint competent observers to the staffs of exploring expeditions. Such expeditions cost much and a great deal of that cost is unwisely spent if the sole results are to be the attainment of records. It is much to be hoped that the scientific side of expeditions, not only from Great Britain but also from other countries, will be strengthened in future along lines suggested by the Soviet Arctic Expedition, which has reached such a happy conclusion.

Lucretius

(1) Lucretius, Poet and Philosopher

By E. E. Sikes. Pp. ix + 187. (Cambridge: At the University Press, 1936.) 7*s*. 6*d*. net.

(2) Lucretius: De Rerum Natura

Translated by R. C. Trevelyan. Pp. xv + 295. (Cambridge. At the University Press, 1937.) 8*s* 6*d* net.

(1) IN view of the small compass of Mr Sikes's book and the steadiness with which the author keeps his object before him throughout, it would be difficult to over-praise his achievement. It is certainly the best and most attractive presentation of the poet which we have in English, and, that being so, its small compass is a strong additional recommendation. Here we have the background and the spirit of Lucretius faithfully described, and in Mr. Trevelyan's book, which Cambridge has also lately published, we have the poems themselves excellently translated. Cambridge has done herself great credit and conferred a signal service on English scholarship and learning by these two works. But in the case of Mr. Sikes's book, 'learning' must be understood in the widest and wisest sense. He gives us not only a mature and well-balanced account of the poem of Lucretius in relation to Greek and Roman writers, but also he estimates—very judiciously on the whole—the origin, truth and permanence of the scientific moral and religious thought which it contains This side of Lucretius will interest us most in these pages; it will probably always be regarded as the most abiding element in his work, however highly we may rate its poetic merits.

Our view, then, in this notice will be rather the converse of that which Macaulay is recorded to have expressed in the marginalia of the Lucretius which he read on his voyage to India. To him the poetry was often "neat and clear" and sometimes even "sublime beyond any passage of the kind in poetry". But the thoughts expressed were "drivelling", "wretched reasoning" or "contemptible nonsense". It would be strange if a writer, capable of the most sublime passages in poetry, were at the same time constantly falling into contemptible nonsense in his thought. The true judgment is much more balanced, though one might go a little farther than Mr. Sikes does in recognizing the "anticipatory" character of the scientific thought embodied in Lucretius. If, as Mr. Sikes admits, "the principles of Greek Atomism satisfied not only Gassendi but Newton", it is surely going too far to say, as he does in the next sentence, that to "look for anticipations of the present day in the Democritean system is misleading". No doubt the modern thinker, with his trained power of observation and his elaborate machinery for measuring and recording results, stands in a quite different position from the old Greek with his unrivalled power of guessing. But the guess has its anticipatory value. The Greeks made men think and examine all the problems of the material world and life.

It is impossible to deny, and easy to underestimate, the intellectual stimulus of such pioneer work. Two great realms of the Epicurean thought, presented by Lucretius, stand out as examples of this, one in which we are now re-interpreting our definitions, another in which we have widely extended our field without disturbing the foundations on which it rests. The first is that conviction of a reign of law throughout the physical world on which the whole school of Democritus, Epicurus and Lucretius laid so much stress. It surely is not true, as Mr. Sikes suggests, that a quite different 'law'—of chance—has now taken the place of this belief in the uniformity of Nature. The law remains, and is in fact more universally observed than ever, as the basis both of our reasoning and our action. But, logically, we have been compelled to re-interpret it differently, by observing that when we reach a certain point in our examination of the infinitesimal, the law of uniformity escapes us and we are driven to take refuge in the idea of the levelling out of differences by a law of uniformity in the whole or the average. It is well known that Max Planck, to whom we owe the quantum theory, is himself one of the stoutest in re-affirming in a new sense the reign of law, and it is almost needless to add that no well-thought-out action, based on science, has been affected by the supposed vagaries of the infinitesimals of our thought.

On the other great department of Epicurean thought there is less to be said by way of re-interpretation, though much more by way of expansion and of deepening its import. This is given in Lucretius's first sketch of anthropology and of the progress of man from the savage to civilization. He is here, as elsewhere, building on the knowledge and thought of the Greeks, who for centuries had been open-minded and curious travellers in all the lands which surrounded them. He gives us at the end of his fifth book a well-knit summary of the result. There is, of course, no trace in it of any idea that man arose from a lower animal form. Lucretius will not hear of any mixed breeding between man and beast and, like a good rationalist, scoffs at the stories of the Centaurs. But on the subject of man's rise as man, he hits on the truth again and again with the insight of a poet enlightened by science. These five hundred lines are one of the marvels of literature and well repay repeated study. The origin of speech, its kinship with gesture, the discovery of fire from lightning, the birth of gods in dreams, the first working of metals, the development of the cultivation of the soil and the later blossoming of ships, laws, walled cities, pictures, statues and all the pleasures of civilization—these all find their place and they are explained much as our fuller knowledge of to-day would explain them. He actually winds up with the first known use of the word 'progress', as denoting the advance of the active mind of man.

It should be added that Mr. Sikes is at his best in appreciating the poetic worth and affiliations of his subject. Lucretius was no mere rhymester of a materialist philosophy but a great and moving poet, himself often moved by, and often using, the imaginative fictions which he would not admit as science. Virgil knew, studied and loved him. It was he in the "Georgics", "felix qui potuit rerum cognoscere causas", and to him may be applied in the fullest sense Longinus's definition of poetry, as amended by Matthew Arnold—"A great subject made great by the greatness of the poet's mind".

(2) It is in this spirit that Mr. R. C. Trevelyan has carried out his labour of more than twenty years in completing a verse translation of the "De Rerum Natura" and publishing it with a modest and most attractive introduction and an appendix by Mr. H. Sykes Davies on Macaulay's 'marginalia' to his copy of Lucretius. This has happily survived and makes most amusing reading. Macaulay evidently unburdened his philosophic soul by these solitary scribblings, much as the Kaiser Wilhelm did on his State-papers, though with less danger to the peace of society. They are very neatly summarized and countered in Mr. Sykes Davies's essay. It adds greatly to the interest of the volume, which will undoubtedly become the standard version of Lucretius in English.

No doubt there are some awkward lines, places where Mr. Sikes and others have done better than Mr. Trevelyan. But these are inevitable and quite subordinate to the general excellence of the whole. It reads as an original and is so readable that it should add many thousands to the number of those who know and appreciate the most remarkable literary relic of ancient Rome, one of the most remarkable of all antiquity.

In language, of course, Virgil is more finished, and for poetry, pathos and charm, much in Greek takes a higher place. But there is nothing in which are combined so much deep thought, argument, moving passages and stately diction—certainly in Latin, possibly even in Greek. As we have seen, it conquered even Macaulay's detestation of its philosophy, and he read it through three times in the course of four years. Nearly all the great questions which have exercised the scientific mind in later times are here raised, often no doubt in a crude and dogmatic shape. But the argument carries one on, and Mr. Trevelyan's verses are clear and generally flowing. He uses the ten-syllabled blank verse as the most familiar of English verse-forms and also the most adaptable to expressing different shades of thought and feeling. Yet it must be said that Mr. Sikes, where he gives us some of his too rare versions of short passages, makes us wish very much for more. Here is Mr. Sikes's version of the most famous line in Lucretius:

"Such crimes could Superstition teach mankind."

That is certainly better, both for sense and sound, than Mr. Trevelyan's

"To such crimes
Religion has had power to persuade mankind."

But we are under a deep debt to them both.

F. S. MARVIN.

Entomo-Museology

Über entomologische Sammlungen (ein Beitrag zur Geschichte der Entomo-Museologie)

Von Walther Horn und Ilse Kahle. (Entomologische Beihefte aus Berlin-Dahlem, Bände 2, 3, 4). Teil 1. Pp. 160 + 16 plates. 15 gold marks. Teil 2. Pp. 161–296 + plates 17–26. 8 gold marks. Teil 3. Pp. 297–536 + plates 27–38. 10 gold marks. (Berlin: R. Friedlander und Sohn, 1935–1937).

THE completion of Dr. Walther Horn's account of entomological collections, entomologists and "entomo-museology" is a matter upon which to congratulate not only the author, but also that numerous race of museum entomologists who have already given it a hearty welcome. The work is, in fact, a revised and greatly expanded edition of the same author's "Über den Verbleib der Entomologischen Sammlungen der Welt" (Suppl. Entom., 1926 and 1929). Those combined papers occupied 182 pages; the present work fills 536 pages. A rough estimate shows that in this new volume some 6,600 entries occur, each giving a collector's name as fully as ascertainable and date of birth, and of death if not still living. This information is followed by a brief, sometimes almost laconic, statement as to the present whereabouts of the collections he formed. As those know who have had the pleasure of personal contact and correspondence with Dr. Horn, he is not only an indefatigable entomologist, but also a keen humorist; perhaps that is why he opens with "Å (Norwegian): see also under Aa"; "Aa" does not occur, except in Aall and in two "Aarons". Incidentally, the first correction in the supplement is "Å is to be deleted"—what a pity to spoil the joke.

The present whereabouts of the many collections to which Linnæus, Fabricius, Esper, Cramer and other early writers so often referred is a matter of keen concern to the serious student of systematic entomology, for without access to these it is frequently impossible to interpret many of these authors' descriptions—unless a guess can be called an interpretation. The information gathered together by Dr. Horn concerning these collections is extremely useful to his 'entomo-museologists'; the utility of some of the entries dealing with more recent collections, is, however, rather more debatable. For example, a statement that the collection of British insects formed by "Smith, H — J — (b —, d —)" was "sold at Stevens' by auction in 1872", to take an imaginary example, does not bear any clear evidence of being a fact of great scientific or even historical interest. But it is easy to criticize; far harder is it to draw the line in a compilation of this kind. In the entomological registers kept in the British Museum now for nearly a hundred years, there must be, at a chance computation, at least 50,000 entries of collections received. Should an abstract of these have been sent to Dr. Horn?

The body of the work is supported by thirty-six plates of reproductions of the handwriting, usually on a label, of a great number of well-known systematists. In museum work, the authenticity of a label is often of great importance; let us hope that these plates will help to solve many a puzzle—one scarcely dares suggest that some of the labels might conceivably have just the opposite effect! It is not until one has passed by all this, however, that the real personality of the author is discovered, for at the end of the work Dr. Horn has added a series of chapters in which he traces the evolution of museum entomology, with special reference, naturally, to Germany and Central Europe. The great names of the past, the old societies, the early publications are woven into a story of the beginnings of entomology such as only Dr. Horn could tell.

The mixture of foresight and fantasy in some of the early writings surely produced its finest blossoms (but no harvest) in Herbst, who in 1781 propounded a plan for the formation of a "German

Entomological Republic". Had the 'laws' of these 'republicans' been enforced, what an amount of labour would have been spared us; for example, descriptions were to be limited to *really* new species, had to be published in a single central journal, and be properly illustrated. One is tempted to quote much from this chapter on the old amateurs; but there is plenty of fun in the next one as well, for here Dr. Horn tells of the birth of the older national museums of Europe—London, St. Petersburg, Vienna, Paris and Berlin—and he is by no means complimentary (and justly so) about the Walkerian epoch of the British Museum. It is only in here that there does seem to be a lapse, for twenty-four pages of criticism of the reform proposals of Dr. Titschack seem rather out of place. Obviously this chapter and the next, which deals historically and discursively with the relation of systematic entomology to experimental zoology, are designed principally for internal consumption. "On lending specimens", is, however, sparkling and very personal; we should not like to incur Dr. Horn's wrath!

These later chapters bubble with facts and ideas, praise, blame and surprises—like Dr. Horn himself, full of the unexpected. Indeed, what better ending could he have chosen than the words he actually uses: "Was that not heroic?" Entomologists, especially those whose work lies in museums, will certainly answer 'yes'; but that is not what he meant.

N. D. RILEY.

A Biochemical Feast

Perspectives in Biochemistry:
Thirty-one Essays presented to Sir Frederick Gowland Hopkins by past and present Members of his Laboratory. Edited by Joseph Needham and David E. Green. Pp. ix + 362 + 6 plates. (Cambridge: At the University Press, 1937.) 15*s*. net.

A SHORT time ago, someone was happily inspired to suggest that a book of essays on modern biochemistry should be presented to Sir Frederick Gowland Hopkins to celebrate his seventy-fifth birthday. As the editors mention in their introduction, "It was felt that no greater tribute could be paid to the doyen of English biochemistry than a concerted creative effort by those who have had the privilege of his inspiration". No higher compliment could be paid to both the recipient and the gift than to suggest that each is worthy of the other.

Perhaps it would not be regarded as too frivolous if this book is likened to a sumptuous biochemical feast. Each dish on the menu has been prepared by a world-renowned chef, and all are gathered together to offer their own creations and masterpieces to a beloved master—the supreme chef, who gave inspiration to so many of them. The organizers of this feast, Joseph Needham and David E. Green, have done their work extremely well, and the arrangement of dishes is excellent.

The first essay, "The Biochemistry of the Individual", by J. B. S. Haldane, certainly has the stimulating action of a cocktail, but in its sustaining and appetite-promoting properties it resembles more closely the *hors-d'œuvre*. After that, there is a long succession of nutritious dishes totalling thirty-one in all, and even the most critical epicure could find fault with very few of the items. Few will wish to partake of every dish, but every biochemist will find food and stimulation in plenty.

Passing now to the more usual form of review, the first point which is of special interest is that most of the authors have shown an eager desire to "indicate the most promising lines of advance" in the fields which they survey, and to speculate a little as to the future. The ordinary scientific publication is usually a very dull article, since it necessarily deals with facts and not fancy. Any tendency towards speculation or dreams, which may or may not be inspired, is ruthlessly dealt with by the editor and his blue pencil. In this book the authors have been given a free hand, and in most cases they have shown their appreciation of this liberty. In consequence the articles are interesting, illustrative and inspiring. No one could read the article by Raistrick, for example, without believing with the author that in the realms of microbiological chemistry "there is an almost inexhaustible field awaiting exploration", while on the other hand Haldane convinces us that it is probably a biochemist who will discover how to influence gene-reproduction in a definite direction.

In a book of this type the personal touch is so often evident, the suggestion that eleven genes may be controlling successive stages in the synthesis of chlorophyll "much as a team of well-controlled Ph.D. candidates would be in a certain type of German Laboratory", and the statement "This simple conclusion gave me the greatest mental satisfaction that I have experienced in my life as a scientific worker. That is why I now offer it to Sir F. G. Hopkins" will perhaps suffice to indicate these features. Authors of scientific papers are usually compelled to write in the stilted third person and it is rather refreshing for once to meet with pronouns of the first person.

Without giving a list of the different chapters, it is almost impossible to indicate the immense field covered by the authors—again a tribute to the widespread interests of Sir Frederick Hopkins. Various aspects of protein chemistry are dealt with by Dorothy Jordan Lloyd, Peters and Luck; muscle by Bernal and Dorothy Moyle Needham; oxidation by Dixon, Krebs, Szent-Györgyi, and Green; vitamins and diet by Friedmann, Sir Edward Mellanby, and Harris; microbiological chemistry by Raistrick; calcium and blood coagulation by John Mellanby; molecular forces and surface films by Adam; biochemistry and mental disease by Quastel. Other articles discuss viruses, insect growth, hæmoglobin, drugs and mankind, and colour variation in flowers.

Sufficient has been said to show that in most cases the authors have consented to indulge in a little harmless but helpful speculation, and possibly because of this, these essays are of a very interesting nature. The articles by Sir Edward Mellanby, Raistrick and Wigglesworth might be quoted as typical examples of essays which will be read time and time again by many biochemists. The average biochemist should find interest and food for thought in at least nine-tenths of the articles. The majority may find one particular chapter rather indigestible, but there is adequate choice, and no one will be expected to assimilate and store the whole of the food provided. To sum up, it might be said that this book is one which every biochemist should buy, and decline to lend to his colleagues, for it is certain that the borrower would never return it. A. WORMALL.

Carl Friedrich Gauss

Carl Friedrich Gauss

Inaugural Lecture on Astronomy and Papers on the Foundations of Mathematics. Translated and edited by G. Waldo Dunnington. Pp. xi + 91. (Baton Rouge, La.: Louisiana State University Press, 1937). 1 dollar.

THIS monograph on Carl Friedrich Gauss, though short, has evidently necessitated a good deal of research, in the "Gauss Archive" at Göttingen, the Gauss Library, and elsewhere. The time of publication coincided with the celebrations arranged to mark the two-hundredth anniversary of the foundation of the University of Göttingen.

The book contains in the first place a sketch of the early life of Gauss from his birth (on April 30, 1777) down to 1803, which is a reproduction (with minor additions, changes and corrections) of an address given in 1933 before the Mathematical Association of America, Kansas Section; and this sketch the editor apparently hopes to expand into a complete biography in a later volume. The rest of the present volume is devoted to translations of two little-known papers by Gauss, with all necessary historical notes and references to the works quoted. The first (six pages only), recently discovered, seems to belong to the early years when Gauss was forced to think of becoming a teacher of mathematics; it is on the foundations of mathematics, and is not abstruse. The second is an inaugural lecture on astronomy, which may be the first of a series of lectures offered by him as his only course in 1808 when he lectured for the first time in Göttingen. It is, as the editor says, interesting in that it furnishes a clear picture of the development of astronomy up to the time of Gauss, and abounds in classical and historical allusions. In this lecture, Gauss quotes with admiration Schiller's charming poem "Archimedes und der Schüler."

The biographical sketch is well worth reading. It appears that two of Gauss's sons settled in the United States, and most of his descendants live there. To two of these, the late Mr. William T. Gauss and his daughter, the editor is indebted for much valuable information and source material. He has many references to Gauss's "Notizenjournal," or diary, the most important guide for dating *seriatim* his principal discoveries. He has also consulted the text-books used by Gauss and now in the Gauss Library, because Gauss was in the habit, all his life, of using the empty pages and the inside of the book-covers as writing-paper for entering not only formulæ and minor calculations but also, often, abstract researches.

A story on p. 36 illustrates Gauss's habit of self-assertion, verging at times on the inhuman. In thanking H. G. Grassmann for a copy of his "Ausdehnungslehre", he wrote that he found in it methods practically the same as those he had himself used for fifty years. Archimedes would not, one feels, in such a case, have written like that. T. L. H.

(1) The Observer's Book of Trees and Shrubs of the British Isles

Compiled by W. J. Stokoe. Pp. 240.

(2) The Observer's Book of British Butterflies

Compiled by W. J. Stokoe. Pp. 191.

(3) The Observer's Book of British Wild Flowers

Compiled by W. J. Stokoe. Pp. 224.

(4) The Observer's Book of British Birds

By S. Vere Benson. Pp. 223.

(The Observer's Pocket Series.) (London and New York: Frederick Warne and Co., Ltd.) 2*s*. 6*d*. net each.

UNLIKE many so-called books for the pocket, these handy volumes are only 5½ in. × 3½ in. and therefore actually will fit a coat or knapsack pocket with ease. From that point of view, and also that of a modest price, the books will prove a boon to those who are in the habit of going into the country on Nature rambles.

(1) 117 species of trees and shrubs are here described, and the text is illustrated by 177 photographs, line diagrams and coloured plates. Unless an inquirer is confronted with a garden escape or is examining some exotic cultivated species, it is scarcely likely that this useful volume will fail him.

(2) Every British butterfly appears to be included in this descriptive list to which reference is made easy by 154 illustrations, 68 of which are in colour. A résumé of the life-cycle of a butterfly and hints on collecting precede the actual detailed descriptions. To refer to this volume periodically, even if one is not fortunate enough to be able to go into the country for practical observation, will give endless pleasure and a good working knowledge of this group of insects.

(3) Though not so exhaustive, this volume will not fail the field naturalist except in very rare circumstances. Two hundred species of flowers are described and the text is illustrated by 120 line diagrams and 100 coloured pictures. The glossary might with advantage have been extended.

(4) 220 species of birds are here described. There are 200 illustrations, 100 of which are in colour. The author, who is honorary secretary of the Bird-Lovers' League, has spent many years in bird-protection work. His enthusiasm seems to have inspired this useful book, which in its turn should easily inspire readers to watch and study but not to destroy.

All four volumes are accurate and reliable—a credit to authors and publishers alike. They will make acceptable presents to Nature lovers and a source of inspiration and delight to hikers and ramblers.

Chlorkautschuk und die übrigen Halogenverbindungen des Kautschuks

Von Dr. Andreas Nielsen. (Chemie und Technik der Gegenwart, herausgegeben von Dr. H. Carlsohn, Band 16.) Pp. viii + 123. (Leipzig: S. Hirzel, 1937.) 6 gold marks.

RUBBER, owing to its unsaturation, is readily open to the formation of addition compounds, and it is somewhat surprising that investigation in this field was so long dormant. Apart from the addition reaction with oxygen—a perennial rubber problem in relation to ageing or perishing—the outstanding group of addition compounds is that formed with the halogens and halogen acids, of which the present book treats. Their relative importance can be judged by the 78 pages devoted to chlorinated rubber, the other seven compounds being dismissed in 26 pages of text.

Chlorinated rubber was first observed in 1835, but it is only in the last fifteen years that its commercial exploitation has expanded under the impulse of over-production of raw rubber and the organized search for "new uses". A large volume of literature has rapidly accumulated, however, partly on patents for the preparation and stabilization of chlor-rubber and partly on the application of the material in varnishes and lacquers, in which the author has had much experience. The present book is an excellent critical analysis of this scattered literature. Tested against the various controversies that the new industry has occasioned—such as, to depolymerize or not before chlorination, stability of chlor-rubber films against heat and water, adhesion of the films, suitable film vehicles—the book is always admirably lucid and balanced in its judgments. The wealth of precise detail in the sections on properties obviously contains much new and valuable work.

Rubber hydrochloride, which bids fair to become an important material for the production of transparent film, is adequately treated so far as existing, somewhat scanty information goes. The other chapters are only slight sketches.

The book is sufficiently indexed, and includes a comprehensive patent list. T. R. D.

Progress and Conquest

By S. Rivers-Smith and W. K. Spencer. (Simple Science in Simple English.) Book 1: The Creation and the World around Us. Pp. vii + 100. 1*s*. Book 2: The Soil and the Plants. Pp. x + 96. 1*s*. (London: Oxford University Press, 1937.)

THESE little books have been written to "realise the ideal whereby no child shall leave school without some knowledge of scientific principles". The language has been related by Dr. Lawrence Faucett to his 1,500-word vocabulary based on frequency principles, words outside that vocabulary being often illustrated by small sketches.

Book 1 is much the better of the two, and is difficult to praise too highly. Chapter iii, "Plans in Nature", introduces the idea of planning and the book is therefore especially significant. It is not true that "all living things come from eggs", but the chapter on "Living Things" is otherwise admirable.

Book 2 is similar in conception though there are some unhappy expressions. "Make or become liquid" is a poor equivalent for "dissolve". There is confusion about the purpose of pasteurization of milk: the tubercle bacillus is not a spore-former. The account of the value of humus is the most commendable feature in the book, which is worth buying for that alone. H. N.

The Physikalisch-Technische Reichsanstalt

Fifty Years of Progress

By a Correspondent

WHEN in the second half of last century the political and economic union of Germany had been effected, it was realized by far-seeing men that the new Reich could only maintain its position in the world, if the exact sciences, which had then reached a stage of development never before thought possible, were given adequate assistance by the State. In particular, there were many urgent physical problems, the solution of which was of the greatest importance for the general weal not only of Germany but also of the whole civilized world. This work could be undertaken only by a large State institute, in view of the considerable financial aid necessary to carry it out. For this reason, the Crown Prince Frederick, Werner v. Siemens, and Count Moltke took the matter up with the Government, and, in spite of much opposition, they obtained in 1886 the sanction of the Reichstag for the foundation of a "Physikalisch-Technischen Reichsanstalt" in Berlin-Charlottenburg. Hermann v. Helmholtz, the most famous physicist of his time, was appointed the first president of the new foundation, and took up his duties as director in 1887.

The institution was at that time unique, and had as its object primarily the development of the technique of accurate physical measurements, and the related establishment and control of the legal units of measurement, as well as the performance of tests submitted to it by industry. The uninitiated often regard measurements of precision as being opposed to the work of the discoverer, whose services they readily appreciate. Nevertheless, the successful activities of the discoverer would often have been frustrated but for the application of precision methods, as strikingly exemplified by Michelson's experiment, the discovery of the rare gases, the investigations on the effect of external fields on spectral lines, and the discovery of heavy hydrogen. Moreover, our belief in the trustworthiness of our conception of the atom is based essentially on the accuracy with which the fundamental constants involved have been determined by a variety of different methods.

The Reichsanstalt can look back with justifiable pride on having had on its staff men of science who, as a result of laborious and often inadequately acknowledged endeavour, have developed many important methods of measurement to an extraordinarily high level, or devised new ones. Of this we have ample testimony, for example, in the "Lehrbuch der praktischen Physik" of F. Kohlrausch, who was the second eminent president of the Reichsanstalt, which has been responsible for editing the book for many years, as well as in the "Elektrische Messtechnik" by that well-known investigator W. Jaeger. The Reichsanstalt has been responsible for the development of much of the standard equipment for measurements of precision which is used to-day throughout the civilized world. We need only mention here the Diesselhorst precision potentiometer, which is free from thermoelectric disturbances, the multiplex-interference spectroscope of Gehrcke and Lau, C. Müller's bolometer, and the Lummer and Brodhun photometer.

The precision methods of measurement were immediately applied to the establishment and control of the legal units in physics, which at the time of the foundation of the Reichsanstalt were subject to great uncertainty and lack of uniformity, a state of affairs equally intolerable to science and industry in all countries. The Reichsanstalt was concerned not only with the establishment of these units with the greatest possible accuracy, but also with their production in a form suitable for practical use. In other words, convenient secondary standards had to be derived from the primary standards. From among the relevant fundamental researches of the Reichsanstalt, which have extended over the whole field of physics, it will suffice if we direct attention here to only a few of them, such as the evaluation of the standard metre in terms of wave-lengths, the determination of the ohm and the related development of precision resistances of manganin, the researches on the standard cell (Weston cell), and those on the silver voltameter. Moreover, as a result of much laborious work, the temperature scale was fixed between the limits of $-259°$ and $+1773°$.

The precision methods devised for these purposes also opened up the way to the accurate determination of a number of fundamental constants that were not previously known with sufficient accuracy, such as the constants of radiation (Warburg, C. Müller), and the mechanical equivalent of heat (Jaeger and v. Steinwehr). We shall give only one example of the progressively increasing accuracy attained in measurements of this kind. Within the relatively short span of thirty years, it was possible to reduce the error in the measurement of the frequency of electro-magnetic waves from one per cent to one part in a hundred millions!

From the start, however, it was evident to German men of science that their work would have only a restricted value if they regarded it only as a service to their own nation and not as a cultural undertaking for the whole civilized world. For this reason they have always endeavoured to maintain a connexion with the advance of scientific work in other lands. Thus the Reichsanstalt has almost always been represented at the numerous international scientific conferences that have been held to fix and control physical and technical units of measurement, and its results have often had a decisive influence on the resolutions passed at these conferences. In particular, co-operation with the important foreign State institutes which have the same aims, for example, the National Physical Laboratory at Teddington, and the U.S. Bureau of Standards in Washington, has been so close that from time to time and also since the Great War representatives of the Reichsanstalt have worked in these other laboratories, and conversely. The importance of the guarantee of trustworthy international physical units is further exemplified by the fact that two presidents of the Reichsanstalt who were scientific men of world-wide repute, v. Helmholtz and Warburg, have taken part personally in international conferences dealing with these questions.

When we consider the enormous quantities of energy and material goods that are bought and sold in the world to-day, and that they are all measured in terms of these units, it is readily appreciated that this problem of units is of supreme importance not only from the scientific but also from the economic point of view. In these matters, insistence must be laid on the very accurate calibration of all measuring equipment. Thus it has been calculated that an error of only one per mille in the polarization apparatus used for the determination of the sugar content of beet would correspond at the present time, in Germany alone, to an annual market value of approximately one million Reichsmarks. Measuring equipment which has been tested at the Reichsanstalt in terms of its standards and by use of its precision methods is to be found all over the globe ; and in the work of scientific investigators and technologists for the welfare of humanity, which cannot be too highly apprized, it has been of inestimable value. The continuously increasing range of the work of the Reichsanstalt is illustrated by the growth in the number of tests which have to be carried out by that institution. The present income from fees for tests undertaken is about twenty times that of the year 1890, and much more than double that for the year 1913.

The progressive rise in the demand for accuracy of measurement which has resulted from the work of the Reichsanstalt has necessarily also brought in its train advances in industrial development. Thus, as soon as it has been certified that the permissible limits of error of a measuring instrument have been reduced, it is incumbent upon industry to strive after increased accuracy in the manufacture of the instrument. This has been especially noticeable in the work of the optical industry.

Since the economic importance of its work in carrying out tests was obvious even to those not directly concerned with physics, the Reichsanstalt has as a rule been granted the requisite funds and equipment by the particular Ministry concerned. On the other hand, the accommodation, equipment and staff necessary for the prosecution of exhaustive and extended investigations in pure science before 1933 were far from adequate. Thus it can readily be appreciated that the development of the Reichsanstalt was determined primarily by its obligations in the matter of testing instruments and the like, whereas the scope of its purely scientific activities lagged behind. It is a great tribute to the idealism and deep-seated scientific enthusiasm of many men who have worked at the Reichsanstalt that, in spite of the obstacles already mentioned, many excellent investigations of the greatest value to pure science have been carried out within its walls.

Included among about 1,500 publications from the Reichsanstalt, with a total of some 18,000 pages, which have appeared since its foundation, there is a large number devoted to problems of pure science. In particular, it should be mentioned here that the important problem of the spectral distribution of intensity of a black body was completely solved experimentally by Lummer and Pringsheim at the Reichsanstalt. The investigations of Hagen and Rubens on the connexion between the electrical conductivity of metals and their optical properties in the infra-red region of the spectrum are outstandingly brilliant in their formulation and execution. They confirmed the existence of the relation between the reflective power and the conductivity of metals, which results from Maxwell's theory. It was at the Reichsanstalt that Goldstein discovered canal rays, and Gehrcke and Reichenheim the anode rays ; here de Haas found experimentally the celebrated relation, fundamental in atomic theory, between mechanical and magnetic moments ; and here Geiger presented atomic physicists with the point-counter, so indispensable in modern research. The list could be extended by further examples, but we have confined ourselves here to those discoveries from which we are already sufficiently far removed in time to be able to estimate their great influence upon physics.

Although it is often difficult to determine immediately the value for our future knowledge of physics of an investigation in pure science, this applies in still greater measure when we consider its significance for applied science or in the field of economics. Here things are not always so simple as in the discovery by E. Gumlich, who has worked in the Reichsanstalt since its foundation, that certain iron-silicon alloys have an extraordinarily small electrical conductivity and excellent magnetic properties. He immediately recognized the great importance of the diminution of eddy current losses, which depend on the conductivity, in sheet, used for the construction of transformers and dynamos. Gumlich's alloy sheet has found world-wide application, and it has been calculated that in Germany alone, by the use of the alloy sheet, industry saves in iron and electrical energy the equivalent of about one hundred million Reichsmarks a year.

Speaking generally, one can say that the statement made by Werner v. Siemens in 1884, in a memorandum urging the foundation of the Reichsanstalt, still holds good : "Almost without exception it is the result of new scientific discoveries, often with no apparent significance, that such new paths are opened up and important branches of industry newly created or revivified. Whether or not the recognition of a new scientific fact has a practical application cannot as a rule be determined until that fact has been systematically and completely investigated, that is, often after an appreciable lapse of time. For this reason, *scientific progress must not be made dependent on material interests.*"

The Reichsanstalt has never lost sight of this point of view, and its researches were never linked up only with considerations of time, for the high scientific value of its work of standardization is also bound up with its research work. In order to appreciate the spirit that has always been cultivated in the Reichsanstalt, it will suffice to mention the names of its presidents, in chronological order : H. v. Helmholtz, F. Kohlrausch, E. Warburg, W. Nernst, F. Paschen, and J. Stark. As already mentioned, the Reichsanstalt had not long been completed (in 1897) before great difficulties had to be faced as a result of the lack of accommodation and funds, and these reacted on its scientific development, in spite of the eminence of those in charge. Thus between 1897 and 1933 the effective area of its buildings increased only by about 35 per cent, mainly due to the construction of a heavy current laboratory (1913) and of a low-temperature laboratory (1927), and the funds available to the Reichsanstalt for its work lagged far behind those which would have corresponded to the enormous development of physics in the same period. But the new National-Socialist Minister Rust, who has been in office since 1933, began immediately to try to improve these conditions, and his Ministry has succeeded in augmenting the available accommodation almost to double its earlier area, partly by renting suitable buildings, and partly by the acquisition of funds for the erection of new buildings, so that the number of laboratories of the Physikalisch-Technischen Reichsanstalt is now seventy-seven. This process of development is still being actively pursued, and Prof. Stark believes that the leaders of the National-Socialist State, recognizing the importance of the Reichsanstalt, will see to it that adequate financial aid is placed at its disposal, for without this the Reichsanstalt cannot fully realize its aims.

Apatite, Nepheline, and Rare-Earth Mining in the Kola Peninsula

PARTICIPANTS in the northern excursion of the seventeenth International Geological Congress in Russia were afforded ample facilities for inspecting recent mining developments in the Kola Peninsula, and especially the unique apatite deposits at Kirovsk. The latter occur within the world's largest known massif of nepheline-rocks, the Khibine Tundra*.

The Khibine massif (Umptek in the Loparian language) has an area of 1385 sq. km. It is of roughly circular outline, with a diameter of about 40 km. The neighbouring Lovozero massif to the east is similarly shaped, with diameter 25 km. and area 485 sq. km. Still farther east there occur great intrusions of alkaline granites, which occupy an area of 3700 sq. km.

The Khibine massif is of annular structure and may be regarded as a lopolith, with steep contacts cutting across Archæan gneisses and the Proterozoic Imandra-Varzuga series. A broad peripheral ring and the central area consist of coarse-grained nepheline-syenites. Along the annular break between these rings a series of younger fine-grained nepheline-syenites, and rocks of the ijolite-urtite range have been injected (see accompanying map). The apatite-nepheline injections which are mined occur as intercalations within the ijolite-urtite series.

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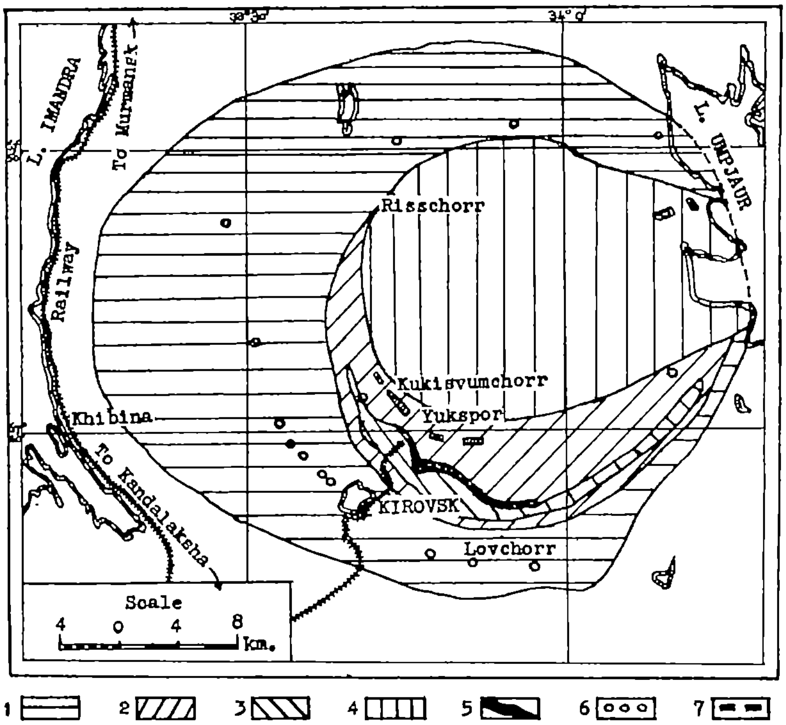
*The Lapp word *tundra* means the barren uplands above the limits of tree growth, and not the flat, frozen Arctic swamp lands ; hence the Khibine and Lovozero Tundras as names applied to mountain groups.

The less well-known Lovozero Tundra (Lujavrurt) is also built of successive intrusions of the same types of rocks, but it appears to be a horizontally stratified sill-like mass. Both massifs abound in complex zirconotitanosilicate minerals, and minerals containing rare earths as well as niobium and tantalum. As xenoliths of hornfels with imprints of Devonian plants have been found enclosed within the nepheline-syenite of Lovozero, its age is certainly post-Devonian. Radium determinations have shown that the absolute age of the Khibine massif is about 350 million years. Hence Russian geologists assign both intrusions to the period of Variscian diastrophism.



GEOLOGICAL MAP OF THE KHIBINE TUNDRA, KOLA PENINSULA.

1, KHIBINITE (VERY COARSE-GRAINED NEPHELINE-SYENITE); 2, NEPHELINE-SYENITES (FINE-GRAINED TYPES); 3, IJOLITES AND URTITES; 4, FOYAITE (COARSE-GRAINED NEPHELINE-SYENITE); 5, APATITE-NEPHELINE ROCKS; 6, OUTER ZONE OF RINCOLITE AND LOVCHORRITE DEPOSITS; 7, INNER ZONE OF RINCOLITE AND LOVCHORRITE DEPOSITS.

The apatite-nepheline rocks that form the basis of the mining industry are confined to the hanging wall of the ijolite-urtite ring. The ore body is divided into an upper zone consisting of up to 80 per cent apatite and 20 per cent nepheline (average P_2O_5 content, 30·8 per cent), and a lower zone with predominant nepheline (40–70 per cent), and P_2O_5 content ranging from 7 to 22 per cent.

The great new phosphate mine at Kirovsk, developed in eight years, is one of the industrial wonders of the world. This achievement is entirely due to Russian enterprise and energy. Owing to the close collaboration of seven organizations, the U.S.S.R. Academy of Sciences, the Arctic Institute, the Apatite Trust, the Scientific Institute of Fertilizers, the Central Geological and Prospecting Institute, the Rare Metals Trust, and the Leningrad Geological Trust, apatite is now being mined at the rate of 2 million tons per annum, and a reserve of 2,000 million tons has been established. The southern face of Kukisvumchorr Mountain has been blasted back into five broad ledges to a height of 1,500 feet. There are now more than twenty miles of underground galleries seven feet in height, electrically lit, and with electric haulage. A tunnel which admits the ordinary freight train has been driven to the heart of the mountain to facilitate loading. The social and industrial development of the region which, nine years ago, was a desolate arctic waste peopled by a few Lapp families, has kept pace with its scientific and technical investigation. The new town of Kirovsk with 40,000 inhabitants, and villages with the picturesque names of Nepheline and Apatite, have been built, and hundreds of miles of railway has been electrified.

Besides apatite, nepheline is mined for use in the ceramic industry and for its content of potash as fertilizer. The new mineral *lovchorrite*, a massive form of rincolite, chemically a fluorine-bearing titanosilicate of calcium, strontium and sodium, with up to 20 per cent of rare earths, is mined from pegmatites at the rate of several hundred tons a year. Another new mineral, *loparite* (titanoniobate of cerium, calcium and sodium) occurs in deposits of economic importance. Titanite (sphene) is also mined at the new Yukspor Mine, for what reason was not disclosed, but presumably for titanium, and possibly for its content of niobium and tantalum.

G. W. TYRRELL.

The chief sources of information are:

"Minerals of the Khibina and Lovozero Tundras" (English edition, abridged from the Russian monograph under the same title). U.S.S.R. Academy of Sciences, Moscow (see adv. in "Nature"); *Memoir of the Lomonossov Institute of the U.S.S.R. Academy of Sciences*, 1937. Pp. 152. Edited by A. E. Fersmann. Offices of the 17th International Geology Congress, Bolshaya, Ordynka, 32, Moscow 17.

"The Northern Excursion, Kola Peninsula", Guide-book, XVIIth International Geological Congress, Moscow, 1937. Pp. 119. Edited by A. A. Polkanov.

Recent Cancer Research

A SUMMARY of recent progress in cancer research is to be found in the fourteenth annual report of the British Empire Cancer Campaign and the thirty-fifth annual report of the Imperial Cancer Research Fund, which were published at the end of 1937. Work from widely distributed centres is described, and the two reports indicate the lines along which the problem of cancer is being attacked.

Dr. P. Stocks, the Medical Statistical Officer at the General Register Office, has continued his investigations on the distribution of cancer of various organs in England and Wales. In the present report of the British Empire Cancer Campaign, he shows how the mortality from cancer of the bladder and of the prostate increases, while cancer of the skin decreases, with diminishing rainfall. This correlation is possibly due to the fact that more water is excreted through the skin and less through the urinary tract under dry atmospheric conditions. The difference is illustrated by a comparison of cancer mortality figures for twelve different sites for Lancashire county boroughs and London. When all sites are considered, the male mortality from cancer is the same in both districts, yet cancer of the skin is almost twice as common in Lancashire, while the mortality figures from cancer of the prostate, of the bladder and of the lung in Lancashire are less than two thirds of those of London. These large differences are probably due to environmental factors such as climate and atmosphere, and support "the hypothesis that certain external factors operating through a man's ordinary environment may be of great importance in determining in what part of the body cancer will appear." The remarkable fact is that though such factors are operating in very different proportions, the same total cancer death rate is found in the different environments.

These findings are of interest from the point of view of factors affecting carcinogenesis which have been discussed by Prof. and Mrs. E. L. Kennaway (*Acta* of the International Union against Cancer, vol. 2, p. 101 ; 1937), who have collected evidence that most cases of cancer are probably due to several intrinsic or extrinsic factors. It is obvious that the differences in cancer mortality found by Dr. Stocks must be largely due to extrinsic factors. Analysis of mortality from cancer of the scrotum in different occupations and of mortality from cancer of the penis in Jews and non-Jews indicates that these forms of cancer are dependent on external factors.

In the report of the Imperial Cancer Research Fund, Prof. M. Greenwood briefly discusses the importance of statistics in assessing the social and economic factors of malignant diseases. He points out that mortality from diabetes is much lower and tuberculosis mortality is much higher among poorer people. Mortality from cancer is also relatively high among lower economic grades, but the differences are not so large as they are with diabetes and tuberculosis.

Much of the experimental work of the Imperial Cancer Research Fund has been concerned with the nature of those tumours which can be transmitted by filterable viruses. Dr. R. J. Ludford has grown fibroblasts and macrophages in tissue culture in the presence of the Rous virus. Under these conditions, fibroblasts were transformed into malignant cells while macrophages were not. This indicates that when infective filtrates of the Rous sarcoma are injected into fowls, the tumour arises among fibroblasts.

Research on the metabolism of tumour tissue has up to the present given interesting results but has been disappointing from a practical point of view. The metabolism of tumours does not appear to be specifically distinct from normal tissues. If some such difference could be found, it might give some clue to the chemotherapy of malignant disease. The carbohydrate metabolism, as shown by the quantitively large changes such as respiration and lactic acid formation, has been examined thoroughly because exact methods for its measurement have been worked out. Recent improvements make it possible to measure the respiration of less than one milligram of tissue. Tumours have a low respiration as compared with their lactic acid formation, but if the respiration were increased *in vivo* it is probable that the rate of growth would be increased rather than inhibited. It therefore appears that other biochemical processes must be investigated in the hope of finding some difference between malignant and normal tissue.

During the past year there has been an increase in the amount of work directed towards the treatment of cancer. The original observation of Dr. T. Reiter that electro-magnetic waves of between 3 and 4 metres wave-length are effective in destroying animal tumours has been confirmed by work carried out at Newcastle-on-Tyne. The action, however, appears to be due to the heating effect of the waves and there is no specific effect of any one wave-length. In order to ensure a cure, mouse tumours must be heated at above 48° C. and rat tumours above 50° for 4 minutes.

The Report of the British Empire Cancer Campaign contains many accounts of clinical results obtained with radium and X-rays. During the year an apparatus has been constructed for the preparation of neutrons to be used to determine their biological effects.

Sir Edward Mellanby has shown that potassium permanganate and iodine destroy the virus of the Rous sarcoma *in vitro*. When iodine is injected into sarcoma-bearing fowls, however, the virus is not destroyed. Workers at Liverpool are still trying to find new lead compounds which will be effective against human cancer and can be safely administered. Researches carried out in the United States have shown that whereas injection of bacterial filtrates into animals with grafted tumours induces hæmorrhage and inhibits growth of these tumours, no such action occurs with spontaneous tumours. Recent experiments performed at the Royal Cancer Hospital show that colchicine, the alkaloid of the autumn crocus, behaves in a similar way to bacterial filtrates, showing the same difference in reaction between grafted and spontaneous tumours. These results indicate that chemo-therapeutical tests are probably best made on spontaneous tumours.

The finding of Dr. A. Haddow that carcinogenic compounds inhibit growth of animals and of tumours has been confirmed in other laboratories. During the past year it has been shown that carcinogenic compounds inhibit the growth of spontaneous tumours, and also that the growth of a tumour which has been induced by a carcinogenic compound may be inhibited by that same compound. If a carcinogenic compound is injected into an animal it disappears, and experiments suggest that the growth-inhibiting action remains when the greater part of the compound has disappeared from the body. Growth-inhibiting power has been found with some substances—for example, acenapthanthracene—which are apparently not carcinogenic.

Derivatives of carcinogenic hydrocarbons have now been prepared in which hydroxyl groups are present and these derivatives have not been found to be carcinogenic. It therefore appears probable that if a carcinogenic compound is abnormally produced in the body from a natural product such as a bile acid or sterol, then the hydroxyl group originally present in the natural product must be removed.

E. B.

Obituary Notices

Prof. L. N. G. Filon, C.B.E., F.R.S.

ON December 29, 1937, the typhoid epidemic at Croydon claimed as a victim Prof. L. N. G. Filon, at the age of sixty-two years, when, in view of his robust frame and vigorous vitality, he might justifiably have been looking forward to many more years of the hard and unselfish work that characterized both his scientific and his public life. His friends had received encouraging news of his struggle against the disease, and the crisis was understood to be over, so that his death came as a shock for which they were ill prepared.

Filon was the son of M. Augustin Filon, the French critic and *littérateur*, who was tutor to the Prince Imperial. Throughout his life he showed a precision and fastidiousness in both the spoken and written word which was, no doubt, due to the atmosphere of his early upbringing, as was also his accomplishment in the French tongue. He started his academic life at University College, London, in 1894, where he had a brilliant career, culminating in the award of an 1851 Exhibition scholarship in 1898. It was at University College that he had his first experience of mathematical research, while acting as demonstrator to Prof. Karl Pearson, for whom Filon always expressed veneration, as witness his speech delivered at the dinner given in honour of Karl Pearson in 1934, when he said, "I had then just taken my degree, and K. P. had taken me upon his staff as Demonstrator, at what then seemed to me the princely salary of £40 a year. Nowadays young people expect at least £250 a year in the same circumstances, but then they do not get the stimulus of a Karl Pearson, which was worth more to me than the difference."

With the 1851 scholarship Filon proceeded to King's College, Cambridge, where he carried out extensive mathematical researches on the theory of elasticity, probably as a result of Karl Pearson's inspiration, since references to Todhunter and Pearson's "History of Elasticity" are frequent. The results are published in several lengthy papers in the *Philosophical Transactions of the Royal Society*. The theory of elasticity remained Filon's chief mathematical interest throughout life. At Cambridge, he also started his experimental work on the behaviour of light in transparent bodies subjected to stress, work which culminated in the standard book "Photo-Elasticity", published in 1931 in collaboration with Prof. E. G. Coker. This work enabled him to make brilliant practical use of that familiarity with the mathematics of stress-distribution which he so eminently possessed. By a foible such as often characterizes great men, Filon prided himself upon being an experimental physicist, although actually his experimental technique was not as highly developed as his mathematical powers.

In 1903 Filon was appointed lecturer in mathematics at University College, London, under the late Prof. M. J. M. Hill, and he became assistant professor of mathematics in 1906, a position in which he continued until 1912, when he succeeded Prof. Karl Pearson in the Goldsmid chair of applied mathematics and mechanics, tenable at University College. It was as a result of his teaching in the Department of Pure Mathematics that Filon produced his standard text-book on projective geometry, now in its fourth edition. He was elected a fellow of the Royal Society in 1910, and in 1935 a member of the Council and a vice-president of the Society, an honour which he much appreciated.

One of Filon's great interests was the University of London Officers' Training Corps, which, as Brevet-Colonel, he commanded from 1926 until 1932. He was already active in this connexion before the Great War, and he went on foreign service during 1914. He commanded the 2nd (Reserve) Battalion London Regiment from June 1915 until September 1916, after which his great technical abilities were more fitly utilized by his appointment to the technical staff of the Admiralty Air Service and of the Air Board.

After the War, Filon began to take an increased interest in the affairs of the University, as a result of which he was elected to the Senate in 1920, on which body he continued to serve until the time of his death. In all that had to do with University administration he showed the characteristic which, perhaps more than any other, distinguished his whole life—thoroughness. Needless to say, his unswerving devotion to what he considered right, and his lack of that praiseworthy pliancy and useful obliquity which adorn some of our leading administrators, occasionally led him to oppose certain notable personalities, but, in spite of this, his services were so outstanding that he was elected vice-chancellor of the University in 1933–35, the period during which the foundation stone of the candid and considerable —may we say elephantine—University building was laid. In spite of his activities in University administration, Filon still found time to produce research of outstanding merit, and to help his students to produce original work.

Throughout his academic life, Filon held that the chief duty of any member of a university staff was to impart learning. He was an excellent teacher and never spared himself, whether the class was large or small, elementary or advanced. He was particularly careful about the organization of exercise classes. One of his enthusiasms was astronomy, and the existence of the University of London Observatory is very largely due to his efforts. He had a deep knowledge of the early history of astronomy, and gave an excellent course on the subject. As a lecturer he had a clear and compelling style, and was well able to adapt himself to a general audience, when he lectured, as he occasionally did, on a general topic.

Filon was a man of wide culture, and one who believed profoundly in the dignity of the academic profession. A congenial companion and a warm-hearted friend, he occasionally indulged in short bursts of irascibility, which, if they arose suddenly, as suddenly subsided. These outbreaks, so well known to his friends, were purely superficial disturbances, for fundamentally Filon was one of the most generous and kindly of men, who would put himself to great trouble even for those who had small claims on him. Nobody could be a pleasanter speaker or a better host. The large numbers which assembled at the memorial service held on January 14 were not brought together by feelings of formal courtesy to a distinguished colleague but came to salute the passing of a great spirit and a great friend.

E. N. DA C. ANDRADE.

Major E. E. Austen, D.S.O.

THE name of E. E. Austen will live as that of a pioneer in the study of Diptera. Educated at Rugby and at the University of Heidelberg, he joined the staff of the British Museum in 1889 as the first curator to have sole and undivided charge of the collections of that order of insects. His first publication (January 1893) was upon a section of the family Syrphidæ (hover-flies), and his second (May 1895) upon the Œstrid genus *Cutiterebra* (American botflies parasitic upon rodents). Quite early in his official career, however, he must have realized that the great amount of undescribed material and the necessity for intensive study made the Diptera as a whole too wide a field for research, and, as at that time the importance of Diptera as vectors of disease was beginning to be understood, he wisely decided to restrict his researches mainly to blood-sucking flies and certain other groups of medical or veterinary importance. It therefore came about that the revision of the Syrphidæ which he had planned was never continued, though he retained his interest in the Œstridæ, publishing several papers on the family so recently as 1933–34.

Austen's interest in blood-sucking flies was doubtless cemented by a visit which he paid to Sierra Leone in 1899 in company with the late Sir Ronald (then Major) Ross, with the object of investigating the mosquitos of Freetown. This was the first expedition sent out by the Liverpool School of Tropical Medicine, and might well have led to his specializing on mosquitos, but he was called for service in the Boer War, and meanwhile the late F. V. Theobald was employed by the Museum to prepare a monograph of the Culicidæ. On his return from South Africa, Austen turned his attention to tsetse flies (*Glossina*) and horse-flies (Tabanidæ). His monograph of the genus *Glossina* (1903) was the first scientific revision of this group, later replaced (1911) by his more concise handbook. His numerous works on other blood-sucking flies include two separate volumes, "Illustrations of African Blood-sucking Flies" (1909) and "Illustrations of British Blood-sucking Flies" (1906), both long out of print, as well as many shorter papers descriptive mainly of African species. More widely known, perhaps, than any of his other publications was the Museum pamphlet which he compiled on "The House-fly as a Danger to Health", which had a very large sale and ran into several editions.

Apart from the expedition to Sierra Leone mentioned above, the only purely collecting trip which Austen made was in 1896, when he and the late F. O. Pickard Cambridge spent three months on the Amazon as naturalists on the cable ship *Faraday*. A greater opportunity for field work came to him during the Great War, when, after a period in France, in command of a company of the Artists' Rifles, he was transferred to the Egyptian Expeditionary Force for special duty in connexion with insect-born diseases. His work on mosquito and house-fly control earned him the D.S.O., and in spite of the arduous nature of this work he still found time and energy to make collections of other Diptera. Arrears of work, and later, official duties when he was appointed first deputy-keeper (1924) and then keeper (1927) of the Department of Entomology gave him little time for studying his Palestine collections. However, his retirement from the Museum staff in 1932 gave him more ample leisure and he turned with zest to the completion of a long-deferred labour of love and eventually (July 1937) produced a handsome volume on the Bombyliidæ of Palestine, which includes descriptions of the numerous species of this family collected by himself.

Austen's descriptive work, though sometimes criticized for a certain lack of conciseness in wording, embodied throughout three qualities upon which he always set a high value: accuracy, consistency and neatness. His neatness was exemplified in the wonderfully clear and firm handwriting, in which he took a just pride, and in the orderly arrangement of the collections under his charge. So precise indeed was this arrangement that visitors not infrequently remarked that the cabinet specimens were like well-trained regiments of soldiers on parade.

Although Austen's published work dealt almost exclusively with the groups of insects which were in his official charge, his interests were much wider. He preferred the Zoological Society to the Entomological Society on account of its wider outlook, and served on the publication committee of the former body. He was at one time vice-president of the Royal Society of Tropical Medicine and Hygiene, a member of the executive committees of the Imperial Institute of Entomology, the British Mosquito Control Institute, and the Society for the Preservation of the Fauna of the Empire. As a colleague he was loyal, purposeful, always anxious to increase the efficiency and prestige of his department, strongly resentful of injustice, and a strict disciplinarian. He was one of the small band to whom the present staff of the British Museum (Natural History) owes, almost entirely, the greatly improved conditions which the staff enjoys. Intensely patriotic, and with a very strong sense of the duty of a citizen, it is not surprising that he looked back with pride upon his service in the "C. I. V." and in the Great War, and that he took a keen and active interest in the local affairs of Northwood, where he had lived since 1913. Those who had the privilege of serving with him will always remember him, a man upright in body and mind, of sterling character, a manly man.

N. D. R. and F. W. E.

Mr. J. L. Starkey

THE murder of Mr. J. L. Starkey, director of the Marston-Wellcome Archæological Expedition to the Near East, in Palestine on the evening of January 10, when he was on his way from his camp at Tell Duweir to Jerusalem to attend the opening ceremony of the new Palestine Archæological Museum on the following day, has deprived field archæology in the Near East of one of its most competent practitioners and exponents.

James Leslie Starkey was born on January 3, 1895, and received his training as a field archæologist under the British School of Archæology in Egypt. When in 1926 Sir Flinders Petrie, owing to the restrictions imposed on archæological excavation in Egypt, transferred his activities to Palestine, Mr. Starkey accompanied him and became his right-hand man. A succession of operations on sites in the neighbourhood of Gaza brought to light important evidence bearing on the periods of the Egyptian occupation, the Hyksos and the early Bronze and Stone Ages of Palestine. More especially significant, perhaps, was the varied evidence which pointed to Palestine having been a centre or gathering point in international relations. This work led Starkey to the excavation of Tell Duweir.

The systematic excavation of Tell Duweir began in 1932. Mr. Starkey, convinced of the importance of this extensive site for Palestinian prehistory by the evidence of surface finds, and more especially by the abundance of potsherds it showed, approached Sir Charles Marston, for whom Prof. John Garstang was then excavating the site of Jericho, and persuaded him to undertake its investigation, at first in co-operation with Mr. H. D. Colt, and afterwards with Sir Henry Wellcome and Sir Robert Mond. The first season's systematic excavation went far to substantiate, if indeed it did not quite fully confirm, his tentative conclusion that Tell Duweir, situated eighteen miles south-west of Jerusalem, rather than Tell el-Hesy, a site some ten miles away excavated many years before by Sir Flinders Petrie, was to be identified with the Biblical Lachish. The site was shown to have been in almost continuous occupation as a position of importance from the early Bronze Age down to the period of Persian occupation, while in the period of the Jewish kingdom when it was probably the centre of the defensive system of Palestine on this front, it had been sacked twice, inferentially by Sennacherib and Nebuchadnezzar—on the second occasion burned. The identification with the Biblical Lachish was borne out later by the discovery here of the famous Lachish letters, the earliest known personal documents in Hebrew, and the earliest example of Hebrew writing. Even more important in the history of written records are the inscribed ewer and copper dagger, on which a primitive form of alphabetic script is held by experts to be closely akin to the Sinaitic script discovered by Sir Flinders Petrie, antedating considerably the earliest known Phœnician alphabetic scripts, which possibly may be derived from it.

This brief notice of Mr. Starkey's work cannot close without reference to one instance of his flair for the importance of a site, of which the full significance was not apparent until last year. This was his foresight in securing for the Marston-Wellcome Expedition the concession to excavate what has since come to be known as the "Bethlehem Bone Beds" (see NATURE, 140, 431; 1937), in which have been found the fossil remains of numerous species previously unrecorded in Palestine, including the first specimen to be found in Palestine of the elephant and also of Hipparion, while fractured pebbles, found in 1937, but still *sub judice*, may turn out to be the first evidence of eolithic man in Palestine.

Mr. Starkey's interests were not confined to the past, and he had taken advantage of the opportunities afforded by the organization of his expedition to secure valuable photographic and other records of the people of Palestine of to-day. By the irony of circumstance, Mr. Starkey met his death at the hands of Arabs, although not only were his relations with his own Arab workmen of the most cordial character, but his scheme of excavation also made provision for ameliorating their condition by instituting cultivation plots on the site as the work proceeded.

WE regret to announce the following deaths:

Mr. W. H. B. Cameron, lecturer in physics in the University of Sheffield, known for his work in spectroscopy, on February 16, aged thirty-six years.

Dr. Ernest Goulding, formerly vice-principal of the Plant and Animal Products Department of the Imperial Institute, on February 15, aged sixty-eight years.

Prof. Gustav Jager, emeritus professor of physics in the Technical High School, Vienna, on January 21, aged seventy-two years.

Prof. Anton Lampa, *Privatdozent* in physics in the University of Vienna, formerly professor in the German University, Prague, on January 26, aged seventy years.

Prof. H. E. Simpson, professor of geography and geology in the University of North Dakota, an authority on the geology of water supply, on January 31, aged sixty-three years.

Prof. H. W. Tyler, emeritus professor of mathematics in the Massachusetts Institute of Technology, secretary of the American Association of University Professors in 1916–33, on February 2, aged seventy-three years.

News and Views

Sir George Simpson, K.C.B., C.B.E., F.R.S.

THE directorship of the Meteorological Office of the Air Ministry of Great Britain is one of the country's most important scientific posts and the recent announcement that Sir George Simpson will retire in September will arouse wide interest and regret. He has had heavy responsibilities. When he assumed office in 1920, his first task was to weld into a coherent whole the very heterogeneous material that the Great War had left behind it, in such a way as to supply the needs of civil aviation, the Navy, the Army and the Air Force, as well as the general public. He shortly had to provide the information demanded by the ill-fated airship programme which came to an end with the *R*101 disaster: this involved a thorough investigation of air motion for use in airship construction and mooring, and an organization for providing route reports for airships in flight such as that which made possible the transatlantic flights of *R*100. Latterly, there has been the organization occasioned by the Air Force expansion and the air mail scheme: accordingly, there is now a section for synoptic work over the North Atlantic and another to give information for the flying boats to South Africa and the East during the first stages of their journeys. Happily, in meteorology, international co-operation is a vital necessity, involving a highly complex arrangement of codes for distributing weather data over the earth; here the British representative has played a very important part. With a fine record of scientific research, both experimental and theoretical, Sir George has shown that, as has often been urged in these pages, executive ability is not confined to those with a literary, political or other training. He is admirable in discussing a purely technical theme; but he is equally impressive in fighting a difficult case through a committee when ingenuity, tact and business capacity have full play; and his success would have been impossible without his obvious courage and sincerity.

Mr. N. K. Johnson

MR. N. K. JOHNSON of the Chemical Defence Research Department has been appointed to succeed Sir George Simpson. Mr. Johnson received his scientific training at the Imperial College of Science and Technology, South Kensington, choosing physics as the main subject for his honours degree. After a period of post-graduate work in astrophysics under Prof. A. Fowler, he went in 1913 to the Hill Observatory, Sidmouth, as assistant to Sir Norman Lockyer and Dr. W. J. S. Lockyer. Relinquishing this post, he served during the Great War in the Royal Air Force, and on the conclusion of hostilities was appointed professional assistant in the Meteorological Office. After a period of service at Shoeburyness, Mr. Johnson was seconded for duty under the War Office at the Experimental Station, Porton. Here he found full scope for his natural inclination towards experimental research work and he tackled with great success the new and difficult meteorological problems associated with chemical warfare. During this period he designed the apparatus described in his well-known paper on "A Study of the Vertical Gradient of Temperature in the Atmosphere near the Ground" (London Met. Office, Geoph. Memoirs, No. 46, 1929). This work yielded much valuable information on the thermal structure of the lower layers of the atmosphere, and has formed the basis of similar work carried out afterwards in other parts of the world. In 1929, Mr. Johnson became Director of Experiments at the Porton Experimental Station, under the War Office, and was promoted later to his present post of Chief Superintendent, Chemical Defence Research Department.

George William Hill (1838-1914)

ON March 3 occurs the centenary of the birth of the American astronomer, George William Hill, who, said Simon Newcomb, "will easily rank as the greatest master of mathematical astronomy during the last quarter of the nineteenth century". His father had emigrated to the United States in 1808 and Hill was born in New York, but his boyhood was passed in the country at West Nyack, N.Y., and there on his little farm he passed away on April 16, 1914, having received some of the highest honours science could bestow. Entering Rutgers College, New Jersey, at the age of seventeen years, he graduated in 1859 and then proceeded to Cambridge, Mass. Early in 1861 he was offered a post under Runkle, the superintendent of the American "Nautical Almanac", and he remained connected with the "Almanac" Office for more than thirty years. In 1877–78, there appeared his new method of dealing with the moon's motion, "his most original contribution to our knowledge of celestial mechanics", and about the same time under Newcomb he took up problems connected with Jupiter and Saturn, and at which he laboured for fifteen years. After the completion of this work he retired from the "Almanac" Office and settled again at West Nyack. "It is difficult," said one writer, "to find such another man as Hill in the whole history of Science. Although holding only a humble post in the 'Nautical Almanac' Office, he lived happily in the liberty it afforded him, and never sought to improve his material position. All he asked for was peace and freedom to prosecute his work". He received the Gold Medal of the Royal Astronomical Society in 1887 and the Copley Medal of the Royal Society in 1909, and France elected him a corresponding member of its Institute. His first paper was published in Runkle's *Mathematical Monthly*, just when he had graduated, and his last in the *Astronomical Journal* in January 1914, three months before he died.

Jacob Da Silva Solis-Cohen (1838-1927)

DR. JACOB DA SILVA SOLIS-COHEN, the founder of laryngology in the United States, was born in New York City on February 28, 1838, of distinguished Spanish and Portuguese ancestry. He received his medical education at Jefferson Medical College and the University of Pennsylvania where he qualified in 1860. After serving for a short time in the United States Army and Navy during the Civil War, he devoted himself to the study of laryngology. His first work on the subject, entitled "Inhalation in the Treatment of Disease", was published in 1867, and was followed in 1872 by his great work "Diseases of the Throat and Nasal Passages", which at once became a standard text-book and ranked with those of Morell Mackenzie (1860) and Francke F. Bosworth (1881) among the classics of laryngology. In 1874, appeared Solis-Cohen's monograph on "Croup in its Relations to Tracheotomy", based on the study of 5,000 recorded cases; in 1875 he published a book on "The Throat and Voice". In 1866, he was the first in the United States to institute regular lectures on laryngology at the Philadelphia School of Anatomy. In 1870 he was appointed lecturer on laryngoscopy and diseases of the throat and chest in the Jefferson Medical College and two years later professor of laryngology. He was one of the founders of the *Archives of Laryngology* and for many years edited the laryngological department of the *American Journal of the Medical Sciences*. He also helped to found the American Laryngological Association, of which he was the second president in 1880–82. As the result of his experience in the Civil War he excelled in the surgery of the upper air passages. In 1892 he was the first in America to perform a successful complete laryngectomy. His death occurred on December 22, 1927.

The Soviet Arctic Enterprise

THE final stages in the rescue of M. Papanin and his three comrades began on February 16, when two planes from the *Murman* and *Taimyr* respectively landed on the drifting floe. It was decided, however, not to remove the men by air since they were in no immediate danger. During the next two days the *Taimyr*, guided by an aeroplane, fought her way through the pack-ice to the vicinity of the camp and on February 18, the four men Papanin, Krenkel, Shirshov and Federov, with all their records and equipment, were taken on board the ice-breakers. The drift had lasted for 258 days and covered about twelve hundred miles. The relief ships *Taimyr* and *Murman*, on emerging from the pack, set out for the port of Murmansk in northern Russia. Congratulations are to be extended to these four men of science and to their rescuers. It is expected that much of scientific importance will accrue from the data obtained at such great risk (see also p. 344 of this issue), and we look forward to the publication of the results when they have been finally worked out.

Pithecanthropus and Peking Man

PROF. F. WEIDENREICH, commenting in another column of this issue of NATURE (see p. 378) on the recent discovery in Java of another skull and a fragment of jaw of *Pithecanthropus*, sets out the grounds for regarding the new evidence, not only as bringing a prolonged controversy to a sudden close, but also as confirming conclusively the close relation between *Pithecanthropus* and Peking man, which he had inferred from his study of the material previously known. From the time of the discovery by Dr.

E. Dubois in the early nineties of the last century of skeletal material in Java, to which he gave the title of *Pithecanthropus erectus*, there has been a division of opinion as to whether these remains were to be classified as human or anthropoid. Of recent years, opinion has tended in an increasing degree to incline to the latter; but recently doubt has been revived. Dr. E. Dubois, after prolonged study not only of the material known to anthropological text-books, the skull-cap, thigh bone and tooth from Trinil, but also of other material from the same provenance in his possession, for the most part not previously published, arrived at the conclusion, mainly on the evidence of the long bones, that we are here concerned with a gigantic gibbon. This conclusion, especially in view of the new material, has been received with respect, but not with general acceptance; and in the light of the new evidence it must be regarded as definitely disproved. *Pithecanthropus* now stands within the line of human descent, if only as a 'prehominid', a class in which Prof. Weidenreich would include him (or her) with *Sinanthropus*, Peking Man. It is interesting to note that Prof. Weidenreich's views as to the close relationship subsisting between *Pithecanthropus* and *Sinanthropus* are fully in accord with the recent conclusion of P. Teilhard de Chardin, who on the palæontological evidence holds that the flora and fauna of China in the early Quaternary period were derived at least in part from the south.

The National Fitness Campaign

AT a reception given by the City Corporation at Guildhall, London, on February 17, in support of the activities of the National Fitness Council, H.M. the King, replying to the Lord Mayor's address of welcome, said that the cause for which they were meeting is one of the first importance, for while we are striving to bring the fruits of education within the reach of all, and to improve the conditions in which everyone may grow and live, we must remember that our bodies are the instruments with which we have to work, and that they, too, need education. In order to become physically fit, all must have the opportunity for regular exercise, and this is what the National Fitness Council and its Area Committees are concerned to promote, and it will be their object to secure facilities for everyone, young and old, to follow his or her own inclination in the method of taking this exercise. The good will and co-operation of all who may be in a position to help being vital to its success, the King warmly commended the movement to leaders of industry and commerce, employers and employed, and to local authorities. In conclusion, addressing youth in particular, His Majesty said, "The future will be in your keeping. The present is your opportunity to fit yourselves for a full, active and therefore happy, life. The decision is left to your free choice. It is for you to make the effort."

British Industries Fair

THE British Industries Fair, 1938, opened on February 21 and will remain open each day until March 4 inclusive, except on Sunday, February 27. As in previous years, the Fair is divided between London and Birmingham. The London Section is held at Olympia and at Earls Court, the latter location taking the place of the White City, which was used last year and for many years before. Again it is to be noticed that only goods manufactured or produced mainly within the British Empire are permitted to be displayed. Among the trades exhibiting at Olympia we may note: chemicals (light and heavy), scientific instruments, photographic and cinematograph apparatus, radio apparatus and plastics, in addition to a large number of other industries usually classified as 'light' industries. At Earls Court, the main exhibits are those of the textile and furnishing trades and an Empire Section. Following the practice of previous years, the Engineering and Hardware Section is at Castle Bromwich, Birmingham. The exhibits here include farm and garden equipment, building materials and products connected with gas manufacture, utilization and distribution, electrical generation and transmission, transport and mining.

IT is interesting to notice that the total space occupied in London is more than 10,000 sq. ft. greater than that taken up for the 1937 Fair, and twenty of the trade sections exhibiting are larger than in 1937. At Birmingham, also, the area taken up by the exhibits is well in excess of the 1937 figure, which was a record. Some eight hundred exhibitors will be represented there, and it is stated that their stands are equivalent to a shop counter of British goods twenty-six miles in length. Holland, for the fourth year in succession, heads the list in the number of trade buyers who are visiting the Fair, Belgium being second, Germany third and France fourth. There is, of course, a large number of Empire buyers from overseas. In the Scientific and Optical Instruments Section at Olympia about twenty-six firms are exhibiting. This section of the Fair has grown considerably. Not many years ago, only a few firms exhibited and their stands were scattered indiscriminately. To-day this section occupies a prominent position in the main gangway, in which more than 5,500 sq. ft. are occupied in a combined display of all kinds of scientific apparatus. The instruments displayed include those used for research, medical, educational, industrial, and navigational (both marine and aerial) purposes. A review of the principal exhibits having scientific interest will be given in a future issue of NATURE.

The Proposed Thames Barrage

AT the meeting of the Metropolitan Water Board held on February 18 the report of the Works and Stores Committee on the proposal to construct a barrage across the River Thames at Woolwich came up for consideration. After relating the circumstances which have led to the institution of a public inquiry into the scheme by the Port of London Authority, the report pointed out that the Board's interests are materially involved in respect of the large filtration works adjoining the Thames at Barn Elms and Barnes where there are, in addition to primary filters at Barn Elms, 5 and 19½ acres respectively of slow sand filters from which a total of 27–31 million gallons a day of filtered water is obtained. The top water level of these filter beds varies from 11 ft. to 16 ft. above Ordnance datum, while the bottoms of the filters lie between 4 ft. and 9 ft. below the same datum. Were the water in the Thames to be permanently impounded, as contemplated in the scheme, the level of the ground water would be raised to a height substantially above the floor level of the filter beds, and these would accordingly stand in a body of polluted water, a condition for which they were not designed, and would be beset with risks of contamination to the filtered water. Another danger would be the increased external pressure against the structures during the periods of evacuation for cleaning. The report went on to show that the reception into the river of sewage and storm water laden with sedimentary matter of a putrefactive and infective character within the limits of the impounded area, would induce in the summer season insanitary conditions, resulting in demands for the release of increasing volumes of water over Teddington Weir in order to abate the nuisance, and that this would jeopardize the integrity of the Metropolitan supply at a time of high water consumption. The report concluded with a strong recommendation to offer strenuous opposition to the scheme.

Galloway Hydro-electric Power Development

AT the Institution of Civil Engineers on February 22, a series of papers was read dealing with the inception and execution of the undertaking belonging to the Galloway Water Power Co., situated in the south-west of Scotland and occupying the southern portion of the mountainous region which lies between the estuaries of the Clyde and the Solway. The first paper by W. Hudson and J. K. Hunter gave an account of the initiatory stages and constructional details of the work. The area which has been developed includes the entire catchment (345 square miles) of the Galloway Dee, with, in addition, a further 50 square miles to the north-west, forming the catchment area of Loch Doon. With a slight exception, all the works lie on the greywacke formation, having a soft and shaly consistency. The climate is mild and the rainfall comparatively heavy, varying from 40 inches per annum on the coast to the south to more than 90 inches on the high ground between Loch Trool and Loch Doon. The more important works in their natural sequence consist of the Loch Doon storage reservoir, which provides main seasonal storage for the upper three power stations on the Dee, having an available capacity of 2,930 million cu. ft. and a total draw-down of 40 ft. The original level of the loch has been raised by 27 ft. Then come the Doon-Deugh tunnels by which water is drawn from the reservoir and discharged, as required, into the Dee. A series of three power stations have been installed at Kendoon, Carsfad and Earlstoun, normally operated together. A fourth station at Glenlee with a reservoir at Clatteringshaws Loch, and a fifth station at Tongland complete the chain of development. The paper by W. Hawthorne and F. H. Williams described the mechanical and electrical plant, consisting of eleven main generating sets with outputs of 6,000–12,000 kilowatts, the total rated capacity being 102,000 kilowatts and the voltage 11,000. The third paper, by H. W. Mountain, co-related the scheme with reference to the Grid, by which the bulk of the output is exported, half to central Scotland and half to north-west England. The total expenditure on the Galloway Development amounted approximately to £3,000,000 and the work was completed in the autumn of 1936.

Planning in a Democratic Government

IN an article, "The Place of 'Planning' in a Democratic Government", in the *Nineteenth Century* of December, Sir Daniel Hall discusses some of the reasons for the apparent inefficiency of democratic Government as compared with the efficiency of totalitarian States, and particularly with reference to the position of the technical expert in democratic administration. The problem of parliamentary Government, he suggests, is that of introducing planning into its administrative machinery to an extent which will permit a degree of foresight in the conduct of public affairs that will take long views, anticipate the effect of material progress on the social organism and concern itself with matters affecting the national welfare which have but little popular appeal. Sir Daniel Hall points out that the conception of planning has already entered our system to some extent, but our schemes are usually piecemeal and without provision for the consideration of their place in the national economy as a whole, while technical opinion is liable to be over-ruled and decisions determined less on intrinsic merits and informed criticism of proposals than by the volume of opposition aroused.

SIR DANIEL HALL considers that it is on this question of expert advice and authority that the British administrative system is weakest, although in recent years successive Governments have come to recognize the need for technical advice and established such bodies as the Development Commission, the Department of Scientific and Industrial Research and the Medical Research Council. These bodies and particularly the Economic Advisory Council provide the nucleus of an organization which could exercise the function of planning within the ordinary machinery of Government, and Sir Daniel Hall suggests that the Economic Advisory Council should be replaced by a Planning Council with a strengthened personnel and a technical staff, linked with the Research Councils. The Planning Council would remain an advisory body with the immediate function of advising the Cabinet or the departments on any question submitted to it. Its most important function, however, would be its initiative in planning, and its constitution would afford men eminent in the industrial, commercial, financial and scientific world opportunity of putting forward their ideas, obtaining criticism from their fellows in all walks of life and collecting the relevant data before formulating a plan of action. Its deliberations would be almost wholly concerned with matters upon which the modern developments of science have a bearing, but it would possess no power of action nor publicity. None the less, Sir Daniel Hall suggests that in this way those responsible for government would be supplied with the services of the expert in a way comparable with that in which Fascist and Communist Governments are served.

Scientific Study of Foreign Policy

THE report on the work of the Intellectual Co-operation Organization submitted by the Sixth Committee to the Assembly of the League of Nations refers to the way in which the scientific study of problems of foreign policy is obtaining recognition as a new branch of learning. The International Studies Conference has devoted two years to the preparation of the study of peaceful change, and as a result of research in many countries a series of works on demographic problems, the distribution of raw materials and colonial questions which would offer reliable contributions to the solution of such problems is about to be published by the Institute of Intellectual Co-operation. The next two years are to be devoted to the study of economic policies in relation to world peace. An international conference on higher education held at the Institute dealt with such problems as the organization of various university faculties, scientific research and higher technical education, overcrowding in the universities and international collaboration. A Permanent Committee on Higher Education was appointed by the Conference to keep in touch with these questions. The report directs special attention to the programme of activities drawn up by the Intellectual Co-operation Organization and the Executive Committee of the International Council of Scientific Unions, which is directly connected with the advancement of all branches of science. The Organisation has also been requested to consider what steps might be taken to enable writers to continue to carry out their work with full freedom of thought and expression and a guarantee of material security. Reference is made to an international inquiry into the reorganization of secondary education, the key to the problem of overcrowding in the universities and liberal professions, and finally the report outlines a draft Act to set up and maintain National Committees on Intellectual Co-operation and to grant financial contributions to the International Institute of Intellectual Co-operation.

Automatic Control for Aircraft

ANOTHER step towards the elimination of the physical and nervous strain upon the pilot in a long flight, caused by his having to maintain continuous manual control over the machine, has just been accomplished by the linking up of several separate devices into one synchronized piece of apparatus for use in such cases. A De Havilland "Dragon" passenger aircraft has been acquired by Messrs. Air Travel and Survey, of Sydney, for photographic survey work. The technique of this demands that the machine must fly on a dead straight line and a level keel for periods, and an automatic pilot that can control this while the crew attend to other photographic duties has been in existence for some time. This apparatus in its latest form, known as a 'deviator', keeps the machine on a given course, but the direction of this must be controlled by the pilot. The new apparatus adds to this a Marconi Wireless 'homing' device which sets the aircraft's course in the direction of the transmitting station, when tuned in to that wave-length. The station would normally be an aerodrome with a special call sign, but ordinary broadcasting stations may be used, provided that the pilot can identify them. He thus has nothing to do except to watch and adjust the wireless receiving apparatus as necessary. This machine was successfully demonstrated on February 17 at Croydon. It brings within sight the day when the pilot of a big aircraft will merely have to exercise a general watch over the instruments in his cabin, more comparable with the manner in which the captain of a ship controls his craft.

Radio Research in India

REFERENCE has been made from time to time in the columns of NATURE to the desirability of encouraging the carrying out in India of fundamental radio research of the type sponsored by the Radio Research Board in Great Britain. This matter was referred to in the presidential address prepared by the late Lord Rutherford for the recent Silver Jubilee meeting of the Indian Science Congress. It was pointed out that the investigations conducted in Great Britain on the propagation of radio waves over great distances have considerably increased our knowledge of the upper atmosphere. The details of the electrified regions of the atmosphere vary considerably with the hour of the day and with the season of the year as well as with geographical location. The results are of great practical importance in the selection of the most suitable wave-lengths for radio communication, and, in addition, it does not seem impossible that such studies may prove of value in long-range weather forecasting. There appears, therefore, to be scope for research on this matter in a wide field and in various parts of the world, and Lord Rutherford expressed the hope that it will be vigorously pursued in India. Reference was made to the very promising beginning that has already been effected by Profs. S. K. Mitra and M. N. Saha and their students in attacking fundamental radio problems. As an instance of the important work which is in progress in other parts of the Empire, mention was made of the admirable progress made in this field by the Australian Radio Research Board, which was established nearly ten years ago.

Research in Foot-and-Mouth Disease

THE Minister of Agriculture and Fisheries has decided to enlarge the Foot-and-Mouth Disease Research Committee. The scope of the problem under investigation has become wider than was envisaged when the work was begun fourteen years ago. There is increasing evidence of the necessity for pursuing the intensive study of this particular member of a group of diseases affecting human beings, animals, and plants in close relationship with investigations into virus diseases generally, and of enlisting the experience of workers in other fields of virus research in the elucidation of the problems connected with foot-and-mouth disease. It has been decided in the circumstances that it would be an advantage if the Agricultural Research Council and the Medical Research Council were more actively and directly associated with the work of the committee than at present, and the following have therefore been appointed additional members: Prof. S. P. Bedson, professor of bacteriology in the London Hospital Medical College; Prof. T. Dalling, professor of animal pathology in the University and director of the Animal Diseases Research Institute, Cambridge; Major G. W. Dunkin, director of the Agricultural Research Council Field Station; Mr. G. M. Findlay of the Wellcome Bureau of Scientific Research; Prof. H. B. Maitland, professor of bacteriology in the University of Manchester; Prof. F. C. Minett, director of the Research Institute in Animal Pathology, Royal Veterinary College, and Mr. J. Henderson Smith, head of the Department of Mycology, Rothamsted Experimental Station.

Fire at the Lister Institute, Elstree

A FIRE occurred in the chemical laboratories of the Serum Department of the Lister Institute, Elstree, on February 21; the cause was the explosion of an acetone-distilling apparatus. The chemical laboratories, dark room, and balance room were completely destroyed, but the adjoining bacteriological laboratories and cold-storage rooms, together with valuable stocks of antitoxins, therapeutic sera, vaccine lymph, and a considerable amount of experimental material were saved through the prompt and efficient work of the staff at Elstree and the local fire brigades. The chemical laboratories were a recent addition to a block of buildings erected by the Institute in 1903 when the Serum Department was under the direction of the late Prof. George Dean. These were afterwards occupied by Mr. Sydney Rowland whilst he was carrying out research for the Indian Plague Commission.

Control of Vehicles in Streets by Traffic Signals

A PAPER on street traffic signals by F. G. Tyack was read to the Institution of Electrical Engineers on November 4. The descriptions and illustrations given show that modern street traffic signal equipment bears a remarkable similarity to telephone exchange equipment. It is proved that where complex switching is required, electrical switching telephone apparatus with its ready adaptability forms an ideal solution. Apart from the contribution of the telephone industry, which applies principally to the controllers, other branches of the electrical industry, such as supply lamps, cables and rotating machines, are represented in the necessary equipment. The earliest road signals were manually operated and the mechanically controlled 'fixed time' signal came next. This type consists of a mechanism arranged to measure off arbitrarily determined 'go' and 'stop' periods. Fixed time signals was a cheap method of solving the problem of accident prevention. They are found unsuitable when the traffic is variable, as they cause unnecessary delays and bring automatic signals into disrepute. The logical solution of the problem is that the signals must be operated by the vehicles themselves. The top of a rubber mat projects slightly above the road level. As the channels in the mat are depressed by the wheels of a vehicle, miniature bellows in the contact box become inflated and an electrical contact is made. Impulses indicating the speeds of the vehicles are thus transmitted to the controller. A further step in advance is to have a master controller which, in conjunction with a traffic 'integrator', adjusts the speed of the signal indications to suit the particular traffic density at the time.

Leyden University Botanical Gardens

THE 350th anniversary of the foundation of the Leyden University Botanical Garden has recently been celebrated. It is the oldest botanical garden in Europe after that of the Vatican (1447), Leipzig (1542), Pisa (1543), Padua (1545), Florence (1546) and Bologna (1567). Only the Gardens of Leyden and Padua have remained in the same place since their foundation. The first catalogue of the Leyden Garden drawn up by Clusen in 1594 contained more than a thousand species of plants, and in the time of Boerhaave this number had risen to 5,800. Numerous Japanese plants were added to the Garden by von Siebold in the nineteenth century.

Medical Research in Canada

THE conference on the organization of medical research which was held in Ottawa on February 18, and was attended by the Governor-General, has resulted in the formation of a National Medical Research Committee for Canada with five members, who have power to nominate ten others. The chairman is Sir Frederick Banting, professor of medical research in the University of Toronto, and the other members are Major-General A. G. L. Macnaughton, president of the National Research Council; Dr. R. E. Wodehouse, the Deputy Minister of Health and Pensions; Dr. T. H. Leggett, president of the Canadian Medical Association; and Dr. G. S. Young, president of the Royal College of Physicians and Surgeons of Canada.

The Night Sky in March

THE date of the Spring Equinox is March $21^d\ 7^h$ U.T. The moon is new on March 2 at $5{\cdot}7^h$, and on March 31 at $18{\cdot}9^h$; full moon occurs on March 16 at $5{\cdot}3^h$. Lunar conjunctions with the planets occur as follows: on March $4^d\ 6^h$ with Saturn; on March $5^d\ 15^h$ with Mars; on March $28^d\ 7^h$ with Jupiter. On March $18^d\ 0^h$ Venus and Saturn are in conjunction; on March $20^d\ 5^h$ Mercury and Venus, and on March

$28^d\ 22^h$ Mars and Uranus. The occasion of the fairly close proximity of Uranus to Mars may be used for locating the latter with binoculars, the magnitude of Uranus being about 6·0 and that of Mars about 1·5. Mars sets at $21{\cdot}7^h$. Mercury is at greatest eastern elongation on April 2, so that towards the end of March there is a chance of seeing this elusive planet in the evening twilight. Venus is likewise an evening star, but sets less than one hour after the sun until the latter part of March. Saturn is passing out of view as an evening star and is in conjunction with the sun on March 29, but Jupiter now rises in the early dawn as a bright star of magnitude − 1·6. In the late evening in the middle of March, the bright stars of Orion and Sirius and Procyon are being lost to view towards the west, but there are compensations. For a small telescope, the double star, Castor, is an excellent subject for observation. γ Virginis is another well-known binary the period of which is about 180 years. 12 Lyncis (R.A. $6^h\ 39^m$, Dec. 59° 31′ N). and 11 Monocerotis (R.A. $6^h\ 25^m$, Dec. 7° 0′ S.) are both triple stars. There is a stellar cluster, Messier 35, north-preceding η Geminorum, and the cluster Messier 44, better known as Præsepe, south-preceding γ Cancri. Away from the obscuration effects of the Milky Way, remote space can be explored with powerful photographic telescopes. In Leo, there is a remarkable group of extra-galactic nebulæ (*NGC* 3185, 3187, 3190 and 3193) exhibiting a variety of types and at a distance of about 7½ million light years from the earth. Another group in Boötes and one in Ursa Major (overhead about midnight in the middle of March) give Doppler displacements in the spectra of the component nebulæ equivalent to recessional velocities of about one-seventh the velocity of light itself; the inferred distances are of the order 230 to 240 millions of light years.

Announcements

Dr. Antoine Lacassagne has been nominated director of the Paris Radium Institute in succession to Prof. Claude Regaud.

The International Conference of Naval Architects and Marine Engineers will be held in London on June 16–18. Further information can be obtained from Mr. P. W. Thomas, 39 Elmbank Crescent, Glasgow.

Dr. G. W. Tyrrell gave an address before the Royal Society of Edinburgh on February 7, on the seventeenth International Geological Congress held in Moscow in 1937, in which he described the Congress meetings, at which 72 per cent of the 422 papers presented were by Russian authors and dealt with Russian geological topics. Excursions to the Kola Peninsula and Karelia, and to the Urals and western Siberia, were then described, and the almost illimitable mineral wealth of the U.S.S.R. illustrated (see also p. 354 of this issue).

The Bureau of the United States Census has recently issued a survey of deaths from motor-vehicle accidents in 1937 showing that in 128 major cities of the United States there were 9,964 deaths in 1937 as compared to the 9,308 in 1936—an increase of 7 per cent. Most of the cases occurred in the first six months of the year. 66 cities showed an increase, 57 a decrease and 5 had the same number of deaths as in the previous year.

A Scientific Book Club has been formed to enable the inquiring layman to keep abreast of the latest developments in modern science and to build up a first-class library of scientific books at a considerably reduced price. Each month the Scientific Book Club brings to its members a recently published book which is of outstanding scientific importance. The books are not confined to any particular publisher but are chosen strictly on merit from the various publishing houses, thus ensuring the widest possible field for selection. Further information can be obtained from the Secretary, Scientific Book Club, 121 Charing Cross Road, London, W.C.2.

In view of the great interest aroused by the National Institute of Industrial Psychology's report No. 7 ("Improving the Blackboard", by W. Douglas Seymour), the Institute has decided to hold a small exhibition of suitable primrose-coloured boards of different materials and of the chalks for use with them. The exhibition, which is non-commercial in character, will be held at the Institute, Aldwych House, London, W.C.2, during the fortnight beginning February 28. From Monday until Friday in both weeks it will open at 9.30 a.m. and close at 5.30 p.m. except on March 1 and 8, when it will close at 1 p.m.

The British Non-Ferrous Metals Research Association, in co-operation with the Swedenborg Society, will shortly publish a translation of Swedenborg's famous treatise on copper, "De Cupro", originally published in Latin in 1734. No translation has hitherto appeared. This book gives an account of the smelting and refining of copper as practised in many countries at the time; the production of brass; the nature of copper ores and their assaying; and various other matters pertaining to the properties of copper, its alloys, and its history. Communications on the subject should be addressed to the British Non-Ferrous Metals Research Association, Regnart Buildings, Euston Street, London, N.W.1.

The Trustees of the Lady Tata Memorial Fund invite applications for grants and scholarships, in the academic year beginning on October 1, for research in diseases of the blood, with special reference to leukæmia. Grants of variable amount are made for research expenses or to provide scientific assistants to senior workers. Scholarships are awarded as personal remuneration; their value will not ordinarily exceed £400 per annum for whole-time research, with proportionate adjustment for work on a part-time basis where this is approved. The grants and scholarships are open to workers of any nationality. Applications must be submitted before March 31, 1938, and the awards will be made in June. Further particulars and forms of application may be obtained from the Secretary of the Scientific Advisory Committee, 138 Bedford Court Mansions, London, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 375.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Structure of Metals

In a recent note with the above title[1], Dr. A. Müller has described interesting effects which are observed when metals are investigated at high dispersion with X-rays. When X-rays fall upon a stationary specimen of metal, and are reflected back through nearly 180°, the reflection from the individual crystal grains appears as a number of distinct spots. If the specimen is rotated during the exposure, smooth Debye-Scherrer lines appear, the centres of which are accurately measurable (in precision measurements of spacing the specimen is always rotated for this reason). In referring to the distinct spots he obtains with the stationary specimen, Dr. Müller says, "the surprising fact is that they are scattered over a comparatively wide range . . . thus indicating lattice variations in the individual crystals of the order of 1/1000–1/2000."

If this deduction were right, it would be rather disturbing, since the accurate estimation of lattice spacing, which is so important a feature in X-ray technique, would appear to be meaningless, or at any rate would only represent a statistical average. We think it possible, however, that Dr. Müller's results may be explained by the optical considerations which are described below; this possibility in any event should be fully explored before adopting the rather revolutionary conception of wide variations in spacing as a general feature of the crystalline grains.

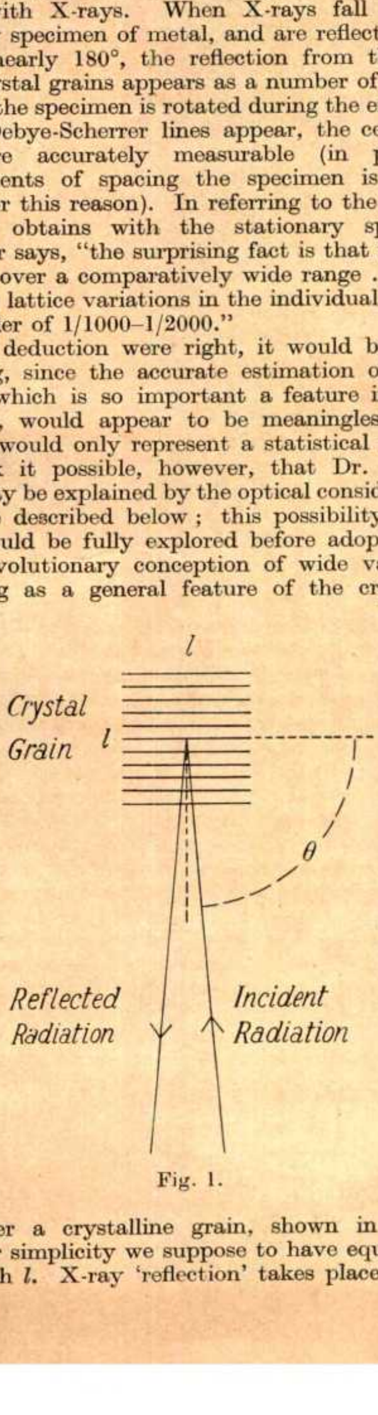


Fig. 1.

Consider a crystalline grain, shown in Fig. 1, which for simplicity we suppose to have equal width and depth l. X-ray 'reflection' takes place over an angular range on either side of the mean glancing angle θ_0, which is nearly 90°; the smaller the crystal the wider is this range. The intensity of the diffracted radiation at an angle $\theta_0 + d\theta$ is governed by the product of two factors which represent:

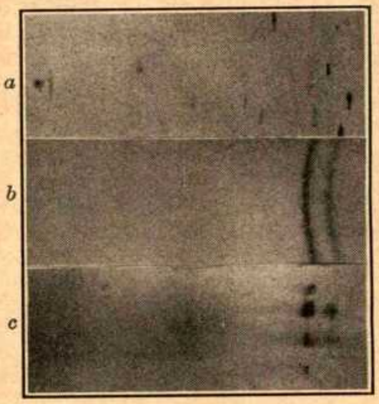


Fig. 2.

(*a*) *The interference between beams coming from successive crystalline planes.* The total range $\delta\theta$ between zero values of the factor on either side is given by

$$\delta\theta = 2\lambda/l \cos\theta.$$

(*b*) *The diffraction of radiation after specular reflection at each crystal plane.* Its angular spread is similar to that of waves passing through a slit of width $l \sin\theta$, and the range is given by

$$\Delta\theta = 2\lambda/l \sin\theta.$$

A. H. Compton pointed out in 1922[2], that when $\theta_0 < \pi/4$, $\delta\theta$ is the smaller, and defines the sharpness of a diffracted beam, whereas when $\theta_0 > \pi/4$, it is $\Delta\theta$ which is the smaller. In Dr. Müller's experiment, where $\theta_0 = 85\frac{1}{2}°$, $\Delta\theta$ is about ten times as narrow as $\delta\theta$.

To see what this means, we may imagine the crystal grain to be rotated through a small arc (of the order of a degree). In any one position it gives a narrow spot of width $\Delta\theta$. This spot appears as the crystal rotates over the whole range $\delta\theta$, being strongest at the centre of the range. Alternatively, if the specimen is stationary, individual grains give sharp spots, which are staggered throughout the range $\delta\theta$ as determined by (*a*) above, although the grains have identical lattice spacings.

It is easy to test this explanation by giving the specimen a 'micro-rotation' over a small angle. The spot due to each crystalline grain is then drawn out into a smear having an intense centre, and fading away on either side. If the grains have different lattice spacings as Müller suggests, the maxima of these smears should be staggered. If, on the other hand, they have the same spacing, the maxima should all fall into place below each other.

Fig. 2 shows the result of such a micro-rotation. The same specimen (a copper wire) was used for all three photographs, the lines being the K_a doublet of cobalt radiation, reflected in the 400 order ($\theta \sim 82°$ for α_1, 83° for α_2). Fig. 2*a* shows the spots produced by individual grains when the specimen is stationary, and it is indeed surprising how much the spots are staggered. Fig. 2*b* shows the ordinary Debye-Scherrer lines when the specimen is completely rotated so that numerous grains pass through the reflecting positions. Fig. 2*c* shows the effect of extending spots similar to those of Fig. 2*a* into smears by a rotation of 3°. It will be seen that their maxima appear in the same positions as the lines in Fig. 2*b*; in other words, the *crystal grains have identical spacings*.

Two suggestions may be offered to explain the striking spread of the spots in a case such as that of Fig. 2*a*. In the first place, though the smooth α doublet lines of Fig. 2*b* appear to be well resolved, examination with a microphotometer shows that they are actually so wide that they overlap, showing that $\delta\theta$ is greater than the separation of α_1 and α_2. Thus there may be a complete overlap of the spots due to α_1 and α_2 when the crystal is stationary.

In the second place, if the incident radiation is not monochromatized, Laue spots due to white radiation appear all over the film. Some of these spots may be near the K_a lines, and seem to belong to them, thus increasing the apparent spread.

We wish to stress, however, that it is still an open question whether all the features of Dr. Müller's photographs can be explained in this way; further investigation is required.

Dr. Müller's experiment suggests an elegant way of examining individual crystal grains, for we gain more information about their dimensions from the individual smears of Fig. 2*c* than from the complete rotation illustrated in Fig. 2*b*, which merely gives the average size.

W. L. BRAGG.
H. LIPSON.

National Physical Laboratory,
Teddington, Middlesex.
Jan. 17.

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[1] NATURE, **140**, 1012 (Dec. 11, 1937).

[2] Compton, A. H., *Phys. Rev.*, **19**, 69 (1922).

Cooling Curves and the Laws of Radiation

I WISH to record a method of treating the radiation between a body and a surrounding enclosure which has been applied to the study of the heating and cooling curve techniques so much used by metallurgists, and may have other uses.

If the time-temperature relationship of such a body is obtained from the Stefan-Boltzmann law, the resultant expression and equations derived from it, if the case is even slightly complicated, are too difficult to be handled by workers of ordinary mathematical attainments. The use of Newton's law of cooling gives simpler expressions, but leaves an uncertainty as to their validity, particularly for theoretical work. By equating a Newtonian expression of radiation such as $k(T-T_e)$ to the corresponding Stefan expression, the 'constant' may be evaluated: and it is found that in many interesting cases the approximation $k = 4C\sigma T_g^3$ (where C is the area-emissivity coefficient between body and enclosure, σ is the absolute emissivity of a black body, and T_g is a fixed temperature chosen by rules which are often very simple) is a very good one, and that equations based on it are easy to handle. For the case of a thermally simple body in an enclosure the temperature of which is a linear function of time, for example, there is, when t is large, an important temperature difference between specimen and furnace (unsuspected or ignored by many previous workers) given by $\rho = - \dfrac{ms}{4C\sigma T_g^3} \cdot \dfrac{dT_e}{dt}$ and the temperature difference at all values of t is given by $\dfrac{\varphi - \rho}{\varphi_0 - \rho_0} = e^{-4C\sigma T_g^3 t/ms}$ where s is specific heat of the specimen, and φ is $T - T_e$.

This manageable form can be modified to allow for heat transfer other than by radiation, and permits, among other things, the existing thermal curve techniques to be examined in a critical manner. In the course of this it was found that if the enclosure temperature as well as the temperature of the specimen were observed, these techniques would be improved in that certain difficulties of interpretation would be removed, and enriched in that the heat quantities involved in a physical change could be assessed and curves of dH/dT (H is the heat contents of the specimen) obtained, not in many cases with the accuracy of Sykes's method[1], but with complication and labour little greater than that of an ordinary thermal curve, and with the ability to work with both rising and falling temperatures.

Two techniques so suggested appear particularly promising. The first is a modified inverse rate curve method. The values of $\delta t/\delta T$ usually observed, when multiplied by the appropriate values of φ, enable a curve of relative dH/dT to be plotted, and absolute values may be obtained if a suitable constant or constants are determined. Mr. W. S. Walker, formerly demonstrator here, has during the last three years developed the practical side of this method and used it to measure the heat changes in carbon steels over the allotropic range, but publication is delayed owing to an unforeseen experimental error. The second technique involves the concurrent plotting of $T-t$ and T_e-t curves by a semi-automatic device permitting a very open scale to be used. The taking of these curves should be less mentally exacting than obtaining a high-grade inverse-rate curve; they will be fairly sensitive and very easy to interpret, and curves of dH/dT are obtainable by measuring areas between the pair of curves. Mr. E. A. Fowler, assistant lecturer here, is collaborating with me in developing this method.

A critical examination of Plato's[2] and Rosenhain's[3] heat evaluation techniques has been made, and it is hoped to publish this shortly.

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Jan. 26.

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[1] Sykes, C., *Proc. Roy. Soc.*, A, **148**, 422 (1935).

[2] Plato, *Z. phys. Chem.*, **55**, 721 (1906); **58**, 350 (1907); **63**, 447 (1908).

[3] Rosenhain, W., *Proc. Phys. Soc.*, **21**, 180 (1908).

Stimulation of Paramagnetic Absorption by a Constant Field

IN previous researches[1] it has been found that paramagnetic absorption at frequencies of about 2×10^7 may decrease considerably under the simultaneous application of a constant magnetic field. We have now observed that, on the contrary, paramagnetic absorption may be strongly stimulated by a comparatively large constant field applied parallel to an alternating field of comparatively low frequency. The accuracy of our observations did not allow us to detect the dissipation of heat in iron alum at a frequency of $3 \cdot 7 \times 10^6$ and a temperature of 77° K. in the absence of a constant field. But under the influence of such a field a strong absorption appeared which attained a maximum at 1,000 oersteds and decreased in still larger fields. The maximum shifts to larger fields for higher temperatures and lower frequencies.

These results are in agreement with our recent observations[2] on paramagnetic dispersion in the same region of frequencies and temperatures, which had already indicated that the absorption region shifted enormously (from about 10^9 to 10^6) under the influence of a strong parallel field. Further, the conclusion[3] that the phenomena at a fixed temperature and field cannot be described by one single relaxation time is corroborated by these results.

Details will be published in *Physica*.

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Groningen. Jan. 20.

[1] Gorter, C. J., *Physica*, **3**, 503 (1936); **3**, 1006 (1936).

[2] Gorter, C. J., and Brons, F., *Physica*, **4**, 579 (1937). Brons, F., and Gorter, C. J., *Physica*, **5**, 60 (1938).

[3] Kronig, R. de L., *Physica*, in the press.

A Wireless Interferometer

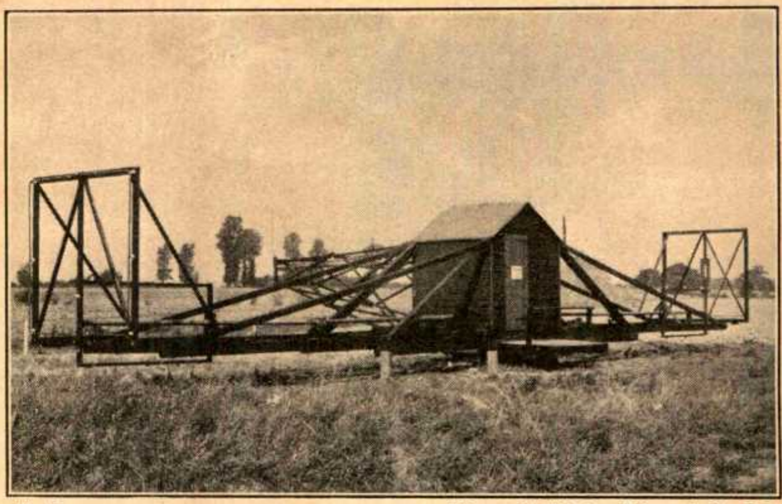
IN a recent communication in NATURE[1], the use of a pair of spaced frame aerials for locating the position of the scattering clouds in the E layer of the ionosphere was described. The system, an example of which is shown in the accompanying illustration, has another function, which is also of importance in the investigation of scattering, namely, the determination of the spread in direction of the scattered rays.

In the presence of a single ray, the E.M.F.'s in the two aerials are definitely related in phase and amplitude, and so it is possible by varying these quantities in the central circuit completely to balance the output of the system. When, however, there are many rays of random direction and phase forming a spread pencil or cone of independent rays, the setting for any one ray differs from that of the others, and all the rays cannot be balanced simultaneously. It is no longer possible to obtain a complete balance since the E.M.F.'s in the two aerials are not exactly correlated. There is a certain random diversity effect which increases as the frames are spaced farther apart. It is possible to calculate the degree of correlation between the E.M.F.'s in the two aerials when it is assumed that the E.M.F. arises from rays of random phase and direction within a cone of angular aperture φ_0, the distribution being

$$Ae^{-\varphi^2/\varphi_0^2}$$

The correlation coefficient r is then approximately

$$r = 1 - \left(\frac{2\pi d}{\lambda} \frac{\varphi_0}{2}\right)^2, \text{ so long as } \left(\frac{2\pi d}{\lambda} \frac{\varphi_0}{2}\right) \leqslant 1.$$



Photo] [*Marconi's Wireless Telegraph Co. Ltd.*

With such a correlation coefficient, it is also possible to calculate the ratio of the residual E.M.F. at the best obtainable balance to the E.M.F. of one aerial alone. This ratio is

$$\frac{u}{v} = \frac{2\pi d}{\lambda} \frac{\varphi_0}{\sqrt{2}}$$

and becomes unity, that is, there is no effective balance at all, when $\pi d\varphi_0/\lambda = 1/\sqrt{2}$.

It will be observed that except for a numerical factor of the order of unity depending on the distribution function of intensity within the pencil of rays, this is exactly the Michelson interferometer formula relating the angular diameter φ_0 of a pencil of rays to the observed mirror spacing d at which the contrast ratio in the fringes disappears. Thus the pair of spaced frames constitutes a wireless Michelson interferometer, the frames taking the place of the mirrors and the ratio u/v corresponding to the fringe intensity ratio.

In the radio technique, the spacing is left constant but the contrast ratio measured. In the astronomical technique, the distance d is varied until the contrast ratio is unity. The same quantity, namely, the angular spread, is, however, measured in both cases.

Observations have been made during the past year to measure the angular spread of the rays reflected from the ionosphere.

Two salient facts emerge: The first is, that whereas for local ground signals balances, that is u/v ratios, of 1/1,000 or less can be obtained, it is very rare for a reflected signal from the ionosphere to give a better balance than about 1/30, with 20-m. frame spacing, and the balance is usually of the order of 1/10, giving a spread of the order of 1° or 2°. The second is that the behaviour of the short scattered echoes (from heights of 100 km.) is in complete contrast with that of the normal echoes from the *E* or *F* layer (indicating a completely different mechanism of reflection). Whereas the latter all give a quite well-defined balance, it is almost impossible with 20 m. spacing to find any balance at all on the former, except on rare occasions. With 6 m. aerial spacing, the balance is broad and ill-defined, with a minimum-maximum ratio of ½ to ⅓ implying angular spreads of the order of 30°. Thus the spaced aerial system, used first as a direction indicator and secondly as an interferometer, indicates, in both cases, that the sporadic short-scatter reflections are of an entirely different character from the normal *E* and *F* reflections. Both the results imply that the sporadic echoes are not reflected from a uniform *E* layer, but from high density patches in the *E* region, which are irregularly distributed both in time and in space.

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[1] NATURE, **140**, 846 (Nov. 13, 1937).

Spectrum of Chromium Chloride, CrCl

RECENTLY Mesnage[1] has reported a system of bands, degraded to the red, in the region 2600–2650 A. He obtained the bands by an electrodeless high-frequency discharge through a heated quartz tube containing chromium chloride. We have noticed that the wave-lengths recorded agree very closely with those of the known system of aluminium chloride. The wave-lengths given by Mesnage, with their vibrational quantum numbers, are reproduced beside those for the corresponding aluminium chloride bands as observed by Bhaduri and Fowler[2]; the intensities given are those for AlCl, Mesnage not having recorded any intensities for the bands which he observed.

CrCl (Mesnage)		AlCl (Bhaduri and Fowler)	
λ	v',v''	λ	Int.
2638·1	2,4	2638·10	3
2632·9	1,3	2632·80	3
2629·8	0,2	—	
2627·0	1,2	2627·00	3
2623·5	3,2	2623·54	5
2622·3	0,1	2622·40	4
2619·9	1,1	2619·98	4
2618·1	2,1	2618·21	3
2614·3	0,0	2614·44	8
2612·0	1,0	—	
2610·3	2,0	2610·22	6

It will be seen that all except two of the eleven bands agree to within 0·14 A. Of the AlCl bands, all the strongest of those which are degraded to the red are included in the above list; the AlCl bands degraded to shorter wave-lengths in the same region do not appear to have been observed. Jevons[3] has commented on the occurrence of AlCl bands when using aluminium electrodes in discharge tubes, and the bands appear to be of frequent occurrence as an impurity, but it is not easy to see how the bands could arise in an electrodeless discharge, unless perhaps the chromium chloride picked up a chip from the mortar when it was pulverized. In the absence of published photographs of Mesnage's bands, or any estimates of their intensities, it is difficult to be quite certain of the identity of the two systems, but the agreement seems to be much too close to be entirely fortuitous.

The vibrational analysis proposed by Mesnage gives the vibrational constants $\omega_{1/2}'$ and $\omega_{1/2}''$ for the upper and lower electronic states of CrCl as about 33 cm.$^{-1}$ and 117 cm.$^{-1}$ respectively. These values are in any event surprisingly small and can scarcely be correct; judging by the values of these constants for other chlorides, we should expect values of the order 300–400 cm.$^{-1}$ for CrCl.

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[1] Mesnage, P., *C.R. Acad. Sci.*, **201**, 389 (1935).

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[3] Jevons, W., *Proc. Phys. Soc.*, **48**, 563 (1936).

Lecture-Room Demonstration of Electron-Optical Crystal Patterns

AN electron-optical image of the crystalline pattern of a metal surface in a sealed-off cathode-ray tube was obtained by Schenk[1] for nickel, cæsium metal serving as activator. The optimum of emission was obtained at a temperature of about 500° C.

Some time ago, we succeeded in obtaining similar results for nickel, nickel iron and iron, using strontium and barium as activator. Metallic strips of the first-mentioned metals were mounted as cathodes in vacuum tubes of similar type to that already described[2], in which a tungsten spiral covered with a suspension of strontium carbonate in amyl acetate and a barium evaporator[3] were mounted.

After evacuation and while the tube was still connected with the pumps, the cathode was heated to a fairly high temperature, then strontium (probably together with strontium oxide) was deposited on it by heating the tungsten spiral. Afterwards a quantity of barium was evaporated in order to absorb the gas residue. Although by this procedure the main part of the evaporated barium was deposited on the wall of the tube, part of it was deposited on the cathode, the latter thus being probably activated by both strontium and barium. Finally the tubes were sealed off.

With an 'electron-microscope' of this type (using a magnetic focusing coil as described elsewhere), intensive emission patterns could be obtained after a (not always identical) heat treatment of the cathode. With nickel and nickel-iron, the intensity of the emission after suitable activation at a temperature of the cathode of about 700°–800° C. was such that the fluorescent pattern could be projected optically on a screen (for example, 50 cm. × 50 cm.), thus giving rise to a highly magnified image of the crystal pattern of the metal surface, visible in a lecture-room[4].

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[1] Schenk, D., *Z. Phys.*, **98**, 753 (1935).

[2] Burgers, W. G., and Ploos van Amstel, J. J. A., *Physica*, **4**, 5, 15 (1937); J.A.T.M., London Congress (1937), p. 82.

[3] See Burgers, W. G., and Ploos van Amstel, J. J. A., *Physica*, **3**, 1057 (1936). Kemmnitz, G., Knoll, M., and Walcher, W., *Z. Phys.*, **96**, 612 (1935).

[4] Cf. Burgers, W. G., *Z. Metallk.*, **29**, 250 (1937).

Seismic Waves in the Core of the Earth

THE velocity of longitudinal waves in the earth increases with depth down to the core, at a depth of about 2,900 km., where there is a discontinuous drop from 13·7 km. to about 8 km. per sec. Within the core, the velocity has usually been calculated as increasing gradually to about 11·5 km. per sec. at the centre.

This velocity distribution leads to a well-known focusing effect for longitudinal waves which have passed through both mantle and core (*P′* waves), at about 142° from the epicentre. The interval between this focus and the last arrival of direct longitudinal waves through the mantle (*P*), at about 105°, should be a shadow zone. The *P* waves are known to continue into this interval by diffraction around the core. Apparently, the *P′* waves also extend backward into the shadow zone from 142° to about 110°. These observations have been referred to diffracted *P′* waves, although the process of such a diffraction is very obscure. The large amplitudes of these waves, especially about 122° and 111°, strongly suggest that another explanation is needed. Supposing that these are also direct waves through the core, we find that all observed travel times and amplitudes are consistent with a velocity in the core increasing from 8 km./sec. at its surface (depth 2,900 km.) to about 10·2 km./sec. at 4,850 km., where a rapid but probably continuous increase takes place, the velocity reaching 11·4 km. per sec. at 5,150 km., then decreasing very slowly to 11·3 km./sec. in the central part of the core.

This velocity distribution requires two additional reversals in the travel time curve, which accounts for various peculiarities in the observations of *P′* near the focal distance (which remains unchanged at 142°). It also accounts for similar observations of other waves, such as *SKP* and *P′P′*.

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Effect of Veiling Glare on Apparent Size and Distance

THE effects of the veiling glare due to illuminated fog may be imitated by reflecting diffused light into the eye from a piece of plate-glass at 45° to the line of vision. The intensity of the glare may be varied readily, but remains unchanged relatively for objects seen at different distances through the glass plate. In this it differs essentially from the glare of fog, which may be greater for distant than for near objects.

The relative apparent sizes of two similar disks seen at different distances in normal vision do not depend simply on the inverse square law, but on the index of 'phenomenal regression'[1] peculiar to each individual subject of the experiment. When two such disks, or other objects, are seen through a veiling glare, the 'articulation' of the visual field is reduced by the glare, and the influence of distance cues is cut out to some extent. We have found, in an experiment done at the University of Glasgow, that, when glare is present, the relative apparent sizes of similar disks at different distances approximate to the sizes expected on the inverse square law. As the glare increases, this approximation increases too, until, with monocular vision and glare such that all distance cues are cut out, it is very close indeed. Glare appears to be the only factor which has such a marked effect on phenomenal regression. With monocular vision under fullest glare, however, one subject out of seven saw the distant disk the same size as the near disk when the near disk was about three times the diameter expected on the inverse square law—even larger than in binocular vision without glare.

The full report on this experiment will be published in the *British Journal of Psychology*, but we should like to point out that it is of great interest in relation to the problems of vision under fog and glare conditions in everyday life. It should be possible to get a more satisfactory imitation of fog glare by an apparatus in which differential glare could be made for the objects of which the sizes or distances are compared. The problems centre around apparent distance as well as apparent size. It is well known that in fog objects seem unexpectedly large, and this is believed to be due partly to the increase in their apparent distance. Artists habitually avoid showing detail in objects which are to seem distant, and the increase in apparent distance of objects seen in fog is partly due to the blurring of detail and partly to the reduction of distance cues in the surrounding visual field. Experiments could be devised in which apparent distance varies, and in which the objects compared have some visible structure which would be blurred by the glare.

Only one subject out of seven who did the experiment at Glasgow confirmed, under the conditions of that particular experiment, the common observation that distant objects look large in fog, and, in general, the results indicate that great individual differences are to be expected. Individual differences in phenomenal regression probably affect the relative accuracy of different people in comparison of sizes, distances and speeds under normal conditions, but it is likely that the man with the highest phenomenal regression will be most disturbed by fog.

These and other points could be investigated experimentally, and might be of great interest in relation to the problems of the control of motor-vehicles, aeroplanes, ships, and also of the accuracy of aiming and shooting, under glare, fog, or in twilight vision.

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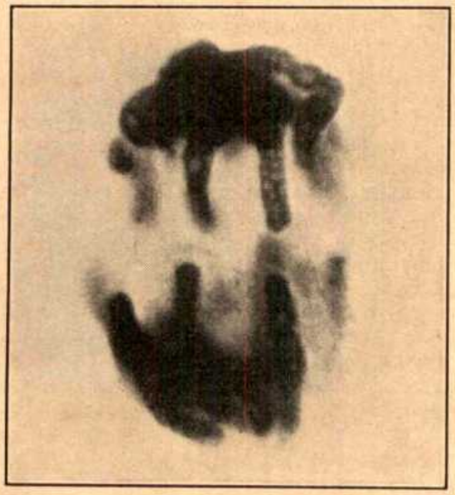
[1] Thouless, R. H., "Phenomenal Regression to the Real Object" *Brit. J. Psych.*, 21, 339–359; 22, 1–30 (1931).

Structure of Chromosomes

PROF. RUGGLES GATES has published photographs of chromosomes at mitosis in *Trillium sessile* by Mr. Mensinkai, which he states show a double coiled structure of chromatids[1]. It happens that structures of this kind have also been obtained in the John Innes laboratory in root tip preparations of the same species and are described in an article by my colleague Mr. La Cour and me in a paper now in the press[2].

It is generally recognized that the fixative employed may influence the products of fixation observed in the cell. Our paper deals with the comparative effects of various fixatives in current use, and we found that the appearance of two threads was an artefact induced by the fixative and due to bubbles of different refractive index in the chromatid. In our experiments these were shown clearly when a fixative containing a high proportion of acetic acid (alcohol acetic, Flemming with acetic) was used. They were practically absent when the acetic was omitted in Flemming solution. Prof. Gates does not state what fixative was employed by Mr. Mensinkai. It will be seen in Mr. Mensinkai's photographs (as in the accompanying figure) that the bubbles are of different sizes, and the single line may be broken by two lying side by side. This would imply, in parts at all events, a triple thread. Prof. Gates concludes that the chromatid is double or even quadruple; is he prepared to admit that it may be triple? Until Prof. Gates can establish the fact that the structures observed by Mr. Mensinkai are real properties of the chromatid itself and not effects induced by the fixation, it would be idle for me to discuss their problematical bearing upon my hypotheses of chromosome structure and the relation of meiosis to mitosis.



Trillium sessile, ROOT TIP SMEAR FIXED MEDIUM FLEMMING + ACETIC, STAINED FEULGEN. × c. 1600.

Prof. Gates also rejects specifically the evidence of X-ray changes in the chromosomes. The genetical experiments on these lines by Morgan and his collaborators[3] and the cytological experiments by Riley[4] and Mather[5] have not to my knowledge been disputed by anyone but Prof. Gates. Elsewhere[6], Prof. Gates has similarly rejected the evidence of the chromomere at meiosis and in the salivary glands of Diptera. If the observations of Belling and Belar and of Heitz and Painter are thus disposed of, I am content that my views should place me rejected in their company.

C. D. DARLINGTON.

Hyderabad.
Dec. 12.

[1] Gates, R. R., NATURE, **140**, 1013 (1937).

[2] Darlington, C. D., and La Cour, L., *Ann. Bot.* (in the press).

[3] Morgan, T. H., Bridges, C. B., and Schultz, J., *Carneg. Inst. Yearbook*, **32**, 298 (1933).

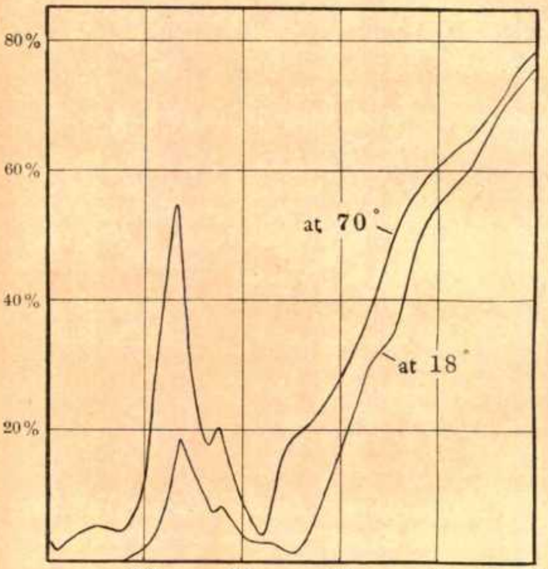
[4] Riley, H. P., *Cytologia*, **7**, 131 (1936).

[5] Mather, K., *Proc. Roy. Soc.*, B, **124**, 97.

[6] Gates, R. R., "Proc. 25th Ind. Sci. Cong. 1938, Abstracts", p. 143.

Hydroxyl Frequency in Carboxylic Acids

THE recent work of Errera and Mollet[1], Fox and Martin[2] and others has shown how the association of single molecules of the alcohols may be studied by means of their infra-red absorption spectra, more particularly in the region of the 'O—H' fundamental frequency and its overtones. In the course of an investigation (suggested by Prof. E. K. Rideal) of the inter- and intra-molecular interactions of the hydroxyl (OH) and carboxyl (COOH) groups in solutions of the ω-hydroxycarboxylic acids, we have been making a preliminary study of the infra-red absorption of some of the simpler carboxylic acids in solution and have established the existence of a similar phenomenon for association of these acids. Although indications of this have already been apparent from the work of Gillette and Daniels[3] on the shift of the 'C=O' and 'C—O' frequencies during association, and from that of Badger and Bauer[4] on a presumed overtone of the 'O—H' frequency in the photographic region, the effect of association on the fundamental 'O—H' vibration would appear to have been missed. Yet here the effect may best be studied and presents (as we have found) several interesting contrasts to the case of pure hydroxyl interaction in the alcohols.



Our results are best described by reference to the accompanying graph, which shows the absorption of a 0·0167 molar solution of benzoic acid in carbon tetrachloride at temperatures of 18° C. and 75° C. It will be seen that at ordinary temperatures there is a very weak band at $2 \cdot 837 \pm 0 \cdot 003\,\mu$, which greatly increases in intensity on raising the temperature. This corresponds exactly to the behaviour of the $2 \cdot 76\,\mu$ band of the alcohols, indicating the formation of a greater concentration of the monomeric molecules at the higher temperature. The shift in the position of the characteristic OH absorption from $2 \cdot 76\,\mu$ to $2 \cdot 84\,\mu$ is of particular interest in distinguishing the OH group in a carboxylic acid from the OH group in an alcohol.

Acetic acid gave results exactly similar to the above, but an investigation of trichloracetic acid was more interesting in that the monomeric OH frequency was shifted to $2 \cdot 860 \pm 0 \cdot 003\,\mu$. This indication of a slightly weaker OH bond presumably corresponds to its behaviour as a much stronger acid than acetic. We have also found that the apparent gradual shift in the 'C=O' frequency at 5·8 μ observed by Gillette and Daniels is really due to there being two separate bands, one coming from the monomer and the other from the dimer.

Another important result from the examination of trichloracetic acid was the discovery of an extremely broad absorption band near 3·3 μ, the intensity of which decreased with rise of temperature. It is difficult to see how this can be anything other than an "association band" corresponding to that in the alcohols at about 2·95 μ.

It should be added that the variation in the monomeric OH band was also achieved by varying the concentration of the acid in the solvent and measuring the integral absorption. The possibility of determining the heat of association of the acid in solution from the integrated absorption curves at different temperatures is being investigated.

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Cambridge. Jan. 31.

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[1] Errera and Mollet, Nature, 138, 882 (1936)

[2] Fox and Martin, *Proc. Roy. Soc.*, A, 162, 419 (1937)

[3] Gillette and Daniels, *J. Amer. Chem. Soc.*, 58, 1139 (1936).

[4] Badger and Bauer, *J. Chem. Physics*, 5, 852 (1937).

Separation of the Glucolytic Enzyme System from the Brain Cells and its Coenzymes

Numerous attempts have been made in the past, with little success, to separate the glucose-splitting enzyme system from brain cells[1,2,3]. The most active extract obtained hitherto had less than 1/20 of the activity of the original tissue[3].

Table 1

	Lactic acid formed by 10 ml extract (corresponding to 2 gm. brain) in 1 hr. from glucose	from glycogen
Brain extract alone	0·22 mgm.	0·24 mgm.
„ „ and boiled yeast extract	0·56 „	4·44 „
„ „ „ „ „ and *Co–Z*	4·21 „	7·22 „
„ „ „ „ „ „ and *Ap*	4·28 „	7·78 „
„ „ „ „ „ „ „ and *GSH*	6·28 „	7·91 „
„ „ „ „ „ „ „ „ and *Cr–P*	24·68 „	7·85 „
„ „ and all the former activators without yeast extract	0·72 „	1·04 „
2 gm brain pulp ground in Ringer sol. and all activators added	12·24 „	1·05 „

No lactic acid was formed by brain extract from substances contained in boiled yeast extracts.

A cell-free brain extract has been prepared with about twice the glucolytic activity of intact brain cells. On cytolysis, a potent inhibitor of glycolysis is liberated from brain. This inhibitor, which is probably an enzyme, does not pass into the extracts if the extraction is carried out in slightly acid medium (*p*H 5·5–6·0). Such an extract contains the glycolytic system but no inhibitor. It has a very slight glucolytic activity. By the addition of suitable activators or coenzymes, however, the glucolytic activity of this extract may be increased up to 2–3 times that of intact brain cells.

One of the coenzymes—the nature of which is yet unknown—is contained in boiled extracts of beer-yeast, in boiled muscle extracts and, in small amount, in boiled extracts of brain. Creatinephosphate was found to be a specific coenzyme of the glucose-splitting enzyme system. Glutathione and cozymase are also required for full activation.

Lactic acid is also formed by brain extracts from glycogen on addition of boiled yeast extract, adenosinetriphosphate and cozymase. About three times more lactic acid is formed from glucose than from glycogen. Creatinephosphate has no activating effect on lactic acid formation from glycogen, although it strongly activates lactic acid formation from glucose.

The extracts are made by grinding one part of rat brain with three parts of ice-cold distilled water and one part of 0·1 *M*. phosphate solution of *p*H 5·5–6·0. After standing on ice ten minutes, the suspension is centrifuged. Air-dried beer-yeast is extracted with three parts of water. The centrifuged yeast extract is heated in boiling water for three minutes.

Table 2.

	From glucose lactic acid	From glucose P_2O_5	From glycogen lactic acid	From glycogen P_2O_5
	mgm	mgm	mgm.	mgm
Start	—	3·92	—	4·14
15 min. at 37° C.	0·42	3·77	0·22	4·01
35 „ „ „	1·05	3·56	0·44	3·96
70 „ „ „	2·57	3·14	1·12	3·87

The experiments described here were made by mixing 2 ml. of brain extract with 1 ml. of boiled yeast extract and making it up with the additions to 6 ml. Activators were added in the following amounts: 2 mgm. adenosinetriphosphate (*Ap*), 3 mgm. creatinephosphate (*Cr–P*), 2 mgm. glutathione (*GSH*), 1 mgm. cozymase (*Co–Z*). 1 ml. of brain extract corresponds to 0·2 gm. fresh brain.

The same amount of lactic acid is formed from glucose alone as from glucose and glycogen when both are added to the same flask. In one experiment, for example, 3·27 mgm. lactic acid was formed from glucose alone, 1·05 mgm. from glycogen and 3·19 mgm. in a flask where both were added together. It seems, therefore, that the glucolytic and the glycogenolytic enzyme systems in brain, though different, probably have common components.

Inorganic phosphate (or creatinephosphate) is esterified in brain extracts during glycolysis as shown in Table 2. (Inorganic phosphate includes creatinephosphate.)

The experiments described above indicate that the observations made on intact brain cells are not valid for cell-free extracts.

Full details will be published elsewhere.

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[1] Mazza and Malaguzzi-Valeri, *Boll. soc. Ital. Biol. sper.*, 10, 722 (1935).

[2] Geiger, A., *Biochem. J.*, 29, 881 (1935).

[3] Euler, Guenther and Vestin, *H.-Seyl. Z.*, 240, 265 (1936).

Mechanism of the Biological Synthesis of Acetylcholine

Stedman and Stedman have stated in a recent issue of NATURE[1] that the presence of acetoacetate leads to acetylcholine synthesis in the brain. The evidence for this conclusion is apparently the fact that the rate of acetylcholine formation by brain tissue macerated in the presence of chloroform and eserine and incubated at 37° is increased on the addition of sodium acetoacetate to the macerate.

Such evidence by itself seems to us quite insufficient to justify the conclusion that acetoacetate takes part directly in acetylcholine synthesis. In the first place, we have found that the rate of acetylcholine formation by ox brain tissue, treated in the manner adopted by the Stedmans, is greater at 18° (room temperature) than at 37°. In fact, this so-called synthesis of acetylcholine is no less at 0° than at 37°. Acetylcholine production by chloroform-treated brain in the absence of added acetoacetate at 18° is greater than that which occurs at 37° in the presence of acetoacetate. At 45° the apparent synthetic action of acetoacetate in the presence of whole ox brain is marked (even exceeding the 100 per cent increase claimed by the Stedmans to take place chiefly with the basal ganglia) but the greatest rate of acetylcholine formation found at this temperature in the presence of acetoacetate is less than that which occurs at room temperature in the absence of acetoacetate. At room temperature where, under the Stedmans' conditions, there is considerable formation of acetylcholine, the addition of acetoacetate has little or no effect.

We have further found that, under conditions approximating as closely to the physiological as possible, substances such as glucose, sodium lactate and sodium pyruvate effect rates of synthesis of acetylcholine in brain tissue which are six to ten times that which take place when such substrates are not added[2]. Yet under these optimal conditions for acetylcholine synthesis in the brain, the addition of sodium acetoacetate has little or no effect on the synthesis.

It seems to us that the acetoacetate effect noted by the Stedmans is connected with the peculiar conditions under which their experiments are carried out. Maceration of brain tissue with chloroform in the presence of eserine, and incubation of this in the absence of buffer solutions or physiological media at 37° under semi-anaerobic conditions, certainly leads to free acetylcholine formation, but the mechanism of this formation requires elucidation. Until this elucidation has been obtained it seems to us rash to conclude, if a given substrate increases the rate of formation of acetylcholine, that this substance necessarily takes part in the synthesis of acetylcholine. Our own results lead us to believe that the action of chloroform on minced brain tissue is greatly to accelerate the breakdown of a complex precursor into free acetylcholine. We consider it likely that the Stedmans' results are connected not with a true synthesis of acetylcholine but with the breakdown of a precursor preformed in the brain tissue. Conceivably, under the conditions obtaining in the Stedmans' experiments, acetoacetate and other substances may affect the velocity of breakdown of the precursor.

It is difficult to compare the results of our experiments with those of Stedman and Stedman since the conditions under which they are carried out are so very different. But under our conditions, which very much more closely approach the physiological, there is as yet no evidence for the conclusion that acetoacetate is directly concerned with acetylcholine synthesis.

Our results and conclusions on the mode of synthesis of acetylcholine have already been communicated to the Physiological Society and will shortly be published in the *Biochemical Journal.*

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Jan. 19.

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[1] Stedman and Stedman, NATURE, 141, 39 (1938).

[2] See also Quastel, Tennenbaum and Wheatley, *Biochem. J.*, 30, 1668 (1936)

Ethnographical Museums

THE student of ancient civilizations, who knows how much of the raw material of history is to be found in our museums, will be grateful to NATURE for the leading article in the issue of January 29 on the purpose and function of ethnographic collections.

The critics of the India Museum in South Kensington, some of whom are apparently prepared to view with equanimity the dispersal of the present collection, will have served a useful purpose if they have directed attention to the interesting experiment in arrangement which is being made under the present keeper, to whom a well-deserved tribute is paid in the article. Those readers of NATURE who are familiar with the report of the Museums Association on the museums of India, and who know from its contents how many collections of antiquities in India have defied arrangement and continue to defy examination by the specialist and student, will best be able to judge how much has been done for the study of Indian civilization by the authorities responsible for our own museum in London. The detailed accounts of Indian history and mythology that accompany the exhibits are a model of what such things ought to be. Indeed, the masterly sketch of the influence of classical art in India on the wall next to the exhibition of the recently acquired sculptures from Hudda in the entrance hall is one that even the specialist may ponder with profit.

The amalgamation of the Indian collections in South Kensington and in the British Museum would provide in London a permanent centre for the study of Indian history and Indian art, which would have no equal in Europe. The advocates of an Indian exhibition, as a step towards the solution of this problem, will command less support from students and scholars. It is appropriate to ask whether those enthusiasts for cultural relations who recommend a temporary Indian occupation of Burlington House, London, have carefully considered what they propose to exhibit. The Ajanta caves cannot be brought to the Royal Academy, nor the gateway of the Sanchi Stupa (a plaster copy of which towers over the staircase in South Kensington), nor, for that matter, the remains that still lie buried under the soil of India and of neighbouring countries, awaiting the spade of the archæologist. A mere exhibition of arts and crafts would involve just that divorce between art and life which, as is pointed out, is such a disservice to the student of any civilization. It is precisely because the authorities who are now responsible for the Indian Museum have not confused the function of a museum with that of an art gallery, that wide support should be given to any proposal to bring together the various Indian collections in London under one roof and under their control.

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Feb. 4.

Realistic Social Studies

I DID not see the leading article on "Realistic Social Studies" in NATURE of January 22 until more than a fortnight after its publication, when it seemed already too late to offer any comments on it. As, however, NATURE of February 12 contains a further reference to this article and to the London School of Economics and Political Science, of which I was until recently director, I hope I may be allowed to make some comments now, registering disagreement on two points and agreement on one.

My first disagreement is with the statement in the NATURE article that I graduated in astronomy. It is true that at one time I aspired to be an astronomer, and, with that in view, studied mathematics for my first year at Oxford. But at the end of that year I became convinced that I was not a mathematician, and less rightly that there was nothing more to be discovered in astronomy.

My second disagreement is with the suggestion, which perhaps was not intended but which appears to arise out of the article, that the Rockefeller Foundation declined to renew a grant to the School of Economics because of some special dissatisfaction with the economic teaching and research of that institution. It is a matter of common knowledge that at the end of 1934 the Rockefeller Foundation adopted a new policy in regard to the social sciences generally. This policy excluded the indefinite continuance of any grants similar to those which had been made for several years by the Foundation to the School, but, subject to this, it is, I think, fair to say that the Foundation treated the School with exceptionally friendly consideration rather than the reverse. The new policy involved termination of grants to many institutions all over the world. The temporary renewal on a tapering basis of the grant to the School, which was due to terminate immediately after the adoption of the new policy, was not a blow at the School, but a piece of special consideration for it.

My third point, of agreement, is with the view implicit in the NATURE article that progress in the social sciences depends upon their coming nearer to the natural sciences in methods and spirit. This I take to be the main point of the article, as it was the theme of my address on "The Place of the Social Sciences in Human Knowledge", of which a summary was published in NATURE of June 26, 1937 (139, 1117).

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Feb. 15.

Points from Foregoing Letters

Prof. W. L. Bragg and H. Lipson consider that the scattered spots observed by Dr. Muller in X-ray crystal photographs taken at an angle of nearly 90° for the incident rays—from which he had deduced comparatively wide lattice variations in individual crystals—may be due to the angular range of the diffraction of the radiation after specular reflection at each crystal plane, the small crystals being variously oriented. To test this view, they have rotated the crystalline specimen (copper wire) through an angle of 3° while exposed to X-rays, and find that the maxima of the intensities of the spots—now elongated into 'smears'—are not 'staggered', but fall into place below each other. This, they consider, proves that the crystal grains have identical spacings.

The paramagnetic absorption in iron alum is found by F. Brons and Dr. C. J. Gorter to be strongly stimulated at a frequency of $3 \cdot 7 \times 10^6$ and a temperature of 77° K. in the presence of a comparatively large constant field applied parallel to the alternating field. Absorption attains a maximum at 1,000 oersted.

A pair of spaced frame aerials can be used to determine the spread in direction of the rays scattered by reflection from the ionized *E* layer of the atmosphere, according to experiments by T. L. Eckersley. The apparatus described indicates that the observed sporadic echoes are reflected from high density patches in the *E* region, which are irregularly distributed both in time and in space.

It is pointed out by Drs. A. G. Gaydon and R. W. B. Pearse that the band spectrum observed by Mesnage and attributed to chromium chloride agrees closely with the already known spectrum of aluminium chloride.

To explain the registration, in the 'shadow zone', of the *P′*-earthquake waves—Prof. B. Gutenberg and C. F. Richter postulate that the velocity of the waves in the earth's core increases from 8 km./sec. at its surface (depth 2,900 km.) to 11·4 km./sec. at 5,150 km., and then decreases slightly to 11·3 km. in the central part of the core.

T. M. Martin and Dr. R. W. Pickford find that in the presence of 'glare'—such as produced by illuminated fog or by reflection of diffused light into the eye by a plate-glass at 45°—the relative apparent size of a disc at different distances is much nearer to what would be expected from the inverse square law than is the case under normal conditions. This may be attributed to the absence of 'distance cues' when the glare is strong.

A cell-free brain extract with about twice the glucolytic activity of the intact brain cells has been prepared by A. Geiger by carrying out the extraction in slightly acid media. The addition of coenzymes (found in extracts of beer-yeast, boiled muscle, etc.) is necessary and glutathione and cozymase are also needed for full activation.

Experiments on the formation of free acetylcholine by brain tissue macerated in the presence of chloroform lead Drs. P. J. G. Mann, M. Tennenbaum and J. H. Quastel to the view that the chloroform accelerates the breakdown of a complex precursor into free acetylcholine and this increases the rate of formation of acetylcholine. They throw doubt on the mechanism suggested by Stedman and Stedman who assumed that the presence of acetoacetate leads to acetylcholine synthesis in the brain.

Research Items

War and Morality among the Ngoni

THE interrelation of the moral code and the character of the community and its demands on the individual are considered by Dr. Margaret Read in a study of the moral code of the Ngoni of Central Africa in relation to their former military state (*Africa*, 11, 1; 1938). Before the coming of the Europeans, the Ngoni were a nation under arms, to whom war had been in the first instance the means by which they maintained their right to settlement in a new country, and afterwards to extend their territory and acquire cattle. It was also, however, as affecting the individual, a moral training ground by which certain moral qualities were inculcated, especially after puberty, and by which they were taught that strength and bravery were not a momentary flash in times of stress, but the outcome of training and discipline and a clear conscience. If a man had committed adultery before going to war, he was 'afraid in his heart' lest he should play the coward. If a regiment failed to carry out its task, the cause was assumed to be some moral lapse. Apart from the conditions of war, the traditional sanctions were directed to preserving the solidarity of the State and to maintaining aristocratic traditions. The preservation of these traditions rested with the women of good family. The moral code, which was inculcated from infancy to puberty and marriage, and afterwards regulated the conduct of married life, was rigidly enforced in the interests of the community. Upon its observance depended the internal security of the State and the success of its arms in war. The situation to-day as regards sexual morality is deplored by the Christian and non-Christian Ngoni alike. They attribute it to the coming of the Europeans, which has torn up by the roots the sexual morality, which was so closely bound up with the needs of the community. The chiefs could no longer exercise control over the lives of their subjects, while the prohibition of war involved abolishing the regiments with their discipline and training.

The Desert Locust in Arabia

R. C. MAXWELL-DARLING has recently published an article on the outbreak areas of the desert locust (*Schistocerca gregaria*) in Arabia (*Bull. Entomol. Res.*, 28, 605; 1937). In his capacity as locust investigator of the Imperial Institute of Entomology, the author undertook journeys in southern Arabia with the view of ascertaining whether there is likelihood of outbreak centres existing in that area. As the result of several years' work in the Anglo-Egyptian Sudan, Mr. Maxwell-Darling concluded that the only centres of outbreak of this locust in North East Africa lay on the Red Sea coast. This did not, however, rule out possibilities of such centres occurring in Arabia. As the result of 12 months' travel in the latter country, he concludes that the south part of the Red Sea coast and probably that of Yemen are outbreak areas. Concerning other areas, less definite conclusions were arrived at and, as the author points out, if the outbreak areas are properly defined and given the requisite organization, there is every hope that the desert locust might be destroyed before spreading beyond these areas. Large regions have been found to be purely invasion areas, in which outbreaks cannot originate, and only certain restricted areas have been proved to comprise outbreak centres. It has been shown that outbreaks of the desert locust can be suppressed at their source by timely application of poisoned baits. Such outbreaks were prevented, for example, in the Tokar district of the Sudan, during three successive years by the district commissioner and his staff.

Western Indian Ocean as a Faunal Unit

FURTHER evidence that the western Indian Ocean might be regarded as a faunal unit is offered by Dr. K. H. Barnard in his study of the Amphipoda of the recent John Murray Expedition (Scientific Reports, 4, No. 6; 1937). The collection was not a large one, comprising only 116 species, almost all being well-known forms, but they provide useful zoo-geographical information for an area the amphipod fauna of which has remained hitherto practically unworked. That many of these Indian Ocean species extend along the east coast of Africa as far as the southern point of the continent is explained by Dr. Barnard as being due to the Mozambique-Agulhas current. Three problematical species which turned up in the material were *Karoga megalops*, *Sympleustes grandimanus* and *Thoriella islandica*, the first-named of which is known only from Iceland and Alaska in deep water, while the others are deep-water Atlantic forms. Dr. Barnard asks whether it is "too unreasonable to regard these deep-water forms from the Arabian Sea as relics of the Cretaceo-Tertiary Sea of Tethys". He mentions that Lieut.-Colonel Seymour Sewell had also previously found two or three species of arctic copepods in Indian waters.

Meteorology in Egypt

A VERY detailed study of wind, temperature and lapse-rate of temperature in the first sixty-one metres above the ground at Ismailia, on the shores of Lake Timsah, in Egypt, is contained in Geophysical Memoir No. 71, of the Meteorological Office, by W. D. Flower. The observations extend over a period a few days longer than twelve months, but in a climate of such a steady type this period is long enough for bringing out the essential diurnal and seasonal variations of these quantities. The thermal observations include continuous records of air temperature as registered by a platinum resistance thermometer at a height of 1·1 metres and of temperature differences between that height and a height of 16·2 metres, between 16·2 m. and 46·4 m., and between 46·4 m. and 61·0 m. A wind vane and a Robinson anemometer were mounted at the top of the latticed steel tower that carried the thermometers; in addition, there was a Dines pressure tube anemometer several hundred metres away from the tower, with its vane at a height of 15·2 m., and various thermometers of ordinary pattern much nearer to the ground. The analysis of this observational material has been carried out in the most thorough manner, in relation to season, type of sky, strength of wind, situation as regards the synoptic chart for the Mediterranean and neighbouring countries, etc. The results obtained are so many and of such equal interest that it is impossible to summarize them in a short note. This memoir will be a happy hunting ground for students of dynamical meteorology who have theories to test, and above all for those especially interested in terrestrial and atmospheric radiation, for both the inward radiation from the sun and the terrestrial radiation from the ground act powerfully upon the atmosphere in turn each day, under a sky that is very rarely overcast, and yet there is enough water vapour to lead to fog and low cloud at times just before sunrise, and well-marked thermal effects can sometimes be traced to the radiation and absorption of this suspended water and water-vapour.

Use of Pulverized Fuel in Cylindrical Boilers

DURING the last few years, the Fuel Research Station's programme of experimental work on pulverized fuel has included a great deal of research on the use of this fuel in cylindrical boilers. Mr. T. F. Hurley has undertaken to present to the Institute of Fuel a series of papers dealing with results obtained at the Station. His first paper, read to the Institute on December 7, goes far to quash the prevalent idea that powdered coal cannot be successfully applied to Lancashire boilers owing to the smallness of combustion space available as compared with water-tube boilers. In the case of water-tube boilers it is impracticable to reduce the size of combustion chambers owing to the tendency for molten ash particles to be carried out of the furnace. In the case of Lancashire boilers, however, the ratio of boiler heating surface to furnace volume is far higher than that of water-tube boilers. Thus a correspondingly greater heat release can be obtained without molten ash being carried out of the furnace. In this type of boiler, therefore, heat releases are governed primarily by combustion conditions. Admittedly, the high surface to volume ratio is not conducive to good combustion, but reasonably good results can be obtained by suitable methods of rapid ignition followed by rapid combustion. Vindication of the Lancashire boiler fired with powdered coal is substantiated by actual test figures which prove that it can be operated at loads far in excess of those normally obtained.

Cosmic Evolution

PART 5 of vol. 146 of Division 2a of the *Sitzungsberichte* of the Academy of Sciences of Vienna contains a paper on "The Evolution of a Cosmic Dust Cloud" by Prof. Hildebrand. He assumes the cloud to have initially the simplest properties which admit of dynamical treatment, that is, its density is uniform throughout and it is spherical in shape. Each particle is describing an ellipse with a natural period proportional to the 3/2th power of its distance from the centre of the sphere and inversely proportional to the square root of the mass of dust within that distance from the centre. The plane of the ellipse and the direction of motion round it are distributed at random. Impacts between the particles are taken as inelastic. Under these conditions the author shows that impacts will produce mass conglomeration and a tendency for the augmented mass to move in paths nearer the centre of the cloud than before the impact. This increases the central field of force and the central tendency is augmented. In addition the concentrated masses tend without impacts to carry with them an atmosphere of smaller dust. The planes of motion of the masses which effect the primary concentration about the centre determine the "invariable plane" of Laplace, the direction of motion in that plane, and the tendency of the cloud to assume the disk form. This, the author points out, is the first step towards the production of a central system such as the solar system. He proposes to deal in a later paper with the consequences of the heat developed by the non-elastic impacts which he postulates.

Radial Velocities of Cepheid Variables

AN important addition to our knowledge of Cepheid variables has been made by Prof. A. H. Joy (*Astrophys. J.*, 86, 363) who has made a series of velocity observations of 128 stars of this class. Our previous knowledge of Cepheid velocity curves was confined to 29 stars which had been measured frequently and were known with considerable accuracy. Joy has abandoned the practice of intensive observations of selected stars, and attempted a general survey of the fainter Cepheids, using the minimum number of observations of each which would give a reasonable approximation to its velocity curve. Using low-dispersion spectrographs he has been able to extend observations to stars of magnitude 14, and now, in declinations north of −40°, only 35 Cepheids are left for which no observations are available. These are mostly fainter than the fourteenth magnitude. Full details of the individual measures are given, together with diagrams of the velocity curves of 106 stars and a table showing the various data available for 155 Cepheids as deduced from the present observations and including previously published results. A short discussion of the relationships between period and certain characteristic properties of the stars is also given in the light of this extensive new material.

The System of α Ursæ Majoris

THIS is the title of a paper (*Mon. Not. Roy. Astro. Soc.*, 98, 2 ; December 1937) by Dr. H. Spencer Jones and Mr. H. H. Furner. The duplicity of the star was discovered by Burnham in 1889, the separation being then 0″·9, but this had decreased to 0″·6 in 1902, and after this the companion was not seen until 1933. The paper contains a very full description of the meridian observations made at Greenwich and also of the double star observations, as well as a summary of the radial velocity measures made at Lick Observatory. Combining the results, the orbital elements and the mass of each component are deduced. Taking the mass of the sun as unit, the masses of the brighter star and its companion are 2·14 and 0·96 respectively, but a serious discrepancy arises when the mass-luminosity relationship is utilized to find these masses. Use is made of the tables in Eddington's "Internal Constitution of Stars", and it is shown that agreement is reached by the masses derived by this method and from the orbital elements when the parallax is 0″·022. The masses of the components are 8·6 and 3·8 and the velocity of the centre of gravity of the system is − 8·72 km./sec. If the elements so derived are correct, it is difficult to explain the fact that the companion was not seen between 1905 and 1933, as the separation would have been sufficient then for its detection. It is suggested that there may be variation in its brightness, and it may be recorded that a similar hypothesis for the companion of Procyon is the only explanation of the failure to see it from 1914 onwards. Further observations of the α Ursæ Majoris system are highly desirable.

Pithecanthropus and *Sinanthropus*

By Prof. Franz Weidenreich, Cenozoic Research Laboratory, Peiping Union Medical College

DR. R. VON KOENIGSWALD in No. 5147, vol. 191, of the *Illustrated London News* (December 11, 1937) gave an account of the discovery of another *Pithecanthropus* skull in Java and a lower jaw fragment which he also attributes to *Pithecanthropus*. As emphasized in the introductory note by Sir Arthur Keith, these discoveries are of the utmost importance to our knowledge of the history of early man. All students interested in palæoanthropology will, I am certain, appreciate Dr. von Koenigswald's enthusiasm and eagerness in the search for traces of the Java hominids, an undertaking which has now met with remarkable success.

A controversy of many years' standing has suddenly been brought to an end. It may now be considered a certainty that *Pithecanthropus* is not a giant gibbon but a genuine hominid, a fact already demonstrated by Weinert's reconstruction of *Pithecanthropus* Skull I and by the discovery of *Sinanthropus*. In a recent article[1], I have been able to demonstrate that *Sinanthropus* Skull II of Locus *L*, recovered in November 1936, completely conforms in relation between height and length and in other details to the *Pithecanthropus* cap. The more pronounced flatness of the forehead is compensated by a stronger depression in the obelion and lambda region of the former. The new and more complete *Pithecanthropus* skull, which is the very image of the first, confirms this statement. Since the entire temporal bone is preserved, the absolute height of the brain case can be defined and thus permits calculation of the height-length index. This index is the same as in *Sinanthropus* Skull II of Locus *L*; as a matter of fact, it is even somewhat higher than in the latter. The close relationship between *Pithecanthropus* and *Sinanthropus* can no longer be doubted.

With respect to the special nature of the relationship, however, I regret to say that I am unable to accept von Koenigswald's conclusions. He considers *Pithecanthropus* to be more primitive than *Sinanthropus*. This claim is based upon two points: namely, upon the cranial capacity of *Pithecanthropus*, which he estimates to be only 750 c.c. and thus rather inferior to that of *Sinanthropus*, and upon the complete absence of the mastoid process. I doubt the correctness of the first statement. According to the photographs, the greatest length of *Pithecanthropus* Skull II is the same as that of Skull I (about 180 mm.), the greatest breadth (about 140 mm.) only 4 mm. less than that of *Sinanthropus* Skull *E*, and the auricular-bregma-height 95 mm. (against 93 mm. in *Sinanthropus* Skull *E*). The cranial capacity of *Sinanthropus* Skull *E*, however, amounts to 915 c.c. according to exact measurements of the endocast. Unless we consider that the bones of the *Pithecanthropus* Skull II are considerably thicker than the already exceptionally thick bones of *Sinanthropus* Skull *E*—a rather unlikely feature according to von Koenigswald's photographs, especially if the skull is considered to represent a female individual as is surmised by him—it is impossible that the cranial capacity of that skull could be inferior by as much as 165 c.c. According to my own estimation, the cranial capacity cannot be less than 850 c.c. With such a low cranial capacity, *Pithecanthropus* still falls within the range of variation of *Sinanthropus*, for Skull I, recently described[2], certainly did not exceed the 850 c.c. limit. The fragments of the frontal and temporal bones of this *Sinanthropus* skull are considerably smaller than the corresponding parts of the *Pithecanthropus* Skull II. The smallness (complete absence ?) of the mastoid process cannot be considered a standard feature of primitiveness as is suggested by Koenigswald. *Sinanthropus* also shows a very great variability in the size of this protuberance. This process in the Krapina skull is exceptionally small, while in the Rhodesia skull it is as well developed as in recent man.

On the other hand, it should not be overlooked that all *Sinanthropus* skulls exhibit one real primitive feature which is completely lacking in both of the *Pithecanthropus* skulls, namely, the separation of the supraorbital ridges from the forehead by a distinct and broad furrow. In *Pithecanthropus* these ridges continue within the frontal squama, as is also true of the skulls within the whole Neanderthal group.

The entire discussion of the degree of primitiveness, however, is of secondary nature. When compared with other fossil hominids, there is no doubt that *Pithecanthropus* and *Sinanthropus* represent the same general stage of evolution as affirmed by M. Boule, who recently combined the two types under the common name "préhominiens". The differences existing between the two types must be considered as regional or racial deviations. Neanderthal man, as well as recent man, as a rule displays in details a great number of primitive and progressive features existing side-by-side, regardless of the general classification of the types within the order of hominids. Hence, *Sinanthropus* may have retained a primitive character in one of the structures and, perhaps, *Pithecanthropus* in another.

The new discovery of the mandible points exactly in the same direction. Since both the jaw and teeth are rather strongly developed, I doubt whether they actually belong to individuals characterized by such small skulls as the *Pithecanthropus* skulls, although the restorer of the entire head took such a condition for granted, judging by the photograph in the *Illustrated London News*. In the case of *Sinanthropus*, the small skulls (female) have small jaws with relatively small teeth. The mandible fragment, judged by size only, would rather fit the large skulls of *Homo soloensis*. In any event, the teeth are interesting because of the extensive combination of primitive and more advanced characters. The increasing size from M_1 to M_3 is a primitive feature, whereas the shape and patterns of the second premolar and the first and second molars suggest a much more advanced type when compared with the *Sinanthropus* teeth. All the peculiarities specific to primitive *Sinanthropus* teeth are absent in these *Pithecanthropus* teeth (compare my publication on the *Sinanthropus* dentition[3]). Therefore, should the mandible really belong to *Pithecanthropus*, then the degree of primitiveness would once more be directed towards *Sinanthropus*.

The *Pithecanthropus* problem, however, cannot be discussed without referring to *Homo soloensis*. In the publication quoted above[1] I have directed attention to the fact that *Homo soloensis* bears so close a resemblance to *Pithecanthropus* that a conception is suggested that the former represents a male and the latter a female individual of one and the same type. The recovery of the new skull exhibiting the same shape and size as the first one supports this idea. I know that geological conditions seem to contradict such a combination, but as a matter of fact, the similarity is so striking that *Homo soloensis* must at least be considered the next further advanced phase of *Pithecanthropus*. In this connexion, it must be borne in mind that within the *Sinanthropus* group there are small and large skulls with their cranial capacities varying from 850 c.c. to 1,220 c.c. and with corresponding differences in shape and features. At any rate, further discoveries will certainly contribute towards a better understanding of the existing relations.

Thus we proceed to another question raised in von Koenigswald's article. Koenigswald considers the baby skull of Java, the so-called *Homo modjokertensis*, though with certain reservation, as an infantile *Pithecanthropus* skull. Sir Arthur Keith agrees with von Koenigswald on this point. Again, I doubt the correctness of such an interpretation. Since the skull belongs to a very young child, it is difficult to judge it on the basis of criteria valid for adult skulls. This is especially true of the relation between height and length. We know that in young individuals, even in anthropoids, the forehead is much more erect and hence the relative height of the brain case much higher than in adult skulls. However, there are two facts, which, in my opinion, are incompatible with the assumption of a direct general relation between that baby skull and *Pithecanthropus*, so far as the latter is represented by the two adult skulls. One fact is the circumstance that the length of the sagittal border of the parietal bone of the baby skull considerably exceeds the corresponding length of the frontal bone. Such a feature is rather characteristic of recent man, whereas in fossil man and in the great apes exactly the reverse is true. Although that difference is less in very young than in adult skulls, it nevertheless exists. But in the baby skull of Java the length of the parietal bone is, without question, already considerably greater than the respective measurements of the adult *Pithecanthropus* skulls and the *Sinanthropus* skull taken for comparison above.

One other fact must be added. The occipital bone of the baby skull is rather equally curved in the inion region, whereas the adult *Pithecanthropus* and *Sinanthropus* skulls exhibit a distinct angle at this region between the upper and lower portion of the occipital squama. Although this feature may be found to be somewhat altered in young individuals also, it is important that a fragment of a *Sinanthropus* at our disposal which, according to its entire appearance, cannot be much older than the baby skull, shows that characteristic inion angle to be well pronounced already. For these two reasons, I am inclined to consider both of the peculiarities just described as an indication that the baby skull of Java represents a more advanced type than the two adult *Pithecanthropus* skulls, and must thus be attributed as belonging to a *Homo soloensis* type rather than to the latter.

The recent important discoveries of Java have solved one problem, but, as is common in such cases, they have at the same time raised new questions.

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[1] Weidenreich, F., *J. Roy. Anthrop. Inst.* (in the press).

[2] Weidenreich, F., *Bull. Geol. Soc. China*, 16 (1936–37).

[3] Weidenreich, F., *Palæontologia Sinica*, N.S. *D*, No 1, Whole Ser. No. 101.

Science in India*

KALA-AZAR AND MALARIA

The conquest of kala-azar and certain observations on the chemotherapy of malaria were discussed in Sir U. Brahmachari's presidential address to the Section of Medical Research. The earliest epidemic of kala-azar in Bengal ('Burdwan fever') occurred in the seventies of the last century, when it was probably complicated with malaria. In this epidemic, the fell disease defied every human effort. In more recent times, the epidemic of the disease in the Nowgong district of Assam produced such an appalling mortality that there was a decrease of 31·5 per cent in population of the place in the decade 1891–1900. The mortality from the disease has now been reduced from 90 per cent or more to 1–2 per cent. Including complicated cases, it has been reduced from 99 to less than 10 per cent.

The conquest of kala-azar may be said to have begun when Cristina and Caronia obtained remarkable results in infantile kala-azar of the Mediterranean basin by the use of tartar emetic. It has been observed (Brahmachari and co-worker) that when metallic antimony is injected intravenously in a leishmania-infected experimental animal in a state of fine subdivision, the particles are picked up by the same cells in the spleen as those that harbour the parasites of kala-azar, and that the ensuing struggle results in the complete destruction of the parasites in the speediest way. It is one of the most powerful leishmanocides.

It has been found that, in the campaign against kala-azar, treatment with tartar emetic or sodium antimonyl tartrate had the disadvantage of being long and tedious. In Assam, which was once the hot-bed of the disease, mass treatment with these drugs was therefore found difficult to enforce, as patients discontinued treatment altogether or attended very irregularly after a few injections. It was felt that the difficulties in reducing the number of 'stopped treatment' cases would be overcome more effectively if some drug could be introduced which would be more efficacious than tartar emetic and take a much shorter time to effect a cure. Such a drug was found in 'urea stibamine'. Its value in the campaign against kala-azar in Assam is demonstrated from statistics in the Annual Public Health Reports of the Government of Assam.

* Continued from p. 340.

The figures for the Cachar district are very interesting. Out of 5,188 cases treated between 1925 and 1936, the number of deaths was 56, showing a percentage of less than 1·08. Out of 574 cases treated in 1936, the number of deaths was 2, showing a percentage of less than 0·3. The incidence of the disease in Assam has been reduced from 60,940 in 1925 to 10,587 in 1936, and the mortality from 6,365 to 753 during the same period. The disease has lost all its terrors in the Province, and people who suffer from it are less afraid than those who suffer from malaria.

The Kala-azar Commission, India, used, throughout the seven years of its existence, urea stibamine only, in the routine treatment of kala-azar. According to it, the acute fulminating type characteristic of the peak period of an epidemic responded to treatment with urea stibamine extraordinarily promptly and with an almost dramatic cessation of fever, diminution in size of the spleen and return to normal condition of health.

In 1933, the Director of Public Health, Assam, noted that "It is no exaggeration to say that approximately 3·25 lacs of valuable lives have been saved to the Province". In 1922, in studying the treatment of kala-azar, Sir U. Brahmachari observed certain remarkable skin eruptions caused by *Leishmania donovani* developing in kala-azar patients two or three years after completion of antimonial treatment and apparent cure, though, under ordinary conditions, in kala-azar the skin shows very little involvement or none (dermal leishmanoid). Viable leishmania have been cultured from these skin lesions in test-tubes and sandflies. They are therefore a source of infection, and the conquest of kala-azar cannot be regarded as complete unless these lesions are either averted or quickly cured. In the campaign against kala-azar and its conquest, proper handling of cases of dermal leishmanoid is an important point to be taken into consideration.

Research in malaria therapy has been intense in recent times. In certain parts of India it is of greater interest than kala-azar. The chemotherapy of quinoline and acridine compounds in malaria may one day play an important part in the campaign against the disease and its conquest. While some quinoline and acridine compounds have marked destructive action on paramecia, most of them have been observed to have no action on the parasites of malaria when used clinically in patients suffering from the disease.

Recently a compound having a similar composition to that of quinacrine or atebrin has been synthesized in Sir U. Brahmachari's laboratory. It has been used in the form of the hydrochloride or hydrobromide. Its action in benign tertian and malignant tertian infections in man is identical with that of atebrin. Shortt and Menon have observed that in a series of experiments carried out with this compound and atebrin on monkeys infected with *Plasmodium knowlesi*, the effect of the two drugs in sterilizing the peripheral blood, the cure rate, and relapse rate were identical.

The discoveries of effective anti-malarials and leishmanocides rank among the highest triumphs of synthetic chemistry in its application to tropical medicine.

Sir U. Brahmachari concluded by saying that if along with the conquest of malaria and kala-azar there is in India "a proper balance between labour-saving devices and industry-increasing discoveries", and if her people "will but decide to put in play the methods", which science to-day has provided for sufficient supply of food and clothing and shelter, then the health and economic problems of India, with her endless natural resources, will be solved to a great extent and much of her unrest and unemployment will cease, and she will have the opportunity of being richer, happier, healthier and freer than ever before.

PHYSIOLOGY OF THE INDIVIDUAL IN THE TROPICS

Bt.-Colonel R. N. Chopra discussed the physiology of the individual in the tropics in his presidential address to the Section of Physiology. With the development of bacteriology and immunology, medical science has been dominated by the conception of specific infection, and emphasis has been laid more on the invading organism than on the invaded patient. In modern physiology, also, a good deal of stress is laid on the cellular organization of living bodies and on isolated organs or tissues rather than on the organism as a whole. Man is an organic unity in relation to his surroundings, and therefore his normal physiological processes are likely to be modified by the environmental forces which are constantly impinging upon him. Like all other living organisms, he is endowed with powers of adaptation, and he reacts to his environment in such a way as to produce within himself ideal conditions for life within that environment.

The most important environmental factor affecting the dweller in the tropics is the high atmospheric temperature, associated usually with bright sunlight and excessive humidity. These three combine to make the primary demand on the body—that of heat regulation. There is evidence that acclimatization for generations to a hot climate has endowed the skin of the tropical races with the power of getting rid of excessive heat. The pigmented skin prevents the penetration of heat to the more sensitive tissues, and, by absorbing heat, allows stimulation of local heat receptors and consequent reflex sweating and evaporation. The sweat glands also appear to develop a special adjustment; the sweat is not only more abundant but also contains less chloride than that of the European, an indication that the body is striving to prevent an otherwise serious depletion.

Like the skin, the gastro-intestinal tract also shows some adaptive response. The cutaneous vasodilatation leads to splanchnic vasoconstriction, with diminution in gastric and biliary secretions, and possibly also gastro-intestinal atony, with their sequelæ of loss of appetite and constipation.

The respiratory and cardio-vascular systems also share in the process of adaptation; but it is doubtful whether any permanent change is brought about. Changes in water metabolism undoubtedly occur, with reflected alterations in the state of the body fluids, but the changes reported are not significant enough to deserve special attention. Examination of the blood shows that, contrary to the general belief, a tropical climate does not produce anæmia, but may actually have a stimulating influence on the hæmopoietic system.

There is no unanimity of opinion on the degree to which the nervous system is affected, and experimental difficulties make decision difficult. It seems certain, however, that, so far as the endocrine system is concerned, hot climate reduces the activity of the thyroid-adrenal apparatus. The expected lowering of the basal metabolic rate is, however, not observed.

The natural diet of the tropical native appears to be very well adapted to his environment. The low protein intake tends to keep heat production at a low level, fat is undesirable on account of its high calorific value, while carbohydrate, of which there is abundance, is, on account of its water binding power, ideally suited to promote loss of heat by evaporation.

It is clear that human individuals, like other organisms, receive modifying impressions from their physical environment. It is only natural that, in the process of adjustment, individuals residing in the tropics will develop physiological, biochemical, and possibly pathological states, which will be peculiar to the climatic type and different from others residing in other climatic zones. Unless these peculiar characteristics of tropical climate are known, no definition of a 'normal' individual will be possible. The determination of physiological 'normals' provides the essential base line for the study of disease, and therefore both physiologists and medical men should study the problems of environmental adaptation more intensively than they have so far done.

AMBIVALENCE

In his presidential address before the Section of Psychology, Dr. G. Bose discussed "Ambivalence". It is well known that negativistic states occur both in normal and abnormal persons, and in some cases of dementia præcox the state may attain pathological proportions, but there is no generally recognized satisfactory explanation of the symptoms. Some would postulate an innate characteristic, prompting to contradictory emotional attitudes towards the same object, to which the word ambivalence is given; others tend to limit this attitude to the love-hate situation. Now although opposite types of behaviour in different circumstances and at different times are quite common among normal poeple, no one has sought to explain them by the theory of ambivalence. Strictly speaking, the ambivalency theory should be limited to cases where opposite tendencies are observed to be working simultaneously and so affecting behaviour, but because of the unconscious element ambivalence is never a matter of direct observation, and must therefore be regarded as an explanatory concept.

If it be assumed that the motive force of behaviour is *wish*, then it is easy to see that behind the emotional states of love and hate are wishes of opposite types; the real opposition therefore between love and hate lies in the contents of the corresponding wish situation. Only in the domain of a dynamic entity does the concept of opposition hold good, so that if we are to recognize an opposition between such elements as pleasure and pain, love and hate, subject and object, we must suppose that these entities are of the dynamic order. Pleasure and pain are opposites because they are usually associated with opposite types of reaction; otherwise they are just like any two different experiences, for example, red and green colours.

Still, neither the antithesis between love and hate, nor that between activity and passivity gives us any clue to the solution of ambivalence.

We might make the assumption that pairs of active and passive wishes of all sorts exist in the psyche. Ordinarily the wishes inhibit each other and the ego remains in a neutral state free from apparent strain. Sometimes in the presence of an object the equilibrium of the ego is disturbed and the wish corresponding to the objective situation is thrown out by the ego as a pseudopodium—to use a biological term. The subjective counterpart of the wish is felt by the ego as a striving towards the object. When the act is completed, the *subjective* striving finds satisfaction in the situation of the main ego and the *objective* striving in the situation of the object carried there.

Opposite pairs of wishes may, therefore, be supposed to exist in all wish situations. It is only where reciprocity is possible that the components of the pair become manifest. If there is a one-sided influence in childhood favouring one of the pair of opposite wishes, repression results. Repressed masochism makes sadism ambivalent and vice versa.

It is, then, better to consider ambivalence not as a fundamental trait of mental life, but to assume that pairs of opposite wishes are fundamental. The components of such pairs of wishes may have alternate complete satisfaction in reciprocal acts, and partial satisfaction with unpleasant emotion tones in retaliatory acts. They may not necessarily produce ambivalent states and even when they do, in many cases, the ambivalence is removable, thus showing that it is a repression product.

PHYSIOGRAPHY OF RAJPUTANA

Dr. A. M. Heron's address to the newly instituted Section of Geography and Geodesy on "The Physiography of Rajputana" summarized the results of his geological work extending over twenty years in that area.

Rajputana, covering 130,642 sq. miles, is roughly rhomb-shaped with E–W and N–S diagonals, of about 540 and 510 miles in length respectively. The Aravalli mountains intersect the area running N.E.–S.W., from Delhi to Gujarat, a distance of 430 miles. These mountains are a true folded range, deeply eroded at the present time, and are probably the oldest mountains in the world still remaining as a range. It is to the physical and geological features of the Aravalli hills that Dr. Heron pays particular attention.

After a brief mention of the Precambrian succession which forms the principal geological interest, Dr. Heron compares the present-day features of the two divisions into which the region is divided by the range. To the north-west the country is largely desert and, with the exception of the catchment basin of the Luni river, an area of enclosed drainage in which salt lakes have formed. The origin of the salt and the sand of the dunes of the *seif*, *barchan* and ordinary types is traced to the Rann of Kachh. The solid geology has little effect on the topography. South-eastern Rajputana is morphologically more varied, while desert conditions are replaced by a fairly well watered and comparatively fertile land. The relations between the geology and topography are discussed in some detail.

Dr. Heron then proceeds to his description of the Aravalli range. After pointing out that, in contradistinction to the rest of India, the folding continued to a geologically much later date since the Vindhyan rocks have been affected, he proceeds to show that the Aravalli range was in existence forming a barrier between the two areas (west and east) in which the Vindhyans were laid down. The uplift is considered to be pre-Vindhyan in age.

Referring to the folding of the range and the rocks which were involved, Dr. Heron directed attention to the fact that, in spite of its name, the Aravalli range is composed mainly of rocks of the Delhi System. This system lying unconformably on the Aravalli System is developed in a geosyncline with the softer Aravalli rocks exposed on the flanks. The higher grade of metamorphism and the greater amount of igneous intrusion in the Delhis is attributed to the deeper infolding in the synclinorium and the consequent greater temperature and pressure. The synclinorium is compared to a double fan. Where the handles meet, the folding is believed to be that of a simple syncline, spreading out at either end by the appearance of further folds, by the thickening of some of the formations and by deeper folding bringing higher beds into the core. Details of folding and faulting along the range are given.

Dr. Heron then proceeded to discuss the Mesozoic rejuvenation of the Aravalli range, which was accompanied by the formation of the Great Boundary fault and the disturbance of the Vindhyan rocks. On the evidence given he arrives at the important conclusions that the range was peneplaned during the Mesozoic, at some period not much earlier than the Cretaceous, and was re-elevated before the beginning of the Tertiary.

Evidence was brought forward to suggest the existence of a second peneplane of Tertiary age, while a third of Pleistocene age, the 'Bhangar' or older alluvium, is also present.

Medicine and Eugenics

IN the Galton Lecture delivered before the Eugenics Society on February 16, Prof. John A. Ryle, regius professor of physic in the University of Cambridge, pointed out that the aims of the science of medicine and the science of eugenics are in many respects identical. Medicine, however, in the past has paid too little attention to inheritance, and eugenics too little attention to environment. The neglect of eugenics by the medical profession is shown by the fact that out of approximately 650 members of the Eugenics Society only one fifth are medical men.

Prof. Ryle urged that fuller consideration than at present should be given to genetics in the medical curriculum from the first year of biological study and continued until the final clinical year. He suggested that a study of animal genetics should be substituted for some of the routine morphological study in zoology, and that reproduction, genetics, growth and nutrition should take the place of the more specialized biochemistry and biophysics.

It is, moreover, important that the family doctor should be able to give advice on such subjects as sterilization of the unfit and taxation relief for the encouragement of healthy parenthood, and should be familiar with the significance of population fluctuations, the various causes of decline in physical standards, the origin of mental defect, and so forth. It is owing to the medical profession being insufficiently instructed that members of the lay public have to content themselves so frequently with quacks, doubtful literature and advertisements. Prof. Ryle maintains that it is the function of the medical profession to advise politicians in the matter of planning for a health campaign. In addition to nutritional reforms, housing improvements and other comparable measures within the purview of State medicine, statesmen, communities and individuals alike should devote their attention to the study of pedigrees and encourage an optimum fertilization rate. Owing to the present lack of co-ordination within the medical profession and reliance on local enthusiasm and sporadic individual efforts, progress is necessarily slow. What is wanted is a drastic reorganization on a large scale such as is being carried out in the U.S.S.R.

In conclusion, Prof. Ryle made the following recommendations: First, a national council of medicine, eugenics and sociology should be formed not only to direct education and research in human genetics and social reorganization, but also to transmit to the legislative councils accumulated information with suggestions for reform. Secondly, more stress should be laid in the medical curriculum upon all preventive aspects, especially the preservation of health by nutritional and other social reforms and the application of human and animal genetics to eugenic education. Thirdly, existing organizations, eugenic and sociological, should be employed to interest the medical profession in the preventive and educational role which they should play by instruction in domestic eugenics. Fourthly, a limited number of chairs or readerships should be founded in human genetics, the study of which should be carried on in close association with animal genetics and the biological sciences on one hand and the clinical sciences on the other.

University Events

ADELAIDE.—Dr. James Davidson, head of the Department of Entomology at the Waite Agricultural Research Institute of the University, has been appointed to the Waite professorship of entomology.

CAMBRIDGE.—R. H. Angus, of Sidney Sussex College, has been appointed University lecturer in engineering.

Prof. A. R. Radcliffe-Brown, of Trinity College, professor of social anthropology in the University of Oxford, has been appointed to the Frazer lectureship in social anthropology for the academic year 1938–39.

H. E. Hinton, of King's College, has been appointed junior curator of the Museum of Zoology.

The Raymond Horton-Smith Prize for 1936–37 is awarded to Dr. H. L. H. H. Green, of Sidney Sussex College, for a thesis entitled "Monotreme Teeth: a Study in Mammalian Tooth Development".

The Appointments Committee of the Faculty of Archæology and Anthropology expects to proceed shortly to the appointment of a University lecturer in anthropology. In making the appointment preference may be given to candidates having experience of Oceania and the Pacific area and a knowledge of their peoples. Further particulars may be obtained from Mr. M. C. Burkitt, secretary of the Appointments Committee of the Faculty, Museum of Archæology and of Ethnology, Cambridge, on or before May 28.

EDINBURGH.—The Cameron Prize for 1938 has been awarded to Dr. Karl Landsteiner, member of the Rockefeller Institute for Medical Research, New York, in recognition of his researches on isohæmagglutinins and blood-groups and the influence of his discoveries on the practice of therapeutic blood transfusion.

Science News a Century Ago

Druidical Temples

AT a meeting of the Royal Irish Academy on February 26, 1838, reported in the *Gentleman's Magazine* of the following June, Mr. Petrie gave an account of a very remarkable collection of stone circles, cairns, etc., situated in the town of Carrowmore, in the parish of Filmacowen, and about two miles from the town of Sligo. They were of the class popularly called druidical temples, and had in every instance, one or more cromlechs or kistvaen within them. Many of these monuments were greatly dilapidated, but there were still existing vestiges of about sixty circles with cromlechs, and it was known that a vast number had been totally destroyed by the peasantry. They were all formed of granite boulders except the covering of stones and another of the cromlechs in the great cairn, which were of forms. In all the circles which had been either wholly or in part destroyed human bones and their urns, etc., had been invariably found, and one circular enclosure, outside the group, and of far greater extent than any of the others, but evidently of contemporaneous construction, was filled with bones of men and animals. Mr. Petrie stated that this was the largest collection of monuments of the kind in the British Isles and probably, with the exception of the monuments at Carnac in Brittany, the most remarkable in the world.

The Frozen Soil of Siberia

AT a meeting of the Royal Geographical Society held on February 26, 1838, a paper by Prof. Karl Ernst Baer (1792–1876) entitled "On the Frozen Soil of Siberia" was communicated by Vice-Admiral von Krusenstern. It had long been ascertained, said Baer, that over a great extent of the country, the soil in Siberia was never entirely free from ice. During the summer, the surface of the ground was to a greater or less depth, thawed, but at some distance from the surface a bottom of perpetual ice was met with. Gmelin, the elder, had stated that shortly after the founding of the town of Yakuzk (in lat. 62½° N., long. 130° E. nearly) the soil was found to be frozen to a depth of ninety-one feet and the sinking of a well had to be abandoned. Within the last few years, however, a merchant having attempted to sink a well in that town, was persuaded by Admiral Wrangel to continue his operations until he had penetrated the whole stratum of ice. This he did, keeping a journal of his work. The pit was sunk to a depth of 382 feet, when loose soil was encountered, the temperature of the earth being ½° Réaumur. The temperature at various depths was as follows :

−5	at	77	ft.	−1½	at	305	ft.
−4	,,	119	,,	− ½	,,	350	,,
−2	,,	217	,,	½	,,	382	,,

This immense thickness of ground ice would prove that Siberia must have been for a long period in the physical condition as it was at present. In the actual state of our information it was impossible to determine how widely the layer of ground ice was spread under the surface of Siberia. In concluding his paper, Baer said it would be interesting if the Geographical Society would collect information respecting the extent of the layer of ground ice in North America.

Faraday's Experiments on Conduction

ON February 26, 1838, Faraday recorded in his Diary :

> "Made some expts. with 6 of Daniells' cells on conducting power conferred on water by acids, salts, etc. Found them very different and for a first approximation may arrange them into three classes.
>
> *Sulphuric*, *Nitric*, *Oxalic* and *Phosphoric* acids gives much power.
>
> *Tartaric* and *Citric* acids ; *Potassa, Soda*—*Carbonates* of *potassa, Soda* and *ammonia*—*Sulphate of soda*—*Nitre* and *Bicarb. soda*—give less.
>
> *Acetic* and *Boracic* acids—*Ammonia*—*Corr. Sublimate*—*Percyanide* of *Mercury*—*Iodine*—*Gum* and Sugar—give no sensible power tested by Volta meter but would probably by the Galvanometer.
>
> The results are useful general approximations."

Early Proposals for Steam Navigation

ON February 26, 1838, Prof. Stephen Peter Rigaud (1774–1839), the Savilian professor of astronomy, gave an "Account of some Early Proposals for Steam Navigation" to the Ashmolean Society. The latter part of the paper was taken up by a notice of the claim made that Blasco de Garay in 1543 at Barcelona made the first known experiment of propelling a vessel by the agency of steam. The claim was made in a book published in 1831, entitled "A Year in Spain by a Young American", the author being Capt. Slidell, U.S.N. Another notice had appeared in the *Literary Gazette* for 1827. "The critical examination of the question," said Rigaud, "must be left to those who have the advantage of being acquainted with the Spanish language, and have the opportunity of examining the original authorities, on which the statement depends. The Catalonians, indeed, were always the most enterprising people of the Peninsula ; but the machinery, necessary for the effect here described, seems to be beyond the age in which it is said to have been constructed, and it is difficult to persuade ourself implicitly of its existence".

The documents relating to the incident preserved at Simancas, near Valladolid, Spain, were examined in September 1857 by John Macgregor, who in a paper to the Royal Society of Arts, on April 14, 1858, stated that neither of the letters "contained any mention whatever of the use of steam".

The Royal Gardens

THE *Athenæum* of March 3, 1838, said : "Curiosity having been excited by a statement in the newspapers that the condition of the Royal Gardens has been the subject of an official inquiry, we have taken some pains to ascertain the truth of the report, and we find the facts to be as follows : A Committee has been appointed by the Lords of the Treasury to investigate certain matters connected with the Queen's Gardens at Windsor, Hampton Court, Kew, Kensington and Buckingham Palace ; and under the direction of the Committee, Professor Lindley has been lately engaged in a minute horticultural inquiry into the administration of these establishments. In this duty Dr. Lindley has associated with himself two gardeners of great experience, namely, Mr. Paxton, gardener to the Duke of Devonshire, and Mr. Wilson, gardener to the Earl of Surrey. We have reason to believe that a report has already been made, but as it relates to matters connected with her Majesty's household, we do not feel at liberty to make public the results of the inquiry."

Societies and Academies

Paris

Academy of Sciences, January 4 (*C.R.*, 206, 1–80).

Alfred Lacroix : The Archives of the Academy of Sciences and the biographical index of its members and correspondants from 1666 to 1937.

Marcel Delépine and Alain Horeau : The dimer of crotaldehyde. The hydrogenation of the corresponding acid and the transposition of its double bond by the nickel.

Charles Eugène Guye. The possibility of verifying experimentally the relation $\nu = \nu_0\sqrt{1 - \beta^2}$ of limited relativity.

Paul Gillis : The multiple integrals of the calculus of variations.

Alfred Liénard : A particular case of the problem of Dirichlet for a circular ring.

Marcel Brelot : Some properties of sub-harmonic functions and of *balayage*.

Lucien Malavard : Electrical analogy as an auxiliary method of photo-elasticity.

Douchan Avsec : Vortices in transversal bands in a layer of air heated from below.

Louis Goldstein : The theory of nuclear reactions.

Mme. Marie Antoinette Tonnelat-Baudot : The different forms of a function of action expressed with the aid of complex variables.

Pierre Vernotte : Concerning a verification of Rayleigh's criterion.

Louis Néel : The interpretation of the paramagnetic Curie point of the elements of the rare earth group.

Marcel Rouault : The structure of the $GeBr_4$ molecule. By the electron diffraction method, results have been obtained which agree with a tetrahedral structure for the molecule of germanium tetrabromide. The atomic distances found are Ge-Br, 2·32 A. and Br-Br, 3·79 A.

Jean Cayrel : The Devaux reaction (copper, copper sulphide) on a limited surface.

Alexandre Travers and Hamid Zahabi : Some properties of the hexahydrate of tricalcium aluminate and anhydrous tricalcium aluminate.

Jean Kraft : The uranyl ortho-arsenates.

Raymond Calas : The preparation of two stereoisomeric ($d + 1$) dihydrocamphorones.

Paul Gaubert : The formation and orientation of soft macled crystals in anisotropic liquid drops of *p*-axoxyanisol.

Mlles. Wilfried Heller and Germaine Quimfe : The two possible orientations of colloidal goethite in the magnetic field.

Mengli Enikeff : Researches on the soils of the interior delta of the Niger.

Louis Dubertret and Henri Vautrin : The existence of the lacustrine Pontian in Syria and on its tectonic signification.

Antonin Tronchet : The direct mechanical stimulation of the papillary cells of the tendrils of *Eccremocarpus scaber*.

Albert Vandel : The existence of relations between the arrangement of the chromatophores and that of the muscular insertions in Isopods of the genus *Trichoniscus*.

Theodore Kofman : Morphological reactions in the serum of the cancerized rabbit.

Jean Cuillé and Paul Louis Chelle : The *Tremblante du mouton* is inoculable.

Amsterdam

Royal Academy (*Proc.*, 40, No. 10 ; 1937).

H. A. Kramers : The use of charge-conjugated wave-functions in the hole theory of the electron.

J. Clay : Ionization and conductivity in gases at high pressures. Measurements of ionization in air, nitrogen, helium, neon, argon, krypton and xenon with cosmic rays and gamma rays.

J. G. van der Corput : Weyl's method in the theory of numbers (3) : Two, three or four primes.

R. Weitzenböck : Trivectors (3).

P. E. Verkade and J. van der Lee : Syntheses of glycero-phosphatidic acids and glycero-phosphatides.

E. Dubois : The osterone arrangement of the thigh-bone compacta of man identical with that first found in *Pithecanthropus*.

C. S. Meyer : Some further integral representations of products of Whittaker functions.

F. Florschütz and I. M. van der Vlerk : Fossil cell structure in Early Pleistocene deposits in the East Netherlands.

G. H. R. von Koenigswald : A lower jaw fragment of *Pithecanthropus* from the Trinil layers of central Java.

Jean K. Weston : Notes on the telencephalon of *Mormyrus* and *Gnathonemus*.

Brussels

Royal Academy (*Bull. Classe Sci.*, No. 11, 1937).

L. Godeaux : An algebraic surface of divisor two deduced from the surface of Veronese.

P. Gérard and R. Cordier . Existence of glandular cells in the kidney of the *Aglossa*.

E. Lahaye : Solution of Stórmer's equations by real convergent integral iterations.

C. Surquin : Bernoulli's law in two variables.

O. Rozet : Cyclic involutions of order nine belonging to an algebraic surface.

L. J. Tison : Wear round bridge piers in a river.

A. Grosjean : Some observations on the northern border of the Liége coal-field.

Z. M. Bacq and A. Oury : Note on the distribution of choline esterase in living beings.

Rome

National Academy of the Lincei (*Atti*, 25, 413–524 ; 1937).

L. Petri : Transmission of the leaf-curl virus of the vine through tissues of a resistant variety.

F. Tricomi : Inversion formula of Widder.

L. Cesari : Resolution of systems of linear equations through successive approximations.

G. Pompilj : Cremona transformations of the plane which has a curve of united points.

L. Toscano : Deviation of the permutability in the theory of linear operators.

M. Villa : Varieties in four dimensions which possess ∞^7 conics which are quasi-asymptotics $\gamma_{1,8}$.

G. Colonnetti : Elastic equilibrium of systems in which non-elastic deformations also occur (2).

G. Lampariello : Kinetic interaction between vortices and irrotational currents.

M. Lombardini : Gradient wind.

C. Possio : Rotational motion of gases.

G. L. Andrissi : Variation of the latitude of the Royal Astronomical Observatory on the Capitol from 1920 to 1934 (2).

S. Franchetti: Calculation of the penetration of electrons of some million volts (1).

G. Racah: Isotropic tensors which show particular symmetries (1).

P. Guareschi: (1) Considerations regarding the rapid and approximate calculation of the specific heats of liquids. (2) Association coefficients and their variations as a function of temperature.

A. Banchetti: Reformatsky's reaction carried out on benzamide.

G. B. Bonino and R. Mansoni-Ansidei: (1) Lines attributed to a possible pyrrolenine form in the Raman spectrum of pyrrole. (2) Raman spectrum of *N*-deuteropyrrole.

A. Iandelli and E. Botti: Crystal structure of compounds of the rare earths with metalloids of the fifth group. (3) Arsenides and antimonides of lanthanum, cerium and praseodymium.

G. B. Bonino: Molecular symmetry of pyrrole.

L. Cavallaro: Absorption bands in polar substances at very high radio-frequencies (2).

M. Bolli: Researches on amylases.

Vienna

Academy of Sciences, December 16.

Marietta Blau and Hertha Wambacher: Photographic investigation of heavy particles in cosmic rays. A number of proton tracks, having a mean energy of 12×10^6 e.v., have been recorded. These appear to be secondary particles, as there is no directional effect. Thirty-one nuclear disintegrations have also been recorded, and the energy released in each is estimated to be more than 200×10^6 e.v.

J. Stiny: Structure of the Obir mountain and east–west displacements.

F. Seidl: Dielectric constants and electrical conductivities of annealed and dehydrated Rochelle salt.

O. Ampferer: Junction of the east and west Alps at the Rhine valley.

F. Wessely, H. Hirschel, G. Schlögl-Petziwal and F. Prillinger: Constitution of equol.

A. Demmelmair: Variation of cosmic ray intensity on the Hafelekar according to local and sidereal time. No fluctuation with a period of one sidereal day could be established; but there was a period of one solar day. The maximum occurred at midday and the minimum at midnight. There was also a definite yearly period, the maximum being in the winter.

Washington, D.C.

National Academy of Sciences (*Proc.*, 23, 595–637, Dec. 15).

G. H. Parker: (1) Antidromic responses from the melanophore nerves of the catfish *Ameiurus*. (2) Antagonism in neurohumours as seen in the pectoral bands of *Mustelus*. Cuts across the fin of this dogfish produce a pale band which extends practically to the edge of the fin and has straight sides or irregular sides according as the fish are blanching or darkening respectively. This and other effects are believed to be due to the presence, simultaneously, of the dispersing neurohumour intermedin (causing darkening) and a concentrating lipohumour from the nerves (causing blanching).

E. H. Hall: The four transverse magnetic effects in copper: new measurements. Measurements have been made of the Hall, Ettingshausen, Nernst and Righi-Leduc effects, at temperatures ranging from 20° to 90° C. Using the figures for the Hall and Ettingshausen coefficients, values for the other two can be calculated by the author's theory of dual conduction in metals. The results are in fair agreement with the experimental values.

P. S. Epstein: Magnetic energy of supraconductors.

C. Sobutsky, L. F. Andrieth and R. W. Campbell: Acid catalysis in liquid ammonia. (1) Ammonolysis of diethylmalonate. Liquid ammonia reacts directly with many substances, the reaction being similar to hydrolysis and hence known as ammonolysis. As hydrogen ion often catalyses hydrolysis, so ammonium ion is found to catalyse ammonolysis. Diethylmalonate in liquid ammonia gives malonamide, the yield increasing with the concentration of ammonium chloride added. Equivalent concentrations of different ammonium salts were roughly equally effective.

L. Pauling and J. H. Sturdivant: Structure of cyameluric acid, hydromelonic acid and related substances. X-ray analysis leads to the view that these substances contain a trivalent cyameluric nucleus C_6N_7, consisting of a co-planary arrangement of three fused rings, and resembling the cyanuric nucleus C_3N_3.

Richard Goldschmidt: Spontaneous chromatin rearrangements and the theory of the gene. As a result of innumerable repetitions of pair-breeding in pure stocks of *Drosophila* or in simple crosses involving mutants in a rather labile equilibrium, it is concluded that all so-called gene mutations are chromatin rearrangements. The chromosome is the unit, and a definite order within its texture is required for normal development.

J. D. Hardy and E. F. DuBois: Regulation of heat loss from the human body. Two normal men were studied nude in the large respiration chamber of the Russell Sage Institute of Pathology, New York, in environments ranging from 23° C. to 35° C. under basal and other conditions. No seasonal changes were found from experiments in winter, spring and early summer. Among other results, it is found that regulation of heat loss at 30° and higher is by a combination of increased blood flow to the skin and by vaporization, and is more sensitive between 30° and 35° than in any other range of temperature. Vasomotor regulation of heat loss is effective down to about 28·5°; below this point, heat loss becomes progressively greater than that produced, until a chill is experienced. During periods of basal metabolism, heat loss by radiation is a maximum and that by convection a minimum; convection loss only is increased during a chill. During a chill, heat production increased to 100–150 per cent above basal, while heat loss increased only 10–15 per cent.

J. D. Hardy: Physical laws of heat loss from the human body. An examination of heat loss from a metal cylinder of known dimensions in the calorimeter used for human subjects (see preceding paper). The proportion of radiation loss to convection loss at 25–26° C. is about the same for the human body and the metal cylinder. Applying Newton's law of cooling, it is deduced that 78 per cent of the area of the human body is effective in radiating heat in the position used. Between 28° and 23°, heat is transferred through the body tissues by pure conduction. Above this range, thermal conductance begins to increase, due presumably to increase of superficial blood flow.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Tuesday, March 1

QUEEN MARY COLLEGE, at 5.30.—Sir John Russell, F.R.S.: "South Russia".*

INSTITUTION OF CIVIL ENGINEERS, at 6.—(Joint Meeting with other bodies). Symposium on "The Essential Road Conditions governing the Safety of Modern Traffic".

Wednesday, March 2

ROYAL SOCIETY OF ARTS, at 8.15.—E. V. Evans: "Coal Carbonisation and its Importance in the Life of the Nation".

Thursday, March 3

ROYAL SOCIETY, at 4.30.—Prof. J. H. Orton, J. W. Jones and G. M. King: "The Male Sexual Stage in Salmon Parr (*Salmo salar juv.*)".

H. Grüneberg: "An Analysis of the 'Pleiotropic' Effects of a New Lethal Mutation in the Rat (*Mus norvegicus*)".

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. C. C. Ungley: "Some Deficiencies of Nutrition and their Relation to Disease." (Goulstonian Lectures. Succeeding lectures on March 8 and 10.)

Friday, March 4

GEOLOGISTS' ASSOCIATION (in the Architectural Theatre, University College, London), at 7.30.—Annual General Meeting.

P. McIntyre: "Alps and Glaciers" (Presidential Address).

ROYAL INSTITUTION, at 9.—Prof. D. Brunt: "Gliding and Soaring Flight".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR INSPECTOR to the Royal Commission on Ancient Monuments (Wales)—The Secretary, Sanctuary Buildings, 20 Great Smith Street, S.W.1 (March 2)

ASSISTANT LECTURER IN AGRICULTURE in the Herts Institute of Agriculture—The Deputy Clerk of the Herts County Council, 28 Castle Street, Hertford (March 3).

ASSISTANT ARCHÆOLOGIST to the Royal Commission on Ancient and Historical Monuments (Scotland)—The Secretary, 27 York Place, Edinburgh, 1 (March 9)

ASSISTANT INVESTIGATOR (roof control and haulage) to the Safety in Mines Research Board, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1—The Under-Secretary for Mines (March 12).

ELECTRICAL ENGINEER in the Military Academy of Science, Woolwich, S.E 18—The Commandant (March 8).

ASSISTANTS (Grade III, metallurgy), SCIENTIFIC OFFICER, and ASSISTANT (Grade III, aerodynamics) at the Royal Aircraft Establishment, South Farnborough, Hants—The Superintendent (March 12)

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

National Institute of Industrial Psychology. Report 7: Improving the Blackboard. By W. Douglas Seymour. Pp 35. (London: National Institute of Industrial Psychology.) 1*s.* 6*d.* [271

Imperial Institute. Annual Report, 1937. Pp. 71. (London: Imperial Institute.) [271

University of Leeds. The Second Annual Report of the Brotherton Collection Committee. Pp. 8. Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livesey Professor (John W. Cobb) for the Session 1936–37. Pp. 12. (Leeds: The University.) [281

The Film in relation to the School Curriculum. By Ethel Green and William L. Lally. Pp. 60. (London: Central Information Bureau for Educational Films, Ltd.) 1*s* [281

Other Countries

Smithsonian Miscellaneous Collections. Vol. 97, No. 2: Plant Growth in relation to Wave-Length Balance. By Earl S. Johnston. (Publication 3446.) Pp. 18+4 plates. (Washington, D.C.: Smithsonian Institution.) [251

Indian Forest Records (New Series). Vol 3, No. 7: Four New Indian Ichneumonidæ. By R. A. Cushman. Pp. 141–148. (Delhi: Manager of Publications.) 4 annas; 5*d.* [251

Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1936; together with the Thirtieth Annual Report of the Central Committee of the Association for the Year ending 31st March 1937. Pp. 89. (Madras: Madras Publishing House, Ltd.) [251

Gold Coast. Report on the Forestry Department for the Year 1936–37. Pp. iii+10+2 plates. (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1*s.* [251

Ministry of Agriculture, Egypt. Technical and Scientific Service. Bulletin No. 184: The Effect of Temperature on Locust Affinity. By M. Hussein. Pp v+55+13 plates. P.T. 10. Bulletin No. 185: La séricículture en Egypte; Moisissure noire des cocons *Aspergillus phoenicis* (Corda). Par Dr. Wadih M. Carobin. Pp. 6+5 plates P.T 2 (Cairo: Government Press.) [251

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University. Čís. 240: O difusních potenciálech, V (On the Diffusion Potentials, 5) Napsali V. Čupr a K. Marek. Pp. 14. Čís. 241: Morfologický rozbor a výklad Ptolemaiových zpráv o hydrografických poměrech Komárenské pánve. (Die Anwendung der geomorphologischen Methode bei der Kritik der Nachrichten des Ptolemäus über die hydrographischen Verhältnisse der Niederung von Komárno). Napsal Fr. Říkovský. Pp. 19. Čís. 242: Supplementum II ad Onobrychis generis revisio critica. Scripsit G. Sirjaev. Pp. 14, Čís. 243: Ein Beitrag zur Ethologie der Larve von *Anabolia laevis* Zett (Trichoptera) Příspěvek k ethologii larvy chrostíka *Anabolia laevis* Zett (Trichoptera). Von Karel Mayer. Pp. 10. Čís. 244: Hydrolysa chloroctanů Berylnatých a Hlinitých (Hydrolysis of Beryllium and Aluminium Chloracetates) Napsal J. Šrůček. Pp. 16 Čís 245: Studies on Multiplicative Systems, Part 1. By O. Borůvka Pp. 16. Čís. 246: Buzení ultrakrátkých Hertzových vln elektromagnetickou resonanční brzdou elektronů (Die Erzeugung von ungedämpften Ultrakurzen Hertz'schen Wellen mittels elektromagnetischer elektronenresonanzbremse), napsal Josef Sahánek; Netlumené oscilace mechanické s buzením vlastním (Ungedämpfte mechanische Schwingungen mit Selbsterregung), napsal Josef Zahradníček. Pp. 22. Čís. 247: Vývoj neogenních sedimentů v území mezi Brnem, Znojmem a Mikulovem (Die Entwicklung der Neogen-sedimente in dem Gebiete zwischen Brunn, Znaim und Nikolsburg). Napsal V. Špalek. Pp. 35. Sborník vysoké Školy Zemědělské v Brně. Sign. C33 Příspěvek k poznání barvy jako konstitučního znaku hospodářských zvířat (Contribution to the Knowledge of Pigmentation as a Constitutional Factor in Domestic Animals). Napsal Josef Vařečka. Pp. 48. (Brno: A. Píša.) [251

Twenty-fifth Session of the Indian Science Congress Association, Calcutta, 1938. The Second City of the Empire. Edited by Dr. P. C. Bagchi. Pp v+258+16 plates. (Calcutta: Indian Science Congress Association.) [261

Ibero-Americana, 12: The Extent and Significance of Disease among the Indians of Baja California, 1697–1773 By S. F. Cook Pp. iv+40. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 2*s* 3*d.* net. [261

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 89. The Snake Genus *Enulius* Cope. By Emmett Reid Dunn. Pp. 415–418. *Castilleja* in the Charleston Mountains, Nevada. By Francis W. Pennell. Pp. 419–424. Taxonomy and Distribution of Aragoa, and its Bearing on the Geological History of the Northern Andes. By Francis W. Pennell. Pp 425–432 (Philadelphia: Academy of Natural Sciences.) [281

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 41, Part 2: Studies on the Alcohol Coagulation of Fresh Cow Milk. By Kentaro Mitamura. Pp. 97–362. (Tokyo: Maruzen Co., Ltd.) [281

Brooklyn Botanic Garden Record. Vol 27, No. 1: Delectus Seminum, Brooklyn, 1937; List of Seeds offered in Exchange. Pp. 10. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [281

Royal Observatory, Hong Kong. The Typhoons of August 16 to 17, 1936, and September 1 and 2, 1937. By C. W. Jeffries Pp. 7+6 plates. (Hong Kong: Government Printers.) 1 dollar. [281

Smithsonian Miscellaneous Collections. Vol 97, No 4: The Feeding Mechanism of Adult Lepidoptera. By John B. Schmitt. (Publication 3448.) Pp. 28. (Washington, D.C.: Smithsonian Institution.) [281

Proceedings of the United States National Museum. Vol. 84, No 3026: New Species of Moths of the Family Notodontidæ in the United States National Museum. By William Schaus. Pp. 563–584. (Washington, D.C.: Government Printing Office.) [281

Field Museum of Natural History. Botanical Series. Vol. 17, No. 3: Studies of American Plants, 8. By Paul C. Standley. Pp. 225–284. 40 cents. Geological Series. Vol. 6, No. 18: A Soricid and Two Erinaceids from the White River Oligocene. By Bryan Patterson and Paul O. McGrew. Pp. 245–272. 40 cents. Vol 6, No. 19: Some Notoungulate Braincasts. By Bryan Patterson. Pp. 273–302. 30 cents. Vol. 7, No. 8: Asterism in Garnet, Spinel, Quartz and Sapphire. By Albert J. Walcott. Pp. 39–58. 25 cents. Zoological Series. Vol. 20, No 23: Notes on Sea-Basses of the Genus *Centropristes*. By Alfred C. Weed. Pp. 291–320. 25 cents. Vol. 20, No. 24: American Bats of the Subfamily *Emballonurinae*. By Colin Campbell Sanborn. Pp 321–354. 40 cents. Vol. 20, No. 25: Notes on Snakes from the Yucatan Peninsula. By E. Wyllys Andrews. Pp. 355–360. 10 cents. Vol. 20, No. 26: The History of *Elaps collaris* Schlegel 1837–1937 By Karl P. Schmidt. Pp. 361–364. 10 cents. Vol. 20, No. 27: Variable Dentition in a Chinese Insectivore. By Wilfred H. Osgood. Pp. 365–368. 10 cents. (Chicago: Field Museum of Natural History.) [281

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Vol. 141 SATURDAY, MARCH 5, 1938 No. 3566

The Shifting Focus of Science

THE shifting focus of scientific interest has received scant attention either from historians or from men of science. The temptation always is to study the changing scene in terms of its great figures, to believe, in atomistic fashion, that each problem is born of the personal intellectual interest of the individual man of science ; that it has been brought to the notice of his contemporaries by a pure but inexplicable effort of imagination. While it is true that creative thinking of an individual nature must play its part in the making of science, it is equally obvious that the movement in interest cannot possibly be wholly accounted for, on this basis. The problems of Faraday and Maxwell were beyond the imagination of Newton, and those of the modern period outside the mental scope of all three. This does not mean that Faraday and Maxwell were greater figures than Newton, but rather that no man of science can do other than concern himself with the problems characteristic of his period.

The changing face of science can be seen without difficulty to fall into clearly defined stages. We have just suggested three. Each phase is carried through by the activity of the individual scientific workers, great and small, contributing in various measures, partly driven on by the developing internal logic of the subject and its accumulating experimental knowledge, partly canalized and fed by outside social forces not normally apparent to the individual workers. How scientific work is financed, and for what social purpose that work is pursued, for example, is a question the answer to which, in these days of industrial and governmental research, points to one only of the socially determining factors. The shifting focus of science, however much it may provide subjective satisfaction to its devotees, is nevertheless an objective feature of Nature, and therefore, if for that reason alone, a fit subject for scientific investigation.

To-day we are witnessing just such a shift. It began tentatively in the early days of this century with a scrutiny of the logic of mathematics and a study of the methodology of science. It passed to a series of startling attempts to evaluate the philosophical implications of more recent scientific knowledge, implications that sought to deny the certainty of science and strove to lead it back into mysticism. The significant feature of this phase was that these pronouncements were couched in popularized writings, a concession to a sense of social responsibility. Now at last a serious attempt is being made to probe further back to the social origins and social consequences of scientific discovery. The alertness shown in the columns of NATURE to the social possibilities of science, to its destructive as well as its constructive features, to the travesties of truth that are used to bolster up national doctrines, and generally to the distortion and prostitution of science to ignoble ends, is itself a significant feature of this same analysis. Scientific history, like ordinary history, is at last beginning to be seen in its social context ; and the shifting focus of science is part of its history.

The new concern of men of science with the uses and misuses of science has undoubtedly developed with the increasing tenseness of the international situation. The concern of this journal with these matters evidently derives from this source, but did not in fact become apparent until the latter had reached a critical stage. Nevertheless, the social background was always there for study. It required a social crisis to direct our attention to it.

Every shift in interest of science is accompanied by opposition on the part of those absorbed in the older problems and convinced that the new development leads away from the true path of scientific rectitude. A multitude of specious reasons are certain to be brought forward to show that political prejudice must necessarily intervene to prevent the formation of balanced judgments. Such considerations need not deter those who are genuinely concerned with the trend of scientific development as a feature of natural change.

The personal motives that urge individuals rather than the group to concentrate on such questions when the time is socially ripe for their study are many. In "Mathematics for the Million"*, for example, the author is apparently induced to do so in order to take the mystery out of mathematics, and to open the door to an understanding of its meaning for the ordinary citizen. How mathematics could be anything but a mystery to those who have not perceived its social sources is itself a mystery. In this respect, it is sufficient of a miracle to many scientific workers. To mathematicians who do not see it as one of the forms of social energy, it can have but a restricted meaning. In his own way, Hogben has established beyond dispute the existence of a qualitative relation between the growth of mathematical facts and the severely practical problems of the society that gave them birth. That is in itself a significant scientific advance. What requires further elucidation is the changing nature of this relationship.

In its early history, society encountered quite definite immediate problems that required for their solution a definite mathematical technique. By the eighteenth century, the situation in this respect had become drastically transformed. The new merchant and industrial aristocracy was purchasing social prestige by the endowment of university foundations, and educational institutions generally. While out of the practical needs of social life there had blossomed forth the earlier mathematics that dealt with the directly important problems of mensuration, experimental practice had also been called into being for these same ends: and experimental practice involves theory, and theory its mathematical technique, and mathematical technique its special tools and its specific logical problems. To such questions could the universities devote themselves, but the linkage with the severely practical problems of social life, the problems of the common man, while it still existed, had become more remote. The danger for us lies in the belief that that link no longer exists, a belief that shows itself in the idea that mathematics is an independent logical discipline with an absolute line of cleavage between its pure and its applied form. It shows itself in the effort to accord to mathematical ideas a priority over the physical facts of the world and so to present the universe and the struggling society on this earth as a series of grandiose mathematical theorems. Hogben's book is not a mathematical text-book except in a very popular sense—in itself a very important sense—but if its publication should serve to direct attention to the social linkages between the sciences, it will have performed a very significant service.

H. L.

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* Mathematics for the Million. A Popular Self-Educator By Lancelot Hogben. Revised second edition. Pp. 658. (London: Allen and Unwin, Ltd.) 12*s*. 6*d*. net.

The End of the Road

A Comprehensive Treatise on Inorganic and Theoretical Chemistry

By Dr. J. W. Mellor. Vol. 16: Pt. and General Index. Pp. x + 811. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 63*s*. net.

THE road of inorganic chemical knowledge is paved with bricks, of silver and sodium, lithium and lead, platinum and phosphorus, helium and uranium, representing all the elements which Mendeléeff provided for and more besides, as well as their numerous compounds; it is surfaced with what road experts call a binder, but which we, the initiated, designate as 'Mellor's magic', a highly original and individual variety. Slowly the magic has prevailed, as good magic always must when diligently applied, and so at last the end of the road has been reached—index and all. Riders in quest of knowledge can traverse it from end to end: it has been well and truly printed.

In more prosaic language, Mellor's "Comprehensive Treatise" is completed: in fifteen years, the vast field of inorganic chemistry has been surveyed. Such an achievement ought to be a matter of national congratulation and every Britisher should be proud that there exists such a treatise in his own language. His continental scientific colleagues have for some years borne the burden of similar publications in chemistry, thereby ensuring a large amount of cultural propaganda; for this reason alone, it is most pleasing that there is now a work of outstanding excellence which will spread abroad British scientific culture.

That the book is outstanding has already been demonstrated in the previous fifteen volumes; its preparation, even if it has become a matter of routine, has involved a tremendous amount of hard work of an extremely conscientious character, coupled with the ability to seize the essentials and classify the material in a form which makes it easy of access for the reader.

Chemists, and indeed that far wider circle of persons in any way concerned with inorganic substances, now have a timely opportunity to testify to the debt of gratitude they owe to Dr. Mellor. The task he has undertaken, as anyone who has done work of this kind knows, has been not merely an occupation but something much more strenuous amounting to a whole-time job and the sacrifice of leisure; if it had not been a labour of love, its completion would have been indeed impossible. As it is, one can only hope that the sacrifice of fifteen years at an important period of a man's life has carried with it some recompense and reward to the author. The more thoughtful who consult the book to-day and in the years to come will spare perhaps a moment to think gratefully of him; the hasty will omit even this much unless they fail to find the particular information in the detail and form they want, when perhaps they too will realize the magnitude of the task

The day is long since past when any man can know all chemistry or even one branch of it; although sitting as honours students, the examiners do expect us to qualify in regard to the questions they set at random. It should become clear when these sixteen volumes are set out in stately array on the shelf that the function of education is to teach first the fundamentals, then how to find the information, to know how it has been obtained, to be able to criticize it and utilize it to the desired ends. The amount of new work published every year has now to be measured in yards of shelf room occupied instead of in feet, and the resources and organization of the societies engaged in producing abstracts are strained to breaking point. General reading has become largely impossible, a most regrettable feature; specialist reading is helped by monographs and annual reports. One result is that the learned transactions no longer have their former appeal to any considerable number of members of a society, so that while their cost is increasing, the membership grows less. This is not the occasion on which to suggest any remedy for the trouble, which is a world-wide one and has already become acute.

Fortunately for the worker or specialist, whether in academic or industrial practice, there still exists a limited number of people, of whom Dr. Mellor is the outstanding British example, who are not dismayed by the magnitude of the task and are willing to collect information in a form and according to a plan which makes it easy of access. By arrangement according to certain conventions, by the use of black type and other simple devices, it is not difficult to trace the paragraph giving the desired information.

Dr. Mellor has a somewhat unusual mixture of talents. Few of those who form a mental picture of him as the result of their study of the "Inorganic Chemistry" would recognize him as the author of a book entitled "Uncle Joe's Nonsense", in which he displays high ability as a humorist both in text and illustration. The reviewer greatly values a set of menu cards, for which "Uncle Joe" was responsible, from the *Laconia* on the occasion of the visit of the Ceramic Society to America. It may be that these talents have contributed to make the treatise what it is, so much more than a dictionary or compendium, actually readable in parts and definitely original.

It has been so often reviewed that the resources of the literary flower shop have been largely exhausted in throwing bouquets which the author must be satiated to receive.

The late Prof. H. E. Armstrong was one of its admirers; he used to say it helped you to read chemistry, which he regarded as a most important as well as practically a lost attribute of the chemist. He himself attached much importance to critical reading, in which the reader did not merely accept the statements but also developed his intelligence in seeking to understand their implication.

This volume contains the index to all the volumes, 400 pages in double column, prepared by Miss E. M. Rigby, which gives reference both to each individual compound and to more general topics such as catalysts.

The author is loath to write finis, for we are promised two supplementary volumes which will include the developments and discoveries of recent years, particularly those relating to the elements which were treated in the early volumes. In addition, Mellor is unwilling to leave all compounds of carbon to the organic chemist, and therefore proposes a special volume to deal with the borderland compounds of carbon with hydrogen and nitrogen.

E. F. A.

Animals in Ancient Rome

Animals for Show and Pleasure in Ancient Rome By George Jennison. (Publications of the University of Manchester, No. 258.) Pp. xiv + 209 + 8 plates. (Manchester: Manchester University Press, 1937.) 12*s.* 6*d.* net.

THIS is a remarkably interesting book owing to the fact that the author combines the qualifications of being a scholar and an official of the Bellevue Zoological Garden at Manchester. Mr. Jennison's book has an extraordinarily widening influence. No one before—certainly in English—has been at pains to collect from all classical sources the notices of wild animals brought for any purpose to ancient Rome—for the games, for menageries or as private pets. The result is a brilliant justification of taking up a rather out-of-the-way line of research. It is not only illuminating in itself but also sheds light on all the surrounding subjects—the character of the Roman people and of their successive emperors, the trade-routes and the spread of Roman influence in the ancient world, the climatic and other changes in the countries from which the beasts were drawn.

Another special merit of the book should be noted. Being written by a man in professional intimate contact with the wild beasts and birds of which he writes in the ancient world, it is full of interesting touches about their life and habits, which show how little these have changed. The men have changed more than the beasts. Mr. Jennison tells us of the weak spot in lions—the backbone just above the loins ("I have known two lions killed unintentionally by a blow there from a broomstick") and then shows how well this fits in with the description in the poet Statius of the death of a trained lion in the arena. He knows how difficult it is to train stags to go in harness and applies this to the procession of the maiden priestess of Artemis in a car drawn by stags and described by Pausanias in the second century A.D. He knows the difficulty of breeding leopards in captivity and a host of other things which bring into high relief the skill, patience and expense expended in the Roman world for the production of their great beast shows and *venationes*. He is equally well informed on the domestic side of the culture of animals by the ancient Romans, telling us, for example, how much the breed of chicken has improved in modern times, as the ancient hen would only at the best lay her sixty eggs a year.

The absorbing interest of the book, however, is its description in detail of how the animals were used for show and slaughter in the arena. It is on the whole a revolting tale, for though there was much training of the beasts for wonderful tricks (lions that would hold hares in their mouths without biting them, dancing horses, monkeys playing draughts, etc.), yet the predominant motive was the popular passion for the sight of deadly sports. The apologists for the Romans trace back this passion to the Etruscans, who seem to have practised gladiatorial games. But the Romans improved on their masters in this respect as in others, and there was little abatement in the passion until the poverty and the Christianity of the later Empire gradually led to the emptying of the arena.

The games, including the slaughter both of men and animals, was the recognized way in which generals and leading magistrates aimed at popularity. Larger and larger numbers of beasts were collected from the provinces and stranger and stranger creatures sought for, to make each *venatio* more distinguished. Elephants were first introduced in the third century B.C. for the triumph over Pyrrhus and became the 'royal beast', to be owned only by persons of the highest rank. They were, however, used not only for ceremonial and warlike purposes but were also slaughtered in the circus. This was so horrible and pathetic a sight that even the Roman crowd protested. They rose and cursed Pompey, who had provided this delicacy, and Cicero, who always expressed the best feeling of his time, wrote to a friend that there was some sort of kinship between that animal and man. Julius Cæsar brought in the giraffe, but there is no evidence of its slaughter until the time of Commodus—a sign both of the gradual worsening of the popular taste and of the mad-dog character of the man.

Nothing is more striking in the story than the reaction of this popular passion for bloodthirsty games on the minds of the rulers who provided, and were responsible for, them. The worst—Nero, Commodus and Elagabalus—revelled in them and often took part themselves. But none was strong enough to make a stand and reform the whole wasteful and abominable system. Trajan, who as ruler was the ablest and most successful of the line, inaugurated his reign by making a public demonstration of simplicity and economy by entering Rome without a procession, without a chariot, without even a horse. The populace saw a tall powerful upright man pass up the Via Sacra on foot accompanied by his wife and a few personal friends. His well-known rescripts on the right method of treating Christians in the provinces are a model of humanity and good sense. Yet the same man in A.D. 107, celebrating his Dacian triumph, authorized games for 120 days, during which 10,000 gladiators fought and 11,000 animals were done to death. Marcus Aurelius, whose instincts revolted against the shows, actually attended some of the most brutal, though he turned his back when the specially well-trained man-eating lion was performing his feats.

Of all such sensational facts Mr. Jennison gives us enough, but not too much, and his book is, besides, a fascinating storehouse of the natural history of the ancient world. When the first chimpanzee was seen in Greece; were polar bears ever transported to Rome; how the crocodile is the easiest of all wild animals to trap; how long were lions extant, wild, in Europe. The book is a rare model of minute and extensive scholarship combined with practical knowledge, good judgment and clear arrangement. The production also sheds great credit on the Manchester University Press.

F. S. MARVIN.

Nuclear Physics

Structure of Atomic Nuclei and Nuclear Transformations

By G. Gamow. Being a second edition of "Constitution of Atomic Nuclei and Radioactivity". Pp. xii + 270. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 17*s*. 6*d*. net.

IN the preface it is stated that whereas in writing the first edition the author felt unhappy because there were not enough experimental facts and theoretical calculations, he now feels there are perhaps too many. Indeed, nuclear physics has undergone an enormous change since the publication of the first edition, of which in the present edition nothing but the memory is preserved.

At that time the author was one of a few pioneer workers in the field, the number of problems that could be understood was strictly limited, and the book was mainly intended to show the applicability and usefulness of quantum theory in nuclear problems, together with a fuller account of the passage of charged particles into and out of the nucleus, which, thanks to his own work, was then already well understood.

The rapid development which followed the discovery of new experimental facts and new particles, but which owes much to Prof. Gamow's early work, brought innumerable other workers into the field, which has now lost much of the charm of the unexplored and has become rather more a branch of theoretical physics. Although the book is still more concerned with the general ideas than with too detailed applications, it has to deal with work in a wide field, done by different people with different methods and different (usually mutually exclusive) approximations. This makes such a general report a very necessary but at the same time a very difficult task to undertake. We are very fortunate that it was undertaken by a man like Prof. Gamow, of whom we can confidently expect a lively account which will not entangle us in a jungle of mathematical detail but will pick out the main ideas and use simple pictures as much as possible. It is very refreshing to read such passages as the account of work on the "shell structure" of nuclei: ". . . it is not referred to in detail here because the author was never able in studying these articles to remember the beginning when he was reading the end." This is in the best Gamow tradition, and we can only regret that there are too few passages of this kind. On the whole, the author is more serious, more the impersonal and impartial reporter than before.

One of the difficulties that such a reporter has before him is to steer the good middle course between assuming all the mathematical apparatus of quantum theory to be familiar to the reader (which would make the book lose its appeal to experimentalists) and to explain the methods wherever they are applied (which would bring it to about the same size as another recent book in the same series). This is evidently a matter of taste, but to the reviewer's taste one meets rather too frequently expressions such as "Simple considerations show . . .", where a few words would have been sufficient to make clear what the nature of these considerations were, or where a reference to a text-book could have been given. In general, references are treated rather casually; papers are often indicated by "it has been shown that . . ." and even when we are given the name of the author, it is often not said where and when he has shown it. In two cases (pp. 128, 173, 219) the footnotes send unsuspecting students off to the library on a wild-goose chase for non-existing periodicals, and only the initiated will understand the subtle jokes.

It is unfortunate that in one or two instances in which the reader has to take it on the author's authority that something "can be shown", slips have occurred. For example, on p. 54 the "very intense" fields referred to are of the order of 100 gauss; the Dirac wave equation is not the only possible Lorentz invariant equation for a particle

(p. 60); the definition of 'odd' and 'even' terms in the footnote on p. 71 is rather confusing. A mass-spectrograph is not usually employed to measure particle velocities, and an elementary particle of spin ½ is not normally referred to as a "rotator".

A good book takes some time to write and publish, and with the present rapid development of the subject it is unavoidable that some passages should be out of date by the time the book is published. In this case, the book was written immediately before the publication of Bohr's theory, which not only opened the way for solving problems that had before remained unexplained but also made it clear beyond doubt that the one-body picture (motion of one particle in a suitable potential field) is entirely inadequate except for such problems as the passage of a charged particle through the potential barrier surrounding a charged nucleus. Prof. Gamow warns us against the excessive use of this method (pp. 200, 208). Yet in many places the old optimism of this strong adherent of the one-body picture breaks through. An attempt at justifying a moderate use of the picture is made in the preface on the grounds that a more complete treatment would be very complicated if not impossible. But if one has reason to believe that some results are independent of the one-body picture, it ought to be possible to derive them without it; and if one has no such reasons, the validity of a method cannot be established by the argument that there is no better method available.

The new Bohr theory has already led to many new results, and has thus greatly increased the wealth of material which Prof. Gamow deplores in his preface. Let us hope that future development, by deciding which are valid and which invalid approximations, and by elimination of unreliable speculation, will reduce the bulk of papers he will have to read before writing the next edition.

Dr. Feather is to be congratulated on succeeding in putting the book into the chains of "orthography and conventional idiom" without spoiling its freedom of expression and its liveliness. R. P.

Plant Ecology in Education

(1) Plant Ecology

By Hilda Drabble. Pp. 142 + 12 plates. (London: Edward Arnold and Co., 1937.) 7*s.* 6*d.* net.

(2) Ecology in Town and Classroom

By Dr. R. Bracher. Pp. 96 + 3 plates. (Bristol and London: J. W. Arrowsmith, Ltd., 1937.) 2*s.* 6*d.* net.

THE increasing replacement of the older teaching of a somewhat disjointed nature study by a more truly scientific course in ecology in schools and colleges has resulted in the need for text-books to serve both the teacher and the student. The two publications here noticed are very dissimilar in aim and content.

(1) Mrs. Drabble's book carries the subject, for plant ecology of the British Isles, approximately, though with several important exceptions, to the general B.Sc. standard of the University of London. It is a concise and adequate summary of much of the more important research on the synecology of plant communities published within recent years, and as such can be strongly recommended to both teachers and students. The twelve plates, mostly from photographs by Prof. E. J. Salisbury, illustrate relevant facts concerning the composition and history of a wide range of types of vegetation. The forty-five test questions should enable students to estimate their knowledge of the subject in advance of examinations and to familiarize themselves with the, usually very fair, type of questions set for them to answer.

There is some justification for the criticism that such a book 'spoon-feeds' the student too much. It is suggested that, if another edition be called for, more emphasis should be placed on practical work by the students themselves. Plant ecology offers a wide scope for investigations in the field, the experimental garden, and the laboratory, and it is advisable that students should be urged to solve its problems by their own experience. The study of the life-histories of single plant-species (autecology) should also be encouraged, and general suggestions for such research might well have been included, with one or two actual examples.

(2) Dr. Bracher's book is limited in scope. It is complementary to her "Field Studies in Ecology" published, in a similar format and at the same price, in 1934. It deals, in brief outline, with the botany, from an ecological point of view, of streets, waste ground, coal tips, fresh waters and tidal river banks. The teacher in a town school should obtain useful ideas from reading its pages. In many towns, at least in the suburbs, even small houses have gardens, and allotments are not unknown. Some of the rather numerous blank pages might well have been utilized to indicate how much ecology can be learnt in gardening, and indeed, must be learnt if the gardening is to be successful. W. B. T.

Fish who Answer the Telephone:
and other Studies in Experimental Biology. By Prof. Y. Frolov. Translated from the Russian by Stephen Graham. Pp. x+168+14 plates. (London: Kegan Paul and Co., Ltd., 1937.) 6*s*. net.

THIS chatty little volume should be welcomed by experimental biologists and will make fascinating reading for the layman who is at all interested in the experimental work now being prosecuted on animal behaviour.

The work of Pavlov is well known to all biologists—especially physiologists—and Prof. Frolov, who worked with Pavlov, has for many years pursued similar lines of investigation. Though this book (with a misleading main title, since it signifies the content of one chapter only) does not claim to give scientific detail of value to research workers, it makes interesting fireside reading for a biologist and gives him a good insight into the experimental method of Frolov and his school. Furthermore, many biologists, especially those beginning their careers, will learn much of academic interest; for example, that *Amphioxus* was discovered by Alexander Kovalevsky in an inlet on the Crimean shore, that the well-known Marine Biological Station at Naples was first of all suggested by the German biologist, Dohrn, and is actually the oldest of such stations, that Frolov himself was the first to claim to have demonstrated a sense of hearing in fish (though whether Prof. von Frisch would agree is an open question), and that much which has been written about instinct and behaviour in ants is the product more of imagination rather than of observation.

More mature psychologists and physiologists will be pleased to revive their memories of work on the behaviour of dogs, experiments on the behaviour of chickens even before they are hatched, and so forth.

Anyone opening the book will be unlikely to put it down until he has read it from cover to cover. Mr. Graham is to be congratulated on translating the work in a most pleasing style.

Geological Excursion Guide to the Assynt District of Sutherland
By Dr. M. Macgregor and Dr. J. Phemister. Pp. 62+4 plates. (Edinburgh: Edinburgh Geological Society, 1937.) 2*s*.

THANKS to the Edinburgh Geological Society, the visitor to the Assynt district of Sutherland is now well equipped. The authors give a carefully planned descriptive itinerary of a series of seven excursions to ground easily accessible from Inchnadamph. All the localities are capable of being visited and examined during a week's stay in the neighbourhood; shorter itineraries also are provided, indicating how to use to the best advantage periods of four, three and two days. The detailed excursion section of the guide is prefaced by a short but clear summary of the geology and structure.

The thoroughness of the authors is shown by the provision of a glossary of place-names, an index, blank pages for notes, and details regarding transport and accommodation. The details of the excursions have been carefully checked in the field, and are fully illustrated by four excellent colour-printed maps and three other sketch-maps in the text. The visitor may be confidently assured that with this guide in one pocket and the one-inch Geological Survey map of Assynt in another he will miss none of the main features of this fascinating district. He must not forget the map, for it contains important 'vertical' and 'horizontal' sections which make it an essential complement to the guide.

Enthusiasts will find that the excursions keep them fully occupied. Non-specialists, however, may think that the petrological picnics to Loch Borrolan (of borolanite fame) and Loch Ailsh might be replaced, in part at least, by an excursion of a more leisurely character to one of the places they have already visited; for they are sure to have fallen in love with at least one particular spot or view in such wonderful country.

T. R.

Technical Electricity:
Principles and Practice. By J. E. Phillips and Dr. R. W. B. Stephens. Pp. vii+288. (London: The Technical Press, Ltd., 1937.) 7*s*. 6*d*.

THE great difficulty with students of electrical engineering in technical colleges is that they have very little training in physics, and several well-meaning text-books have been produced recently which try to instil fundamental magnetic and electric principles in the shortest possible time, and without making the student tired with difficult discussions about electro-magnetic units and the reason why one way of deducing our definitions of the intensities of fields and so on is preferable to another. There is always the outstanding difficulty why we use unit magnetic poles for definitions when no such pole exists; it is a difficulty which each teacher must solve for himself, before trying to train the immature mind to think in similar terms. The present authors succeed as well as some others, but perhaps tend to err on the more practical side. This is a good fault, however, since the type of student in view is best appealed to through his practical experience—sometimes more up to date than that of his teacher.

L. E. C. H.

Modern Management
By Prof. J. E. Walters. Pp. xiv+337. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 15*s*. net.

THIS book gives a reasonably comprehensive account of the methods of modern management and of the practical applications of the scientific method to various phases of management. It is emphatically not a book for the general reader; but if it contains rather too much detail for him, those who are concerned with particular problems of management may perhaps regret that its account of the Gantt Chart, the Bedaux system and similar matters is rather too condensed. On the whole, however, it is a well-balanced work, although the section on organization and its principles might with advantage have been expanded. Selected bibliographies are appended to each chapter, and these are reasonably representative, although relating in the main only to American publications.

Soil Erosion: the Growth of the Desert in Africa and Elsewhere*

By Sir Daniel Hall, K.C.B., F.R.S.

USUALLY the soil is regarded as something particularly stable, but this stability is almost wholly due to its normal covering of vegetation. There is always a danger that if the cover of vegetation is removed the soil itself will begin to move under the action of either the wind or the rain. Rarely do we see these actions at work on a large scale in England; the climatic conditions are not favourable, for our rainfall is gentle and evenly distributed throughout the year, and our big winds are mostly associated with rain. It is in semi-arid regions, where long periods of drought may be followed by torrential rains, that soil erosion becomes an active danger.

The earliest cases of erosion to be noticed are those which follow deforestation in regions where the mountains in which the rivers take their rise are below the permanent snow-line. In such countries, typically in the eastern Mediterranean —Calabria, Greece, the greater part of Asia Minor— the natural sequence is forest on the higher slopes where the rainfall is greatest, passing into upland meadows as the slope grows less and finally into river meadows as the river nears the sea. There is no evidence in support of the belief that forests increase the rainfall of a country; but they serve as its regulator. The spongy soil below the trees, rich in humus, absorbs the rain as it falls, whereby it reappears later in the springs and furnishes the watercourses and rivers when the rainy season has passed. But too commonly the forests have been cut down without any regard to their regeneration; not only has the maximum of timber been cut out but there has also been the desire to extend the grazing, and unfortunately in these Mediterranean countries goats are among the chief grazing animals. Hungry goats will eat anything that grows; they destroy every seedling tree as fast as it gets its head up, they complete and extend the destruction the woodcutters have begun. At the same time, with their sharp hooves they break the surface of the soil; in other places they tread hard paths down which the rain begins to run with gathering volume and velocity. In a very short time during the rains, gullies begin to form as the soil is washed downhill; year by year the gullies extend and bite deeper into the earth until in no long time—a generation or two—the hillsides that had been forest and upland meadow get bared down to the hard infertile subsoil or to the rock itself.

Nor does the damage end there; the rainfall running off the bared hill country without a check develops as a torrent lower down, attacking the meadows bordering its course. The earth also that has been washed off the hillsides is carried down to the plains where the rivers lose their velocity; there it is deposited and turns the river into a chain of malarious swamps, chokes its mouth and destroys any harbour that was there. Such has been the history of much of the fairest land on the seaboard of the Levant; on the heights, bare rock where once forest and meadow flourished, rivers that are torrents in winter and dry in summer, old seaports no longer accessible. The destruction of the forest was thus a major factor in the decay of Greece and of Rome itself; it meant in the first place the loss of farming land and of the agricultural population which formed the backbone of the early armies of the republics. With the swamps came the spread of malaria, which again has been invoked as one of the great causes of the fall of ancient civilization.

The most spectacular form of soil erosion is that exhibited by the vast dust-storms which, in 1934 and 1935 especially, swept over the United States east of the Mississippi. A vast area, which included western Oklahoma, western Kansas, eastern Colorado, the Panhandle of Texas and parts of Wyoming, has become known as the Dust Bowl. In 1934 it was estimated that on a single day 300 million tons of rich top soil were swept as far away as the Atlantic. There is a story that in the diary of an old Nebraska doctor was found the entry "June 14th. Hot as hell, wind 40 miles an hour, two Kansas farms go by every minute".

The causes of this terrible wind erosion are easy to discern. It arises only in comparatively arid districts where the rainfall is below the 20-inch level, and (in America in any event) where the fundamental subsoil is of a rather sandy type—a recent glacial drift. Before white settlement, these regions were clothed with grass and were the natural home of the buffalo. Some of the land was good grazing, with a fair depth of black soil rich in humus; in the drier parts the sod was thin and there were only a few inches of soil. The black soil regions were fertile and were the first to be broken up; the poorer land was kept for ranching, healthy for either cattle or sheep if not too closely stocked. The plough, however, began to encroach upon these thin soils, with great rapidity when prices of cereals went soaring up from 1917 onwards. At first all went well, for the cultivation began in a cycle of good rainfall seasons and there was some stock both of humus in the soil and of accumulated rainfall below. Years of drought followed when the original subsoil reserve of water had been used up, and the light soil, no longer bound together either by vegetation or humus, began to drift in the fierce winds that sweep over those great plains. The plough has destroyed the binding power of the soil; the wind is then able to remove the whole of the fertile top layer of soil and leave nothing but the denser subsoil, which is too infertile to carry a crop. Nor has it been the case that the good soil is merely transferred from one farm to the next; as a rule in Canada it has been swept right away into the Great Lakes or the barren lands to the north, or even into the Atlantic itself.

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* From a Friday evening discourse delivered at the Royal Institution on November 12.

Without doubt, much of the poorest of this land ought never to have been ploughed even in boom times; once the crust has been broken it becomes a sort of running sore always eating into the land on its margin. As a ranch under its natural vegetation it had a modest productive value, and to that use it must return.

In Canada, improved methods of cultivation have been introduced to minimize the danger of soil drifting. Since it is inevitable that at certain seasons of the year the soil should be cultivated while bare of a crop, the practice has been introduced of dividing the land into strips, the bare land alternating with land under crop in place of the former large areas under the same treatment. Thus the incipient soil erosion under the wind is checked before it can proceed far, and a very efficient measure of protection is attained.

One other major work of reconstruction is needed, though it is being taken in hand on a large scale in the United States, and that is the establishment of shelter belts to break up the fierce winds which rage over these open treeless spaces. It is not an easy matter to get trees started, especially the north in Saskatchewan and Alberta, where the range of species that will stand up to the extremes of climate is limited, but a certain number of suitable species have been found. Besides the original planting of cross-country belts, farmers are being taught to protect their own holdings.

Erosion by rain is even more common wherever the cultivated land lies on a slope and the rains are heavy. The danger does not lie in a large annual rainfall; some of the worst destruction is wrought in regions where a low total is concentrated into short intense spells.

As soon as the rate of fall becomes sufficient to cause an actual flow of water at any spot it acquires an excavating power and begins to cut a channel in the loose earth, a gulley which not only enlarges itself by the undercutting of its banks but also tends to eat its way backwards. Gulleying can be initiated either by careless management of cultivated soil or on grassland by overgrazing, which bares the surface. Even before actual overgrazing sets in, both cattle and sheep will tread bare tracks along which streams will begin to flow during the rains and to acquire sufficient velocity to eat into the soil. In however small a way such gulleying starts, if it is not checked it extends itself from season to season, until eventually, by a sort of geometrical progression, the large area may become impassable to man and beast. Though agriculture generally is indicted as the initiator of erosion, more properly it is the recklessness or the want of foresight in man that should be blamed. Erosion is like fire; a trivial accident may start it, and if not checked at once there may be no staying its progress.

In a recent book "Rich Land, Poor Land" is described a great crater in Georgia, 200 feet deep, that had arisen from a simple gully. "Do you know what started him? A trickle of water running off a farmer's barn 40 years ago. Just one dam little trickle, and now a third of the county's gone—forty thousand acres." An area in Tennessee ten miles in diameter has been gullied to desolation through destruction of the vegetation by the fumes of a copper smelter.

The loss of land is not all that the community suffers. The soil that the rain starts moving reaches the rivers and has to find a resting-place somewhere. It is in regions liable to erosion that irrigation becomes of so much importance, and dams are thrown across the rivers to store the flood-water of the rains. But no one had foreseen what masses of sand and silt would begin to choke the reservoirs when erosion was going on at the head waters. The Rio Perco is reported to be pouring every flood season 9,000 acre feet of silt into the lake built to supply New Mexico with its quota of water from the Rio Grande. The last Mississippi flood was the wildest and most dangerous of any in the history of the river, notwithstanding all the protective measures that have been carried out, simply because the lower river is being raised more and more above the level of the surrounding country.

A large amount of work is now being done in the United States to control gulleying and to reclaim the devastated land. In the early stages, gulleying can be checked by throwing dams across the gash, dams which may be timber or concrete or just bushes, alive or dead, anything that will check the rush of water and cause the sediment to begin to accumulate. Even more effective has been the introduction of rapidly growing plants, which not only check the flow of water and filter out the silt but also bind the earth and stop further washing. The Soil Conservation Service in the United States is bringing into play all the resources of science and engineering to repair the damage which had been inflicted upon the land of the United States by hasty exploitation. I would instance again the Civilian Conservation Corps, that inspiration of President Roosevelt's, which in 1932, when the youth of America found no prospect of employment of any kind on leaving school or college, gathered some 300,000 of them for service and set them to work to clean up the countryside. They were turned on to fire-prevention work in the forests, to checking erosion, to road making and vermin destruction in the national parks, to various forms of reclamation and salvage work—the corps itself being the most magnificent piece of human salvage this generation has known. One cannot but think that it would be of value to the population of Britain if all our young men could be conscripted for six months of their life to carry out public work for the improvement of our countryside.

The examples of erosion so far considered are due to the unthinking exploitations of the soil by civilized men. Similar destruction of the land is, however, taking place in Africa, where the tribes have not arrived at a system of farming that conserves the fertility of the soil, but practise the more primitive form of 'shifting cultivation'. The cultivator is allotted a particular plot in the area of jungle or bush belonging to his clan; this he, or rather his wives, clears, perhaps burning off the timber before putting in his crop. In two or three years the soil begins to become exhausted or weeds become intractable, whereupon the plot is abandoned and a new piece is taken up. The abandoned plot is soon covered with the natural vegetation, and in the course of time, perhaps ten, perhaps thirty years, recovers sufficiently to be ready to take into cultivation again. Thus the tribe requires many times as large an acreage of land as is actually in cultivation at any one time, and if the tribe is increasing in numbers it will be eating pretty steadily into hitherto unoccupied grassland or forest.

One other feature is of importance. The Bantu tribes, who predominate in East Africa, attach the greatest value to livestock, particularly to cattle. Cattle represent wealth and position; they are intimately bound up in tribal custom with the marriage ceremonies—indeed they enjoy a definitely religious status. They are the essential consideration that has to be tendered for a wife. But they serve little or no economic purpose. They are not eaten except ceremonially, by many tribes, they are not milked, they are not beasts of burden, neither is their dung used as manure. Sheep and goats are in the same category; they are less sacred and less valuable; their only economic product is their skins for clothing.

Consider the consequences: within this century British rule has maintained peace among the tribes, and with the cessation of raiding, numbers have been rising steadily. According to census returns, the native population in the Union of South Africa has doubled in the last fifty years; in Basutoland the estimated population multiplied fourfold between 1879 and 1921. In Kenya the annual rate of increase is estimated at about 1½ per cent, which means doubling the numbers in forty-six years, and similar estimates are made for the Nandi tribes in the Kavirondo and for the Uganda population.

The increase of human population has been accompanied by an even greater increase in the numbers of livestock, which in the old days had been effectively kept under by raiding. With these checks gone, the animal population has outgrown the means of sustenance, and even in some districts is destroying the vegetation in uncultivated areas which should be regenerating against their turn to be brought into cultivation. The Native Economic Commission of South Africa, reporting in 1932, stated: "With the exception of certain parts of Zululand and Pondoland every native area is overstocked", and estimates that between 1918 and 1930 cattle increased from 7 to 17 hundred thousand, and sheep from 2½ to nearly 4 million. The Kenya Land Commission, reporting in 1933, wrote: "Probably about 1920 the main stock areas of the native reserves had attained their optimum carrying capacity, and although fully stocked, were not overstocked. Since then the cattle population has—roughly speaking—doubled itself". Again, of the Kamba reserve: "Mr. Scott Little estimates that the reserve contains 190,000 cattle with 57,000 calves, though he estimates its grazing capacity at no more than 60,000 head. There are also 260,000 goats and 150,000 sheep. A journey through the area east and south of Machakos reveals that over large stretches of hillsides vegetation has been almost wholly removed. The soil has been eroded down to the subsoil and its removal will continue at an ever-increasing rate. On less steep slopes and on better land vegetation still persists, and though the Wakamba are primarily a pastoral tribe, patches of cultivation are in evidence. But even there grazing has been so persistent that the ground is all beaten down into little stock paths and has become in turn open to erosion".

Mr. C. W. Hobley, giving evidence about Tanganyika, said: "The native occupier, if space permits, moves on, leaving exhausted soil and desert behind him". Prof. E. P. Stebbing has uttered strong warnings of the encroachment of the Sahara upon northern Nigeria, due to shifting cultivation and overstocking in the forest. Major Grogan put the matter brutally when he said before the Kenya Land Commission: "The African people have never established a symbiotic relationship with land. They are, in the strict scientific sense, parasites on the land, all of them", and in another place he speaks of flying over Central Africa and picking out the eroded areas by their colour.

These instances will suffice; over a large part of Africa—the eastern side from the Abyssinian frontier down to the Cape, Uganda and parts of Nigeria, everywhere indeed except in the tropical rain-forest of the western seaboard and interior—conditions are such as render erosion by washing a danger. Further, there is a native population practising a destructive form of agriculture and keeping a vast uneconomic head of stock, including the devastating goat in large numbers; they are eating rapidly into such forest areas as are left open. Small wonder that famine is never far away from some of the tribes, that the major political issue between native and white man is the cry for more land. Yet even if there were more land to give, the day of reckoning would only be deferred, the new land would only be eaten up in its turn; the native must either change his methods or limit his numbers. Indeed, the situation has even now gone so far that from time to time the Government has to import food to save a tribe from starvation.

It is but recently that the dangers of erosion in Africa have come to be realized. However, it is now evident that all the African colonies have become erosion conscious, as may be seen from Sir Frank Stockdale's report on his recent tour through Africa.

Much yet remains to be done before the arrears of years of misuse of the soil can be repaired and before the native population can be educated to systems of farming which will maintain the fertility of the land. Not only have drastic changes in native custom to be brought about, but also in many cases expenditure is called for which can scarcely be found within the limited resources of the particular colony.

The regeneration of wasted areas must begin with closing them for a time to grazing, so as to allow the return of natural vegetation; if the land has not been very badly denuded, recovery is rapid; but in places it may be necessary to introduce specially useful plants like the stoloniferous grasses so characteristic of South Africa. A certain amount of minor engineering is needed to check run-offs and dongas by dams or plantations. Measures to deal with the invading weeds like *Striga* in Central Africa or the *Chrysocoma* of the south are still lacking. At the same time cultivators, both natives and white settlers, are being taught the virtues of contour ploughing and planting, and of vegetation strips in cultivated land to break up run-off.

Such measures, however, do not touch the major cause of erosion—overstocking. Legislative action is necessary to compel a reduction in the head of stock. The drastic culling that is called for must be done by way of purchase, and since the animals which would first be drafted are practically valueless for food, one or more meat factories would be required to turn the carcasses into manure and then into successively better products as the quality of the culls improved. A reduction in the numbers of cattle or sheep to one half or so would not only relieve the pressure on the land but also would give the native owners some chance of improving quality both by selection and by better feeding, whereas at present numbers alone are valued. Education should also proceed to induce the natives to use cattle economically for milk or meat and for traction, or at least to sell them for food.

Even more fundamental must be the education of the natives to adopt a conservative system of farming—a rotation that would include leguminous crops and so help the native dietary as well as restore nitrogen to the soil. Compost-making is another method of maintaining fertility which is being taught to the natives. The African cannot increase, cannot even maintain, his present numbers unless he learns how to use his plot of land so that it will continuously produce food.

But it is difficult to speak temperately of the urgent need for effort in this direction on a large scale. Many of the tribes are on the verge of starvation, the desert is growing apace, and as the cropping or grazing area shrinks, the pressure upon it becomes greater, and destruction proceeds at a compound interest rate.

The responsibility for action lies not only on the Colonial Governments but also on the British Government itself. It has declared itself trustee for the native populations; it must save them from themselves. Other nations are demanding colonies in Africa as sources of raw materials and as openings for colonization, but as soon as one gets away from the few mineral areas African land affords little opportunity of exploitation, and will indeed only continue to exist productively if its overlords adopt and persist in a self-denying policy.

Cobalt and Copper in Ruminant Nutrition

By Hedley R. Marston, E. W. Lines, R. Grenfell Thomas and I. W. McDonald
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As the successful use of supplements containing cobalt for the prevention of bush sickness in stock has given rise to a considerable amount of publicity in which the original source of information has been largely lost sight of, a brief résumé of the sequence of events that led to this application seems desirable.

The apparently essential nature of cobalt in the nutrition of ruminants was first suggested by a group of workers in the Council for Scientific and Industrial Research Nutrition Laboratory in the University of Adelaide, from experimental findings during the investigation of the etiology of 'coast disease', a malady which affects sheep confined in their grazing to the highly calcareous shell sand littoral of southern Australia. The dramatic response and rapid restoration observed to supervene when minute amounts of cobalt (1 mgm. a day as soluble salt) were administered to seriously affected animals was announced at the Australian and New Zealand Association for Advancement of Science during the January meeting in 1935, when the close resemblance that coast disease bore to stock ailments known in different parts of the world as bush sickness (New Zealand), enzootic marasmus (Western Australia), pine (Cheviots and Inner Hebrides), nakaturuitis (Kenya), and salt sickness (Florida), was again stressed. This address was published a few months later.

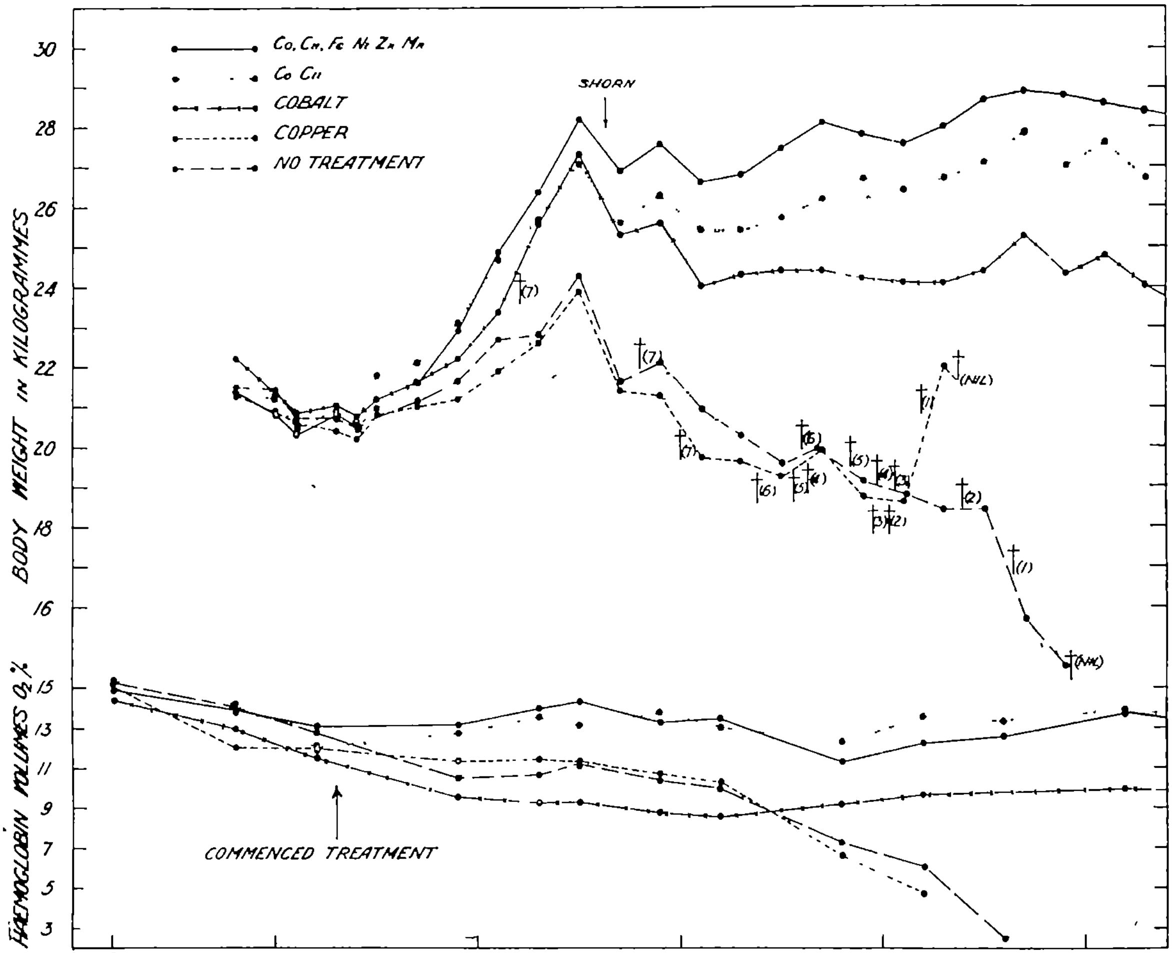
The appearance of symptoms of lethargy, progressive wasting and anæmia in ruminants confined to certain restricted areas, and their rapid alleviation if the affected flocks are changed to a different type of country, has been recognized for many years. The description in 1807 of pining, daizing or vinkish by the Ettrick shepherd, James Hogg, suggests that this malady results from a deficiency, for the ". . . distemper . . . affects sheep confined to some districts . . . but removing them to fine land cures them immediately". The symptoms he reported later (1831) are those commonly recognized in the diseases mentioned above. McGowan and Smith's study of the distribution of pine disease in areas derived from porphorytic rocks on the Scottish side of the Cheviots, and Grieg and Dyrerre's investigation of the lethargic wasting as it occurs among sheep grazing exclusively on the shell sand beaches of the Isle of Tiree, led to the recognition of its similarity to bush sickness.

The New Zealand bush sickness, which occurs in areas usually defined by relatively recent volcanic showers, was referred to in the early reports of Park (1806) and later by Gilruth (1900). Guided by the hypothesis that the associated anæmia resulted from iron deficiency, Aston and his collaborators observed the benefit which followed dosing affected animals with massive amounts of iron salts, which, in the light of our present knowledge, it seems probable were contaminated with traces of other elements. For economic reasons, Aston suggested the use of the naturally occurring hydrated iron oxide, limonite, and this material, providing it originated from certain deposits, undoubtedly helped to control the disease.

The investigations of Filmer (1933) of a similar malady, enzootic marasmus, affecting both cattle and sheep grazed continually over certain highly ferruginous sandy loams of the Denmark district of Western Australia, led to the conclusion that while large doses of limonite prevented the occurrence of the malady and restored affected animals to normal health, pure iron salts were ineffective. Later, Filmer, in collaboration with Underwood, found hydrochloric acid extracts of limonite to be as active as the material itself, and the potency of these was unimpaired on removal of all but the faintest traces of iron. Underwood fractionated these extracts further ; but, owing to the vagaries of the chemical methods and his dependence on so-called pure chemicals, the issue was temporally obscured.

Meanwhile, the investigations of coast disease had proved that therapy with carefully purified iron salts, either alone or in conjunction with copper and with liver extract, failed to arrest the progress of the symptoms. The maintenance of health of sheep which had free access to a complex salt mixture containing cobalt while pastured on affected country was observed, and the publication of the production of polycythæmia in rats by minute amounts of cobalt by the Walthners, led to the experiments that resulted in the immediate response which cobalt therapy brought about in animals suffering from coast disease. The implication that sheep suffering from enzootic marasmus would react similarly to cobalt was amply confirmed by Underwood and Filmer's demonstration following a short visit of Dr. Underwood to the Nutrition Laboratory, Adelaide, that small doses of cobalt rapidly restored affected animals to normal health.

Reports of the variability of the response of bush sick animals to treatment with massive doses of limonite or of soluble iron salts led to the conclusion that Aston's iron deficiency hypothesis, although vigorously defended, was untenable. Rigg and Askew were unable to find a significant difference in the iron content of pastures from bush sick and healthy areas. They demonstrated later that iron-free extracts from healthy soils would completely prevent the onset of untoward symptoms in sheep grazing on bush sick country. Following the announcement of the effect which cobalt exerted on animals suffering from coast disease, Askew and Dixon (1936) demonstrated that cobalt supplements were completely effective as a preventive and cure of bush sickness as it occurs at Morton Mains, and since then the treatment has been widely applied with obvious success in New Zealand.



THE DEATH OF AN ANIMAL IS INDICATED BY A CROSS AND NUMBERS IN BRACKETS SHOW NUMBER OF SURVIVORS IN THE GROUP

Effect of cobalt and copper on young sheep depastured on the littoral where coast disease occurs. Each matched group contains eight lambs aged 8 months at beginning of the experiment. All were depastured together, the treated groups receiving their supplements in aqueous solution three times weekly. The symptoms appear after about 20 weeks and account for all which do not receive cobalt in about 50 weeks. The incapacity of copper when administered alone to prevent the progress of the symptoms and its effect when superimposed on cobalt treatment is obvious.

Reproduced from *Bull. Council Sci. Ind. Research* (*Australia*). (Marston and McDonald).

The part undoubtedly played by cobalt in restoring and maintaining health in sheep suffering from the three maladies, coast disease, bush sickness, and enzootic marasmus, which although strictly regional, occur in markedly different terrain, suggests that pine, nakaturuitis and salt sickness, which apparently evidence identical symptoms, may be the result of a breakdown in the chain of metabolic events for which cobalt provides a link; or not unlikely, they may indeed be of identical etiology, resulting from a metabolic disturbance caused directly from a partial or absolute shortage of cobalt in the fodder of the affected areas.

Coast disease, in some regions, is a rather more complicated syndrome than that resulting from cobalt deficiency. While it shares the symptoms of lethargy, wasting and anæmia with the other maladies which respond to a small supplement of cobalt, sporadic outbreaks of ataxia are frequently observed in young lambs born of ewes which have spent a relatively short sojourn during their pregnancy on certain parts of the littoral.

This condition, which results from degenerative changes in the spinal cord, although strictly regional also, is not invariably confined to areas where coast disease is enzootic. While the resulting lesions of demyelination are anatomically related to those observed in the enzootic paraplegia (renguerra) reported to occur among lambs bred in certain areas in the Peruvian Andes, and to those of swayback, which accounts from time to time for many lambs in certain parts of England, the underlying cause may possibly be distinct. The similar condition, enzootic ataxia of lambs in the Gin Gin area of Western Australia, which Bennetts has recently attributed to copper deficiency and shown to be overcome if the pregnant ewes on this area are supplemented with small amounts of copper, is, however, apparently closely related etiologically with that observed on the affected littoral; for our experiments have amply demonstrated that small amounts of copper are essential to maintain cobalt-treated animals in good health while depastured on the areas where both ataxia and coast disease occur, notwithstanding the fact that supplementing with copper neither alleviates the symptoms of coast disease nor prevents the appearance of the anæmia and fatal decline if unaccompanied by cobalt.

The findings focus attention again on the possible physiological importance of those traces of elements, usually considered exotic, which have been demonstrated to be constantly present in living tissues, and furthermore, the discovery adds yet another example of the remarkable species difference in the behaviour of living organisms towards the nutritional environment; which, with little doubt, reflects subtle differences in the nature of the underlying metabolic processes.

The fact that horses exhibit no untoward symptoms when confined in their grazing to littoral tracts where ruminants will progressively decline and expire if left unsupplemented with cobalt is at present a fascinating subject for speculation, which may be solved when our knowledge of the role which cobalt assumes in the normal physiological function of some animals is extended.

A full description of the investigations of coast disease appears in monograph form in a Bulletin of the Council for Scientific and Industrial Research (1937). The references in the literature to similar maladies mentioned above are discussed in further detail there.

Obituary Notices

Dr. A. B. Rendle, F.R.S.

ALFRED BARTON RENDLE, who died at Leatherhead on January 11, was one of the leading British systematic botanists, and had been keeper of botany in the British Museum (Natural History) from 1906 until his retirement in 1930.

Born in London on January 19, 1865, he was educated at St. Olave's School, Southwark, and St. John's College, Cambridge, where he studied botany under Vines. In 1888, he was appointed assistant in the Department of Botany in the British Museum (Natural History), being placed in charge of the Monocotyledons and Apetalæ. It was characteristic of Rendle that his first taxonomic paper was not published until five years later, when he had mastered the technique of the subject. His work was consistently thorough, and the fact that he was able to accomplish so much is a tribute to his unremitting industry. As lecturer in botany at the Birkbeck Institute, Rendle kept in touch with academic circles, and in 1904 the first volume of his "Classification of Flowering Plants", comprising the Gymnosperms and Monocotyledons, was published by the Cambridge University Press. He described it modestly in the preface as "an attempt to give the student who has some acquaintance with botany a systematic account of the Flowering plants", but it was much more than this. By consultation of original memoirs as well as works of reference, Rendle had enriched it with many observations relating to embryology, anatomy, ecology, pollination and modes of fruit and seed dispersal, as well as with notes on the more outstanding types found in the various families. The second volume, including the Dicotyledons, appeared in 1925, and a new edition of vol. 1 in 1930.

Rendle fully appreciated the importance of the diffusion of scientific knowledge among the general public, and of closer relations between botanical theory and horticultural practice. He regularly attended the meetings of the British Association, and was president of Section K (Botany) at Newcastle in 1916. His knowledge of exotic floras and vegetation was enlarged by visits to Canada, the United States, Australia, South Africa and Bermuda. For many years he lectured on botany at the Royal Horticultural Society, and he took a great interest in the work of local natural history societies, having been president of the South London Botanical Institute and chairman of the Botanical Section of the South-Eastern Union of Scientific Societies.

Among Rendle's more important early scientific publications were an enumeration of the Monocotyledons and Gymnosperms collected by Welwitsch in Angola (1899), a revision of the genus *Najas* (1899), an account of the family Najadaceæ for Engler's "Pflanzenreich" (1901), and an enumeration of the Gramineæ of China and adjacent areas in Forbes and Hemsley's "Index Floræ Sinensis" (1903). The families on which he worked most were the Gramineæ and Orchidaceæ, though the wide scope of his studies left him no leisure in which to do monographic work in either. A joint paper with William Fawcett on the Jamaican species of *Lepanthes* (1904) was followed by the production, in collaboration with Fawcett, of four volumes of their "Flora of Jamaica", the first of which, comprising the orchids, appeared in 1910 and the fourth in 1926. After Fawcett's death, Rendle completed a fifth volume (Rubiaceæ and Compositæ), the greater part of which had been prepared by Spencer Moore.

Among the wide range of subjects which engaged Rendle's attention were bibliography and nomenclature. His studies on the flora of Jamaica and the grasses led to the appearance of bibliographical notes on Swartz's "Prodromus" (1897), Steudel's "Synopsis Plantarum Glumacearum" (1899) and Browne's "Natural History of Jamaica" (1912). After Britten's death, he edited the *Journal of Botany* (1925–38) and the second edition of Britten and Boulger's "Biographical Index of Deceased British and Irish Botanists" (1931).

The world-wide interest in the thorny subject of botanical nomenclature aroused by the publications of Otto Kuntze and other reformers led to the formulation of various proposals for alteration of the Paris "Lois de la Nomenclature botanique" (1867). Those from the British Museum (Natural History) were communicated to the Vienna Congress (1905) by Rendle, who attended the meetings as delegate for the Linnean Society as well as for the Museum Department of Botany. He served as a member of the editorial committee of the International Rules of Botanical Nomenclature in 1905–1935, and was responsible for the English text of the third edition of the Rules.

Rendle became a fellow of the Linnean Society of London in 1888 and served for three periods on the Council before his election as secretary in 1916–23 and president in 1923–27. He regularly attended the Society's meetings, taking part in the discussions and contributing numerous papers to the *Journal* (*Botany*) and *Transactions*. He was elected a fellow of the Royal Society in 1909.

The keynote of Rendle's career was conscientious performance of duty. Whatever came to his hand, he did it.

T. A. S.

Prof. A. V. Martynov

ANDREI VASSILIEVITCH MARTYNOV, whose death occurred on January 28, was born in 1879 in Riazan, Central Russia. After graduating at the University of Moscow, he became an assistant professor in the University of Warsaw, then a zoologist in the Zoological Museum at the Academy of Sciences in Leningrad, and finally professor in the new Institute of Palæontology of the U.S.S.R. Academy of Sciences at Moscow.

The scientific work of Martynov in the earlier period was mainly concerned with the study of the systematics and zoogeography of Trichoptera (caddis-flies), in which group he was one of the leading experts and on which he published several first-class monographs and a very large number of papers. This work led him to broader studies in insect morphology, more particularly in investigations of wing venation from an evolutionary point of view, and in this direction he made most important contributions to entomological science. Later, he turned his attention to the study of fossil insects, again with brilliant results (see below). As an indication of his unusual ability and energy, it should be mentioned that he also found time to work on the systematics of the Crustacea (particularly Gammaridæ), on which group he produced several important works.

A characteristic feature of all taxonomic researches by Martynov was his persistent seeking for the better understanding of the problem, with the aid not of morphology alone, but also of the ecology and the distribution of the animals studied. For his researches he was awarded the degree of doctor of biological sciences by the U.S.S.R. Academy, while the Société Entomologique Belge and the Russian Entomological Society elected him an honorary member.

Owing to the extensive circle of his interests, Prof. Martynov, although he had never been abroad, was probably one of the most widely known Russian entomologists, and his premature death will be felt deeply throughout the entomological world.

B. P. UVAROV.

As a palæo-entomologist, A. V. Martynov had an international reputation. His palæontological work was devoted entirely to the fossil insect deposits of Russia, among which those of the Permian of Tikhiye Gory and those of the Jurassic beds of Turkestan (Kara Tau) deserve special mention. From these and many other localities, Martynov described, in about forty publications, a great number of new forms, many of them of considerable phylogenetic importance. In particular, it was his work on the Permian insects which made Martynov widely known and brought him into close contact with the late Dr. R. J. Tillyard, who worked on the Permian insects of Australia and of Kansas, and with Carpenter, who is investigating the Kansas fauna. Before Martynov's studies in fossil insects, almost nothing was known from Russian territory. Now, after his premature death, Russia occupies a prominent place in palæo-entomology, and this is entirely due to Martynov's energy. His qualifications as a systematist appear in his careful descriptions, which will always retain their high value, even if in some cases his classification may have to be modified in future.

Martynov was able to trace backwards to earlier times the phylogeny of several groups of insects. He contributed a great deal to the knowledge of Permian Hemiptera, Mecoptera, Coleoptera, Odonata and other orders, and he described Phasmatodea and earwigs from Jurassic strata. The relations of these Permian and Jurassic forms to those of other countries were of special interest to him. He found close connexions between the Permian insects of Kansas and Russia, whilst the Jurassic fauna proved to be of an 'Angaran' type, with Indo-Australian relations.

There is no doubt that by Martynov's death palæo-entomology has suffered a severe loss and that his name and work will play an important part in research for a long time to come. F. E. ZEUNER.

Mr. D. Baxandall

MR. DAVID BAXANDALL, who recently retired from the position of deputy keeper at the Science Museum, passed away on January 10 at the age of sixty-three years, after a short illness.

Born on April 9, 1874, at Haworth, near Keighley, Mr. Baxandall received his early training at the Keighley Institute, where in 1891 he succeeded in winning a Royal Scholarship with which he proceeded to the Royal College of Science at South Kensington. Here he studied mechanics under Henrici and in 1894 obtained his first-class associateship in mechanics. He remained at the College for a further period during which he assisted Lockyer, until in 1898 he entered the Science Museum. During his first years at the Museum, he was employed in the Machinery and Inventions Division, but afterwards he was transferred to the Science Division, where he quickly developed a keen interest in early scientific instruments. He also studied the activities of early scientific instrument makers, and became a leading authority on this subject. Although Mr. Baxandall had a good knowledge of all kinds of scientific instruments, it was to astronomical, optical and mathematical instruments that he devoted his greatest attention, and it is chiefly due to his unremitting efforts that these subjects are so well represented in the Science Museum.

Mr. Baxandall was quiet and unassuming in manner, and although he was a fellow of the Royal Astronomical Society and of the Optical Society for many years, he was of such a retiring disposition that it was only with difficulty that he could be persuaded to speak at the meetings. He presented a number of papers on historical instruments and instrument makers before these Societies, and also contributed several articles to the "Encyclopædia Britannica".

By far the greater part of Baxandall's work, however, remains unpublished, for he collected together a large amount of valuable information on early instrument makers and their products, which he was hoping to prepare for publication, but unfortunately he was not able to complete the work. At the time of his retirement in 1934 he was deputy keeper in charge of the Science Division of the Science Museum, a position he had held for more than twelve years. He leaves a wife and two sons to mourn his loss, but he will be remembered with respect and affection by all who were privileged to know him as their friend.

Prof. Gustav Jäger

IN Gustav Jäger, whose death at seventy-three years of age occurred on January 21, Vienna has lost one of the last men who linked present-day physics with the classical period of the Viennese school as represented by the names of Stefan, Loschmidt and Boltzmann, and moreover one who had an unusually wide and all-round knowledge of physics. After several years of study in the laboratories of Stefan in Vienna and Helmholtz and Kundt in Berlin, he became assistant first to Stefan and later to Boltzmann. In 1905, he was appointed professor at the Technische Hochschule in Vienna, and then was called in 1918 to fill the chair of theoretical physics at the University of Vienna, which had formerly been held successively by Stefan, Boltzmann and Hasenohrl. In 1920, Jäger changed this chair for the directorship of one of the University institutes of experimental physics. Generations of students have listened to his lecture courses, and greater still is the number of those who were introduced to the elements of mathematical physics through his "Theoretische Physik", published in the handy volumes of the "Sammlung Goschen", and distinguished by clarity as well as conciseness.

In his original contributions to physics, Jäger showed himself a true pupil of Loschmidt and Boltzmann by his life-long interest in the problems of the kinetic theory of matter. Best known among his papers are probably those devoted to the development of a kinetic theory of 'ideal liquids', analogous to that of 'ideal gases'. That his occupation with technical problems bore fruit is shown, for example, by his contributions to the theory of aircraft construction; he was one of the earliest men of science who defended, on theoretical grounds, the possibility of heavier-than-air flying machines.

Jäger retired from his chair of physics in 1934, but as a member of the Vienna Academy of Sciences remained to the last in touch with scientific matters. His death is deplored by a great number of friends and colleagues, who will miss his amiable and cultured personality and his sound and balanced judgment.

F. A. P.

WE regret to announce the following deaths:

Mr. Thomas Gann, known for his explorations in Central America and his investigations of Maya archæology, on February 24, aged seventy years.

Dr. George Ellery Hale, For.Mem.R.S., honorary director of the Mount Wilson Observatory, Pasadena, California, on February 22, aged sixty-nine years.

News and Views

Prof. W. L. Bragg, O.B.E., F.R.S.

THE election of a successor to the late Lord Rutherford in the Cavendish chair of experimental physics in the University of Cambridge has been eagerly awaited by men of science all over the world, and it may safely be said that the appointment of Prof. William Lawrence Bragg, Director of the National Physical Laboratory, will give widespread satisfaction. Prof. Bragg shares with his father, Sir William Bragg, president of the Royal Society and director of the Royal Institution, the credit of founding the science of crystal structure which has grown in the last twenty-five years until it affects almost every branch of science, and dominates several. This work, a consequence of von Laue's discovery, was begun shortly after W. L. Bragg took his degree in 1912, and so rapid was the progress until the outbreak of the Great War that father and son were jointly awarded the Nobel Prize in Physics in 1915. During the War, Bragg made a great reputation as the leader and virtual creator of the British sound-ranging service which was generally admitted to have been consistently in advance of that of any other army. In this work, he showed both scientific and organizing abilities of the highest order, and led a group of men of whom many are famous in science to-day. Returning to Cambridge after the War, he was appointed in 1919 to succeed Rutherford in the Langworthy chair of physics in the University of Manchester, and proceeded to build up a school of workers with whose aid he disentangled crystal structures of ever-increasing complexity. His work on the silicates may be regarded as the culmination of this phase. Bragg possesses to a quite exceptional degree the power of thinking in the solid, and those who have worked under him speak with awe of his uncanny instinct for seeing the way in which a collection of atoms will group themselves.

IN recent years, Prof. Bragg has turned his attention to alloys, and by the application of the idea of co-operative action to the arrangement of atoms—the 'order-disorder' theory—has made important progress in this difficult, tangled subject. The study of atomic arrangements touches a surprising number of practical problems. Besides that of the invention of useful alloys, one may instance the agricultural properties of clays and recent developments in the study of proteins. It is possible, therefore, that under its new head the work of the Cavendish Laboratory may come into even closer contact with everyday life. It is only last year that Bragg was appointed director of the National Physical Laboratory (see NATURE, 139, 830; 1937), and it must have been difficult to face another change so soon; but the powers of organization and the personal qualities which made him so suitable a head for a large body of research workers will be of equal value at Cambridge. The Cavendish Laboratory is now so large that no one man can control it all closely, and Bragg's tact and gift of leadership form the best possible assurance of the happy co-operation of its many groups of research workers, while his brilliant lectures and personal charm ensure his success as a teacher of undergraduates.

Prof. G. M. Bennett

PROF. G. M. BENNETT, Firth professor of chemistry in the University of Sheffield, has been appointed University professor of chemistry in King's College, London. Prof. Bennett's researches have been of varied character. Some, such as those concerning the synthesis of penthiane derivatives, the nature of the polymeric ethylene sulphides and the derivatives of monothioethyleneglycol have dealt with subjects of particular interest in the chemistry of organic sulphur compounds. Among others of more general interest, his study of the stereoisomerism of di- and tri-sulphoxides is noteworthy; this revealed the existence of isomeric di-sulphoxides derived from substances such as ethylene disulphide, thianthrene and the ethers of dithioethyleneglycol, and it culminated in the isolation of the five oxides derived from trimethylenetrisulphide, an absolute proof of their stereochemical structures being obtained from their relationships. Another group of Prof. Bennett's researches has dealt with the variation in reactivity of a group under the influence of others present in the molecule. These began with a quantitative study of the influence of sulphur or oxygen on the reactivity of halogens or of the hydroxy group separated from the former by a lengthening chain of saturated carbon. The data then obtained and their theoretical interpretation led to experiments dealing with the general influence of nuclear halogens on aromatic side-chain reactivity; these led to the view that the electromeric effects of the halogens vary in intensity in an order which is opposite to that previously accepted. More recently, Prof. Bennett has made a study of organic molecular compounds and as a result has found justification for the view that in many of these the components are united by some form of a true valency bond. Adoption of this view led to the discovery that other electron-attracting groups such as cyanogen, methane sulphonyl, and chlorocarbonyl may serve instead of the usual nitro-group in one of the components.

Gustav Fritsch (1838–1927)

GUSTAV THEODOR FRITSCH, a pioneer in the physiology of the brain and one of the last great personalities of the classic period of German medicine, was born on March 5, 1838. He received his medical education at the Universities of Berlin, Breslau and Heidelberg under Helmholtz, Peters, Traube, Frerichs and Langenbeck among others, and qualified with a thesis on the central nervous system in 1862. He then spent three years in extensive foreign travel. In South Africa he made a study of the anatomy and physiology of the natives. He then visited Aden, where he studied eclipses and passed on to Upper Egypt, where he made some important anthropological and ethnographical investigations. On his return to Germany he devoted himself to the study of diatoms and electric fishes, and in 1868 was made assistant to Prof. Reichert at the Berlin Anatomical Institute. His chief achievement was the discovery in 1870 in collaboration with Hitzig of the motor centres of the cerebral convex and their excitability by the faradic current, which formed one of the landmarks in the history of physiology. In 1908, at the age of seventy years, he published a remarkable work on the comparative racial morphology of the human retina, illustrated by plates prepared from photomicrographs, in which, as in scientific photography generally, he had always shown a keen interest. His death took place on June 12, 1927.

Native Policy in the Union of South Africa

THE arguments in favour of the transfer of the South African Protectorates to the Union of South Africa without further delay were stated ably and perspicuously by Mr. Lionel Curtis in his address to the Royal Empire Society on February 8. He pointed out that such a demand was inevitable on the formation of a National Government, which with its party is bound to consider how far the control it exercises in its domestic affairs, under the law as expressed in the Statute of Westminster, is effective. In such a survey, it is forced on their notice that the inhabitants of the Protectorates are dependent upon the Union territories for the sale of their produce and further a great proportion of them earn their living within the Union. Socially and economically the Protectorates, therefore, are integral parts of the Union. The relations of white to black lie at the root of all South African questions; and it is idle to tell the South African Government that it has been given complete control of its domestic interests so long as they lack control of areas, which, beyond dispute, are component parts of its social and economic community. Mr. Curtis then recited the changed conditions which have been brought about by the Balfour Memorandum and the Statute of Westminster, and argued that in view of that change it is no longer possible to meet the demand for transfer with the reply that it cannot take place until South Africa's native policy within the Union has conformed to British opinion. Not only is he not of the opinion that the interests of the natives throughout South Africa would be best served by withholding the transfer; but he also considers such a policy fraught with disaster. Noting the growth of a reaction against the prevailing opinion on native policy among young Afrikanders in the universities, he concluded by urging that the time is over-ripe for discussion of the transfer, consultation of the natives to form part of that discussion.

THE views expressed by Mr. Curtis have aroused no little criticism. This has served to indicate once more that there is a considerable body of opinion in Great Britain which attaches overwhelming importance to the obligation of the British Government to carry out its pledges—pledges both to the Union of South Africa, as well as to the natives of the South African Protectorates. No one has ventured to suggest that the transfer should be delayed indefinitely; but on the other hand, it is certain that instructed opinion would favour decisively the view expressed by Lord Lugard that some further delay is desirable. It is, however, no less essential that, if there is to be further delay, it should be secured by such means as will avoid hardening public opinion, which is steadily growing in South Africa against the tendency towards a more liberal policy in native affairs. The number of advocates of what may be termed, for brevity, 'the anthropological approach' is increasing, and the influence of the universities in leavening public opinion by the objective, non-political and scientific study of a difficult social problem is becoming stronger. In the long run, this leaven is bound to tell; and time is in its favour. In the last resort, however, the solution lies with the Union Government. When its native policy becomes such that it is acceptable, not as is suggested to opinion in Great Britain, but to the natives of the Protectorates, and wins, if not their assent, at least not their active and stubborn opposition, the time for transfer will have come. The acerbity of the argument in favour of immediate transfer put forward by some of its supporters argues a knowledge that reference to the native population at the moment would meet with an unfavourable reply.

Closing Excavations at Maiden Castle, Dorchester

THERE is a dramatic touch in the discoveries of the fourth and final season of joint excavation by the Society of Antiquaries of London and the Dorset Natural History and Archæological Society on Maiden Castle, which in other circumstances it would be difficult to accept as entirely fortuitous. Dr. R. E. Mortimer Wheeler, in describing his recent finds on this site before the Society of Antiquaries on February 23, was able to give a detailed account of the final assault on, and dismantling of, the fortress by the enraged troops of Vespasian in A.D. 43, which was not merely an imaginative reconstruction derived from topographical observation, but was also a direct inference from the evidence of such archæological finds as projectiles from the barrage of the field train of artillery, which preceded the attack, the ruins of the platforms or towers protecting the approaches, and the ashes of the burnt hutments outside the walls, in which were found the burials, hurried and confused as if interment had taken place in the night following the battle, of the defenders, whose bodies had been savagely hacked by the attacking soldiers. Then followed the evidence of the period of British occupation of the site as an open town, until the inhabitants were removed to the neighbouring Roman city, recently founded, where Dorchester now stands, and Maiden Castle was left waste, except for an isolated burial of a Saxon warrior in the seventh century, which brings the story of Maiden Castle to a close. Though less dramatic, two discoveries relating to the neolithic period are almost equally important as confirming Maiden Castle's position as a classic reference in British prehistory. Of these, one was a crudely shaped chalk idol of the Mediterranean mother-goddess type, "an interesting and rare addition to the equipment of neolithic Britain"; and secondly a vast mound of later neolithic age, the largest of its kind as yet known, in one part of which was the skeleton of a young man with skull and long bones so hacked soon after death as to afford indubitable evidence of cannibalism.

Expedition to Northern Syria

MEMBERS of the joint expedition of the British Museum and the British School of Archæology in Iraq have left England for a fourth season of excavation on the archæological site of Tal Brak in north-east Syria. The expedition is in the charge of Mr. M. E. L. Mallowan, field director. He is accompanied by Colonel A. H. Burn, Mr. G. H. Bell, who is the architect of the expedition, and Mr. I. Threlfall. The excavations of previous seasons have shown that this site is especially remarkable for its evidence of early relations with Sumeria, and for its affinity with Hittite culture. This year the members of the expedition will continue the examination of a palace, which was laid out on an extensive scale under the dynasty of Sargon of Akkad about 2600 B.C. At the close of last season seven treasure chambers had been brought to light, but their examination had to be postponed as their condition was considered to be unsafe. Their investigation will now be resumed. The work of the expedition, however, will be directed more particularly to the remains of about the period 1500 B.C., when there was a considerable Hurrian population in the Khabur valley in close touch with both the cities on the Tigris to the east and with the Mediterranean coast to the west.

Twenty Years Progress in Science in the U.S.S.R.

THE twentieth anniversary of revolution is marked by the U.S.S.R. Academy of Sciences in the issue of special numbers of its periodical publications. The "Vestnik" of the Academy for October–November 1937 is a volume of 346 pages containing brief accounts of the work during the last twenty years of many, but not all, of the scientific institutes, museums and laboratories connected with the Academy. The number of such institutions has grown from 39 in 1917 to well over a hundred in 1937, with more than 4,000 on the scientific and technical staff as against 212. The October part of "Priroda" (published in January 1938) contains a series of brief surveys of twenty years progress in different branches of sciences, namely, mathematics, astronomy, physics, aerodynamics, chemistry, geology, petrography, botany, physiology, zoology (separate articles on ornithology, mammology, ichthyology, entomology, ecology), palæontology, etc. Many of the articles have a broader basis and treat in a concise form the Russian contributions to the progress of science not only during the 'Stalin's era', as the period 1917–1937 is somewhat inexactly termed in the leading article, but also in the years before the revolution. Indeed, the work of such veterans of Russian science as the astronomer Struve, physicist Lebedev, the great Mendeléeff, physiologist Vvedensky, zoologists Menzbier and Sushkin, etc., is given fullest credit, and it is shown how their ideas have been developed by their numerous pupils and followers in later years.

Official Tests of Composite Aircraft

THE combined seaplane *Mercury* and flying boat *Maia*, designed by Major Mayo and built by Messrs. Short Bros. of Rochester, mentioned in NATURE of February 19, p. 321, passed the first properly observed separation trial on February 23. The actual operation was photographed with a cine-camera from another flying boat flying parallel with it, and knowing the exposure times, accurate measurements of the rate and angles of separation can be made. Subsequent views on the film show that the parting was instantaneous and that the gap widened steadily enough to ensure safety under all reasonable air conditions. The test were not quite the most severe, as *Mercury* was not fully loaded with petrol, having only about half her capacity on board. This reduction of weight is necessary to allow a safe landing. Normally most of the fuel would be consumed during the flight, or in an emergency it can be jettisoned. During the take off, the control is entirely in the hands of the pilot of the lower component, the flying controls of the upper machine being locked by the same mechanism that attaches the two machines. When he wishes to separate, he informs the upper pilot by telephone, waits for an agreed number of seconds, and pulls a lever that releases both the upper machine and its controls. The lower flying boat is trimmed so that it automatically becomes nose heavy when released and dips away, while the upper seaplane, at its best climbing attitude, climbs rapidly. The separation took place at about 800 feet height, flying at 140 miles an hour. These figures could probably be increased considerably should bumpy conditions in the air demand it. It is understood that both pilots, Mr. Lankester Parker and Mr. H. L. Piper, considered the tests to be satisfactory.

Alchemy in Scotland

IN a lecture given on February 4 at Marischal College, Aberdeen, before the local sections of the Institute of Chemistry and the Society of Chemical Industry, Prof. John Read of the University of St. Andrews gave an account of alchemy in Scotland. James IV of Scotland appointed an Italian, John Damian, as his court alchemist, a laboratory being founded in Stirling Castle about 1500. Accounts of the Lord High Treasurer from 1501 until 1513 contain information about the costs of the materials used by Damian and his associates in their attempts to prepare the "quinta essentia", which ended when the King was killed at Flodden Field in 1513. Alexander Seton, who is said to have travelled from Scotland to the Continent in 1602 and to have performed a series of transmutations in various German towns, was tortured by the Elector of Saxony and was rescued by the Polish nobleman Michael Sendivogius, but died in 1604 as a result of the cruel treatment he had received. Seton is said to have been the real author of the "Novum Lumen Chymicum", a work which was regarded as of the highest importance and was even treated with respect by Newton. John Napier, of Merchiston, the inventor of logarithms, was keenly interested in alchemy, as were his father and his son. William Davidson or Davisson, of Aberdeen (1593–1669 ?), was a chemist rather than an alchemist. He became physician to the King of France and wrote an early text-book of chemistry, "Philosophia Pyrotechnia seu Cursus Chymiatricus" (1633–5), which contains one of the earliest contributions to crystallography.

Acquisitions at the British Museum (Natural History)

PRESENTS to the Department of Zoology include the magnificent mounted head (the largest on record) of an Asiatic wapiti presented by Lieut.-Colonel Price Wood, and a very large mounted specimen of a Tasmanian platypus presented by Sir Frank Crisp. Among the specimens presented to the Department of Mineralogy is a fine set of minerals from Western Australia sent by Dr. E. S. Simpson. This includes remarkably large masses of petalite and its alteration products from a feldspar quarry at Londonderry, near Coolgardie. The petalite, a lithium-aluminium-silicate, occurs in masses weighing up to a hundredweight. This is the more remarkable as petalite is one of the rarer minerals and until quite recently was only known as comparatively small crystals. In 1935 and 1936, however, a quarry in pegmatite at Varatrask, Boliden, northern Sweden, yielded many tons of the mineral, and individual crystals were found measuring more than a foot in length. A specimen of this petalite also was presented to the Museum by Prof. P. Quensel. Three fragments of meteoric iron presented by Mr. I. Reinvald, Inspector of Mines, Estonia, are of particular interest as they are part of a lot of about thirty pieces found after laborious search in the neighbourhood of the Lake of Kaalijärv in the island of Oesel. This lake was described in 1827 and many suggestions were made as to its origin. In 1929, Mr. Reinvald made a detailed survey and was convinced that the lake filled a meteorite crater. Five other smaller craters were found in the neighbourhood, but it was only in July 1937 that any meteoric iron was found to confirm the theory of their meteoritic origin. Other specimens received include rocks collected by Dr. J. V. Harrison, and Mr. M. H. Donald on excursions in the Urals and the Caucasus, following the International Geological Congress held in Moscow last year, and special mention should be made of a specimen of carved pyrophyllite from China, presented by Mr. B. Cattell, one of the warders in the Museum.

The Universities Bureau of the British Empire

FROM the Universities Bureau of the British Empire we have received the report of its executive council for 1936–37. Its membership, as at July 31, 1937, comprised the 19 universities of Great Britain and Ireland, 10 of the 21 Canadian universities, 3 of the 5 South African, 6 of the 17 Indian, the Universities of New Zealand, Malta, Hong-Kong and Rangoon, 6 university colleges and 4 other colleges. A resolution was passed by the Indian Inter-university Board last February to the effect that it was desirable that universities in India should join the Bureau. In addition to indicating briefly the various activities of the Bureau during the year, the report enumerates the subjects that were discussed by the Committee of Vice-Chancellors and Principals of the home universities, by the Australian Vice-Chancellor's Committee and by the Inter-university Board, India. The Bureau's Handbook for Students from Overseas published last year had a very wide circulation, and a new edition was prepared in collaboration with the British Council on British Teachers Abroad, which had prepared a somewhat similar manual relating to institutions other than universities. In the new edition, issued as a joint publication by the two bodies, the information has been amalgamated to form an outline of the facilities for higher education provided by universities and other institutions in Great Britain and Ireland.

Centenary of Le Officine Galileo, Florence

IN celebration and commemoration of their centenary, the house of Le Officine Galileo of Florence have issued a striking record of their past and present achievements in the sphere of the manufacture of scientific instruments and other high precision products. They pay tribute also to the men of distinction who have been associated with them and among whom they specially mention the late Marchese Marconi. It has been the privilege of this firm to introduce many instruments of epoch-making importance, and, before 1840, they constructed the circular dividing machine designed by and made to the instructions of Giovan Battista Amici. In 1878, they introduced the Caselli motor for torpedoes. In connexion with astronomical instruments theirs is a long and honourable record; in 1884 they constructed the astronomical clock in the Osservatorio Ximeniano in Florence, and have but recently completed the 1·20 metre telescope for the University of Padua—a model of which was shown at the Paris Exhibition. Among the early examples of their work illustrated in the commemorative volume are an electric automobile of 1900, a military goniometer, an electric field telegraph and the periscope for the Swedish submarine *Hajen* of 1902. An interesting contrast between the old and the new can be observed by comparing the illustrations of the theodolites—the spidery construction of the older type is in complete contradistinction to the compact rigidity of the model of to-day, which illustrates how design of fine measuring instruments has been influenced by the high degree of precision attainable in up-to-date manufacturing processes. Among the types of instruments now being manufactured are to be noted such diverse examples as microtomes, dermato-capillariscopes, stereo-cartographs, polarimeters, binoculars and projectors, while a separate list of electrical apparatus shows oscillographs, radio transmitters, measuring instruments, electric pumps and anti-aircraft equipments.

Radio Waves in the Upper Atmosphere

IN a paper read to the Institution of Electrical Engineers on February 21 by J. P. M. Mellor, it is pointed out that pilot balloons sent up to record the electrical state of the atmosphere have failed as yet to detect any regions of particular interest to the radio engineer. Due chiefly to the increasing use of ultra-short waves for television, some six layers of ionized gas have now been discovered between 4 and 10 miles up. Each layer reflects the ultra-short waves under certain conditions. But they have no effect on the longer waves used in radio communication. Ultra-violet light from the sun ionizes the earth's outer atmosphere to different degrees at different heights; the ionosphere consists of free electrons and positive and negative ions in a rarefied gas. The *D* layer, between 40 and 60 miles above the earth, absorbs or attenuates radio waves. Above this, we have the region of maximum ionization, the Heaviside or *E* layer. Above the 120 mile mark, is the Appleton or *F* layer, which varies in height according to the time of the day. The portion of the energy radiated by the transmitter which travels over the surface of the earth is called the 'ground wave'. The magnetic field penetrates the ground causing eddy currents, thus frittering away the energy of the ray. Attenuation of the ground wave increases as the wave-length is decreased. The 'sky wave' is the wave which is propagated in the atmosphere above the earth. When it reaches an ionized layer, its path is bent earthwards when conditions are favourable. If its frequency is less than the critical frequency the wave is refracted, if equal to it absorption takes place and if greater than the wave it passes through the layer with very little attenuation. A wave sometimes arrives at the receiver after making a large number of ricochets between the ionosphere and the earth. If a receiver is situated close to the transmitter so that it picks up the ground wave and is in the area covered by the reflected wave, then since the waves have travelled different lengths they may interfere with one another and 'fading' will occur. 'Delay echoes' up to three seconds are readily explained by Störmer's electron envelope.

Consumption of Electricity by Wireless Receiving Sets

ACCORDING to the *Beama Journal* of October, wireless, more than any other domestic appliance, familiarizes consumers with electricity and encourages them to become electricity consumers. Quoting from a report of M. Deutsch of Brussels, interesting figures relating to the electricity consumption of wireless sets in various countries are given. The B.B.C. returns the highest estimate, namely, an average annual consumption per set of 87 electric units for a wireless receiver, Belgium, France and Holland return 54 units and Germany 40. In the United States, the consumption per receiver is estimated to be 54. Since the number of mains-operated wireless receivers in the United States was 24 millions at the beginning of 1937, the total consumption due to wireless is therefore nearly 1,300 million units. In Great Britain the number of wireless licences issued at the end of August of this year was more than eight million. A few years ago it was considered that 100 sets per 1,000 inhabitants would be about the maximum. According to M. Deutsch, the existing figure in Great Britain is 160 sets per 1,000 inhabitants, Germany having 120 sets. To-day the maximum is reckoned to be about 300 sets per 1,000 inhabitants. Statistics for 1935–36 show large increases in the number of wireless sets sold in some of the more backward European countries. During this year, Bulgaria increased the number of receivers installed by 91 per cent, Rumania, Portugal, Spain and Poland all registered increases between 30 and 50 per cent. In Great Britain, the increase was 9·2 per cent, whilst in Turkey the figure declined by 10 per cent.

The Oxford Farming Conference

AT the Oxford Farming Conference held on January 4–7 a number of interesting questions of fundamental importance were brought up, and the opening paper—the maintenance of fertility and the land fertility scheme—set the stage for discussions of a far-reaching nature. Although soil deterioration due to erosion or exhaustion of virgin land are not serious problems in England, much of the grassland is in a badly impoverished condition. Drainage, liming, application of phosphate and the sowing of wild white clover are the chief remedies, and the Government's Land Fertility Scheme should stimulate the efforts already being made in these directions. Grassland management, and its counterpart, grass conservation, were the subjects of a group of papers in which the different methods of making hay, silage and dried grass were discussed, from both the nutritive and economic aspects. Questions affecting the arable farmer also received attention, and alternate husbandry, on both light and heavy land, was advocated as being valuable for the increase of productivity, profit and employment, and for the control of animal disease and the promotion of national defence. Problems connected with plant disease were represented in a paper on soil conditions and the control of foot-rot in cereals, and the Conference concluded with a discussion on the ever-recurrent question of weed control.

New Varieties of Spring Oats

PARTICULARS of two new varieties of spring oats that will be available for distribution for sowing this coming spring are given in Leaflet Series S. No. 4 (price 1*s*.) issued by the Welsh Plant Breeding Station, Aberystwyth, and farmers, co-operative societies and merchants desiring seed should make immediate application to the Station for supplies. Oats are grown over a wide range of soil and climate, and in the breeding work at Aberystwyth special attention is paid to the production of strains able to resist lodging and suitable to soils of varying productive capacity. The two new varieties, *S*. 84 and *S*. 175, are intended for soils of high and medium productive capacity respectively. For poor soils, the Ceirch

Llwyd Cwta (*S.* 171) is the more suitable variety, and useful information gained from practical experience in its cultivation during the previous season is to be found in the leaflet. Farmers growing the Aberystwyth strains are particularly requested to inform the Plant Breeding Station of the behaviour of the varieties in question, as such reports are of great value to those engaged on the selection work.

Conservation of Natural Resources

IN the United States, strenuous efforts are being made by the Government, through its Forest Service, National Park Service, Soil Conservation Service, Tennessee Valley Authority and other agencies to remedy the disastrous effects of years of neglect and exploitation. Many voluntary organizations cooperate. In "Conservation in the Education Program" (*Bulletin* No. 4 of 1937), the Commissioner of Education presents an account of the progress made in introducing into school curricula instruction designed to awaken an appreciation of the importance to the community of conservation of natural resources and the duty of the individual citizen in relation thereto. Such instruction is conveyed in general in connexion with regularly established school subjects such as nature-study, elementary science, the social sciences, particularly geography; but in at least one State "Protection and Conservation of Life, Property and Natural Resources" is one of a number of social functions selected as bases for organizing instruction according to the theory that things should be learnt in relation to the ways in which they will be used. In addition to outlining existing practices, the bulletin contains a detailed prospectus prepared in the Curriculum Construction Laboratory of Teachers College, Columbia University, of a course of instruction on the theme "How is Man trying to Conserve his Natural Resources".

The History of Science

WE have received vol. 3, part 1, of *Osiris*, the journal devoted to the history of science and edited by G. Sarton. This part is dedicated to Prof. E. O. von Lippmann, a biographical notice (with portrait) and a bibliography being contributed by J. R. Partington. Several of the articles deal with the history of mathematics and astronomy; there is also one on Sir Charles Blagden by F. H. Getman and one on Leeuwenhoek by A. W. Meyer, and L. B. Simpson contributes an account of the medicine of the Conquistadores based on a sixteenth century manuscript. The mathematical papers deal with linear and quadratic equations (Kloyda), the calculus of variations (Carathéodory), and the graphical representation of statistical data (Funkhouser). Other interesting papers make up a noteworthy issue.

Announcements

SIR JOHN ANDERSON, the National Government candidate, has been elected Member of Parliament in the Scottish Universities seat which became vacant on the death of Mr. Ramsay MacDonald.

THE Kelvin Medal Award Committee, on which are represented eight of the most important engineering institutions, has awarded the Kelvin Medal for 1938 to Sir J. J. Thomson, Master of Trinity College, Cambridge, in recognition of the eminent services he has rendered to engineering science. The presentation will be made by Lord Rayleigh at the Institution of Civil Engineers on May 3.

THE first award of the James Alfred Ewing Medal of the Institution of Civil Engineers has been made to Mr. C. S. Franklin, research expert, formerly chief of the Independent Research Department, of the Marconi Company. Mr. Franklin is known chiefly for his researches in connexion with the Marconi beam system. The Bayliss Prize of the Institution has been awarded to Mr. R. Kerridge.

THE following have been elected honorary members of the Institution of Civil Engineers: H.M. the King of the Belgians; H.R.H. the Crown Prince of Sweden; Sir Robert Elliott-Cooper, senior past-president of the Institution; and Sir Frank Smith, secretary of the Department of Scientific and Industrial Research.

SIR ALBERT SEWARD, formerly professor of botany in the University of Cambridge, has recently been elected a trustee of the British Museum.

PROF. E. S. Goodrich, Linacre professor of zoology and comparative anatomy in the University of Oxford, has been elected a member of the Section of Zoology of the Royal Swedish Academy of Science, Stockholm.

THE twenty-ninth Congress of the German Radiological Society will be held on July 4–7 at Munich under the presidency of Dr. G. A. Weltz. Further information can be obtained from Prof. Karl Frik, Bruckerallee 22, Berlin.

THE fifth International Congress of Cell Research will be held at Zurich on August 7–13, when the following subjects will be discussed: epithelium in cultures and in the organism, structure of chromosomes, mechanism of mitosis, cancer cell and normal cell, experimental cell investigation, and investigation of viruses. Further information can be obtained from Das Anatomische Institut, Plattenstrasse 9, Zurich 7.

THE annual Malaria Control Course for Laymen (engineers, planters, etc.) will be held at the Ross Institute of Tropical Hygiene commencing on June 27, 1938. The course will be under Sir Malcolm Watson, director of the Institute. It is designed for planters and mining engineers, but it will be of interest to all (including missionaries) who are proceeding to the tropics. Further information can be obtained from the Organizing Secretary, Ross Institute of Tropical Hygiene, Keppel Street (Gower Street), London, W.C.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

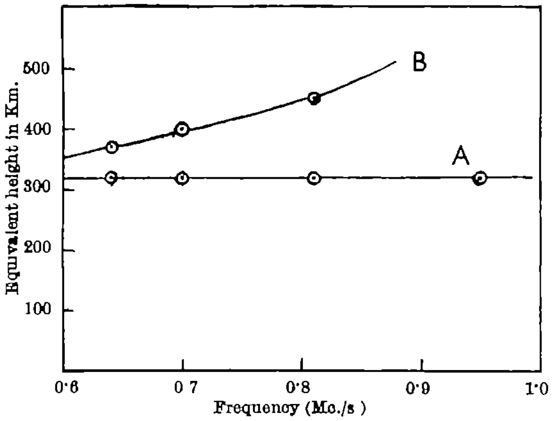
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 417.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Magnetic Double Refraction of Medium Radio Waves in the Ionosphere

IN 1935, two of us[1] reported the results of experiments in which pulses were reflected from the ionosphere using a frequency less than the magneto-ionic gyro-frequency and in which the polarization of the echoes was determined by means of a "circularly polarized" receiving aerial. We found doubled echoes from region *F* on frequencies below about 1·0 Mc./s. and we showed that the echo of shorter delay had left-handed polarization and that of greater delay was right-handed. We therefore interpreted the two echoes as magneto-ionic components, and this interpretation was supported by observations of the change over of the reflection from region *F* to region *E*.

In further experiments of the type then reported, we have since investigated the way in which the echo doubling varies with frequency and have found that the separation between the two components increases as the frequency is increased as shown in the accompanying graph, which exhibits the results of measurements made at 0030 on December 14, 1935. We found that the right-handed echo *B* became weaker as the gyromagnetic frequency was approached, and we could not follow it above a frequency of about 0·9 Mc./s.



In a recent issue of NATURE, Martyn and Munro[2], who have conducted their experiments in the southern hemisphere, produced a graph very similar to that shown above, but have given quite a different interpretation of it. Since, however, in considering the results shown by our graph, we have now arrived at a more complete explanation on the lines of that previously given, it may be of interest to contrast the two interpretations.

Our own reading of the results exhibited in the accompanying graph is very simple. We consider that the curve *A* refers to the ordinary and *B* to the extraordinary ray echoes. Since we are dealing with a frequency *f*, which is less than the magnetic gyro-frequency f_H, the ordinary ray is reflected at a level in Region *F* where the electron concentration *N* is given by

$$N = \frac{\pi m}{e^2} f^2; \qquad (1)$$

while the extraordinary ray is reflected where *N* is greater, that is to say where

$$N = \frac{\pi m}{e^2} (f^2 + f f_H). \qquad (2)$$

Bajpai and Mathur[3] have shown that, for extraordinary waves of the frequency range we are considering, the group velocity is relatively low over most of their track in the ionized medium, so that these waves are delayed in time behind the ordinary waves. Delay occurs as a result of transmission both through regions E_1 and E_2 and through such part of region *F* as lies below the reflection level. This explanation agrees with the observed polarization of the waves. For frequencies approaching the gyro-frequency the absorption of the extraordinary wave echo is very considerable. This explains why it cannot be followed beyond about 0·9 Mc./sec.

The agreement of experiment and theory in the case of our experiments raises a difficulty in connexion with the Australian experiments, where the results to be explained are similar but are given a different interpretation. Martyn and Munro, for example, consider that both traces in their figure refer to ordinary waves, though no experimental check of similar polarization is mentioned. They accept, as we do, that the curve *A* represents the ordinary ray echo which is reflected at the level conditioned by equation (1); but they consider that curve *B* represents an echo due to waves which have penetrated the 'over-dense' stratum which lies between that level and a higher level where the ordinary ray refractive index becomes infinite. The value of *N* at this higher level is given by[4]

$$N = \frac{\pi m}{e^2} f^2 \left(\frac{f_H^2 - f^2}{f_H^2 \cos^2 \theta - f^2} \right). \qquad (3)$$

(There appear to be slips in the formula given by Martyn and Munro). Now it is easy to show that this interpretation requires that, when *f* approaches $f_H \cos\theta$, the waves should 'leak' through a 'barrier' of approximately 100 km. or about 400 vacuum wave-lengths. The difficulty of an explanation along these lines need not be elaborated beyond this point.

To settle the matter an examination of the polarization of the echoes obtained in Australia is needed. If both components are found to be of the same polarization, the explanation given by Martyn and

Munro is acceptable. If, on the other hand, the two echo-components are observed, as in England, to be of opposite polarization, the explanation of the phenomenon given by Martyn and Munro must be abandoned together with the two further deductions they have made from it.

E. V. APPLETON.
F. T. FARMER.
J. A. RATCLIFFE.

Cavendish Laboratory,
Cambridge.
Feb. 2.

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[1] Farmer and Ratcliffe, NATURE, 135, 831 (1935)

[2] Martyn and Munro, NATURE, 141, 159 (1938).

[3] Bajpai and Mathur, *Indian. J Phys.*, 11, 165 (1937).

[4] Appleton, *Proc. Union Rad Sci Int.* (Washington, 1927).

Mean Free Path of Protons in the Universe

IT is known that on different occasions and in different forms a dimensionless constant of the order of between 10^{39} and 10^{40} recurs in physics—the variety being due to the fact that two other dimensionless combinations (hc/e^2 and m_P/m_e) are *comparatively* small and, besides, are of the *same* order (10^3). Some of us believe that the *large* constant is the square root of the number of mass-units (protons and neutrons) in the world (N). I propose to name 'Eddington's relation' the relationship between universal constants which springs from this assumption. For it is essentially *one* and we need a name for it, in order to be able to say, this is essentially Eddington's relation, when we are presented with a disguised form of it.

Moreover, it is known that, from that assumption, if Einstein's relation between mean mass density and curvature is admitted, reasonable values result for the radius (R) of the universe and its mean density (ρ); following Eddington: $N = 1{\cdot}57 \times 10^{79}$, $R = 1{\cdot}23 \times 10^{27}$ cm., $\rho = 3{\cdot}32 \times 10^{-27}$ gm./cm.^{3}).

An interesting form of Eddington's relation occurred to me recently. The mean distance between the closely packed mass-units in the nuclei[1] is $\delta = 3 \times 10^{-13}$ cm. It is seen that

$$\frac{R}{\delta} = \frac{1{\cdot}23 \times 10^{27}}{3 \times 10^{-13}} = 0{\cdot}4 \times 10^{40} \sim \sqrt{N} \text{ very nearly.} \qquad (1)$$

Now let us call it an 'encounter', when two mass-units approach each other within the distance δ; and let us calculate the average number of encounters (n) along a great circle, assuming that all the units are free and form a gas: then

$$n = \frac{2\pi R \,.\, \pi\delta^2}{2\pi^2 R^3} N = \frac{\delta^2}{R^2} N \sim 1. \qquad (2)$$

Thus, with uniform distribution, the mean free path would equal the world's circumference. In other words, the number of protons and neutrons would be just on the border-line of making the universe 'opaque' for a radiation to which each of them presented an absorbing cross-section of $\pi\delta^2$. Or again, the sum of the cross-sections of the particles is roughly of the same order (one sixteenth) as the cross-section of the universe.

There ought to be something essential in these very simple statements—unless Eddington's idea that the mass-unit is connected with the radius, R, is entirely deceptive. For, of course, δ *must* be connected with the mass-unit, since it is so very near to

$$\frac{h}{m_P c} = 1{\cdot}32 \times 10^{-13} \text{ cm.}$$

It ought, by the way, to be remembered that, in adopting Eddington's numbers, we already tacitly admit that the luminous masses concentrated in the nebulæ constitute but a small fraction, about one thousandth, of the mass of the universe.

E. SCHRODINGER.

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Graz.

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[1] Bohr, N., and Kalckar, F., *Kgl. Danske Videnskabernes Selskab.* Math.-Phys., Comm , 14, 10, p 9 (1937).

Neon and Argon in the Earth's Crust

IN the atmosphere, atoms of argon are some 520 times as abundant as atoms of neon. Russell and Menzel[1] have emphasized that in celestial sources neon is much the more abundant. This they explain by the hypothesis that the atmosphere has lost most of its neon, which it could only do at the time of its birth, when the temperature was presumably very high.

From this point of view, it is of interest to examine the earth's crust for argon and neon. I find, in fact, that granite contains these gases, the quantity being of the order of 10^{-6} c.c. neon, and 4×10^{-5} c.c. argon per gram of granite. The argon atoms are thus only some 40 times as abundant as the neon, instead of 520 times as in the atmosphere. These figures are derived from the examination of four samples of granite from different localities. The gases are liberated by decomposing the granite with fused caustic potash. The experiments are difficult because of the risk of atmospheric contamination, but it is believed that this source of error has been avoided. That the ratio neon/argon is greater than for the atmosphere is readily verified. The excess of helium present in the crude rare gases must first be got rid of, and I have done this by allowing it to diffuse out through red-hot silica. The argon spectrum is then dominant, but the yellow line of neon is conspicuous in it, whereas this line is not visible in the neon-argon mixture obtained from the atmosphere. The relative richness in neon is thus verified at a single *coup d'oeil*, and the spectroscopic result can be made quantitative by comparison with made-up mixtures of argon and neon. This gives a check on the volume measurements made on the separated gases.

The present results seem favourable to the view that there has at some time been a loss of neon from the atmosphere. They will be published in detail later. The further question of the ratio of argon to nitrogen in rocks is under examination.

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Feb. 17.

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[1] *Proc. Nat. Acad. Sci.*, 19, 997 (1933).

Electron-Multiplier for Measuring Ionization Currents

THE letter from Prof. Z. Bay[1] gave details of the application of electron-multipliers to the measurement of photons and electrons emitted *in vacuo*. Experiments on similar lines have been carried out in this laboratory with the object of using electron-multipliers for measuring small ionization currents due to any type of radiation.

The saturation current in an ionization chamber was arranged to control the potential and hence the number of electrons emitted from the illuminated photo-electric cathode of the electron-multiplier. The emitted photo-electrons were then accelerated on to a series of secondary electron emitting stages consisting of fine mesh grids, sensitized for maximum secondary electron emission, and arranged as parallel disks inside a metal focusing cylinder. The initial photo-electron current was thus amplified by secondary electron emission and the output current measured on an ordinary microammeter.

In this manner currents of the order of 10^{-12} amp. have been amplified to currents of between 10^{-6} and 10^{-3} amp., while it is possible to detect currents of the order of 10^{-14} amp. Attempts are now being made to measure even smaller currents. The main difficulty to be overcome is, as mentioned by Prof. Bay, a reduction of the thermionic emission of electrons from the multiplying grids. As he has shown, this can be done by cooling the electron multiplier down to temperatures in the region of 120°–150° K. This, however, is considered rather an unpractical procedure for general use. Experiments are now being made with secondary electron emitting surfaces having high work functions and correspondingly low thermal electron emission coefficients.

The advantages of this system of amplification is its general stability, it being comparatively insensitive to changes in the working potentials, making the operation from A.C. mains quite practical. Also, it is unnecessary to use delicate galvanometers, very high resistances, or sensitive balancing circuits, as the output current is large enough to be measured on a microammeter or milliammeter.

On behalf of the governing body, I wish to thank Messrs. Baird Television, Ltd. for their willing co-operation in these experiments. A detailed report of this work is to be published at a later date.

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Feb. 15.

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[1] NATURE, 141, 284 (Feb 12, 1938).

Significance of Gravity Anomalies in Relation to the Viscosity of the Asthenosphere

SOME time ago I published an estimate of the mean viscosity of the earth's silicate mantle on the basis of the rate of post-Glacial uplift of the Fennoscandian region[1]. It has been suggested recently[2] that if that estimate is correct, areas of large negative gravity anomalies, such as that in the Gangetic trough in India, should be rising at an observable rate. It is the purpose of this communication to examine this question briefly.

In the paper referred to, it was shown that at the centre of a radially symmetrical depression in the surface of a highly viscous fluid, the displacement of the surface, $\zeta\,(0)$, and the vertical velocity at the surface, $V\,(0)$, are connected by the relation

$$\zeta\,(0) = \frac{2\sqrt{\pi}\,\eta\,b}{\rho\,g}\,V\,(0), \qquad (1)$$

where g is the acceleration of gravity, η and ρ are respectively the coefficient of viscosity and the density of the fluid, and b is a quantity determined by fitting the surface velocity as a function of the radius, r, to a function of the form

$$V\,(r) = V\,(0)\,e^{-b^2r^2}. \qquad (2)$$

In other words, b may be regarded as the reciprocal of the effective radius of the depression. The quantities $\zeta\,(0)$, $V\,(0)$, and b were determined from data for the post-Glacial uplift of the Fennoscandian region given by Nansen[3], and the kinematic viscosity, η/ρ, was found from equation (1) to be of the order of 3×10^{21} cm.^{2} sec.$^{-1}$.

The Gangetic area of negative anomalies has the form of a long strip, hence instead of equation (1) it would be better in this case to use the equivalent expression for a long trough-like depression. This is

$$\zeta\,(0) = \frac{4\,\eta\,b}{\sqrt{\pi}\,\rho\,g}\,V\,(0). \qquad (3)$$

Equation (3) may be applied directly to the present problem by noting that the depression of the surface is equivalent to a negative load $\sigma = \zeta\,\rho\,g$ dynes per square centimetre. We then have for the velocity at the centre of a loaded strip,

$$V\,(0) = \frac{\sqrt{\pi}\,\sigma\,(0)}{4\,\eta\,b} \qquad (4)$$

where b^{-1} is now one half the effective width of the strip.

The greatest distance between the lines of zero anomaly in a direction perpendicular to the axis of the belt is approximately 400 km.; b^{-1} is then somewhat less than 200 km., and, by analogy with the example worked out in the paper referred to above[1], it should be about 3/4 of this, or 150 km. The defect of load at the centre is of the order of 4×10^8 dynes per square centimetre. If we take $\eta = 10^{22}$, equation (4) gives a rate of uplift at the centre of 8·4 metres per century. This figure should be somewhat reduced since the actual distribution of the load can be better approximated by some distribution intermediate between the linear trough assumed in deriving (3) and the circular depression assumed in deriving (1). The other quantities being equal, the velocity for the circular load is 0·636 times the velocity for the linear load. Thus we should multiply our result by some factor between 0·636 and unity, say 0·9. The indicated rate of uplift will then be somewhere in the neighbourhood of 7·6 metres per century.

Results of repetition of earlier surveys have been interpreted[4] as indicating a rate of uplift varying from zero about fifty miles north of Calcutta to six feet per century in the neighbourhood of Benares. It has also been suggested that sudden changes of level have taken place in connexion with earthquakes, so that the average rate over a period of many centuries might be comparable with that derived above. However, both the levelling results and the changes of level associated with the Bihar earthquake of 1934 have been questioned[5], so that it may be advisable to consider what modifications of the theoretical discussions would be required in case it were demonstrated conclusively that the rate of uplift is of a smaller order of magnitude. Two possibilities are open. (1) The value taken for the coefficient of viscosity may be very much too small. But if that is true, then some mechanism other than viscous flow must be devised to account for the observed rate of uplift in Fennoscandia and the fact that the area which has undergone uplift in post-Glacial time coincides with the area which had formerly been covered by an ice cap. (2) The crust may be strong enough to support a load of the magnitude indicated so that viscous yielding at depth does not enter into the question at all. In the case of a load the span of which is many times the thickness of the crust, as it is in the case of a continental ice sheet, the crust itself might bend elastically while the weaker substratum was displaced by plastic flow. Thus it is not necessary to suppose that the load was great enough to cause stresses exceeding the strength of the crust; it would have to be great enough to exceed the strength at greater depths. On the other hand, a load the span of which is comparable with the thickness of the crust, such as we are dealing with here, could cause only a slight elastic deflection of the crust; hence appreciable plastic flow in the subtratum would take place only if the load were great enough to cause failure of the crust.

Jeffreys has shown[6] that if hydrostatic conditions are assumed below the crust, an uncompensated load implies a strength of the order of $2d/kh$, for a load having the form $d \cos kx$, where h is the thickness of the crust. This is $2dl/\pi h$ where l is one half the wavelength, that is, roughly the equivalent of b^{-1} in the present case. Our quantity $\sigma(0)$ should be identified with the total range of load, $2a$. The stress difference is then $\sigma(0)/\pi bh$. There is some uncertainty as to what value we should use for h in this expression. If we take it to be the Hayford depth of compensation, it is of the order of 100 km. On the other hand, it might conceivably be as small as the depth of the Mohorovičić discontinuity, which has a minimum depth of 25 km.[7] If we use the latter figure, we have a maximum stress difference of $7 \cdot 6 \times 10^8$ dynes per square centimetre. This is less than the strength of granite at the surface, and, considering the rapid increase of strength with pressure[8], it is far less than the strength which must prevail at depths of a few kilometres. It should not, therefore, be necessary to assume a viscosity greater than 10^{22} gm. cm.$^{-1}$ sec.$^{-1}$. In fact, if it should turn out that uplift actually is going on in the Gangetic trough, it would become a problem to explain why the crust should yield at all to stresses of this order.

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[1] Haskell, N. A., *Physics*, **6**, 265 (1935).

[2] Jeffreys, H., personal communication to J. A. Sharpe.

[3] Nansen, F., *Avhand. Norske Videnskaps Akad., Oslo*, Kl. 1, No 12 (1928).

[4] Hunter, J. de Graaff, NATURE, **133**, 236 (1934).

[5] Burrard, Sidney, NATURE, **133**, 582 (1934). Cf. also Survey of India, Geodetic Report, 1936, pp. 93–97.

[6] Jeffreys, H., *Mon. Not. Roy. Ast. Soc.*, Geophys. Supp. 3 (1), 30 and 3 (2) 60 (1932).

[7] Sharpe, J. A., *Bull. Seis. Soc. Amer.*, **25**, 199 (1935).

[8] Griggs, D. T., *J. Geol.*, **44**, 541 (1936).

Kepler, Newton and Bode

MR. J. MILLER's observation[1] that the orbits of the satellites of Saturn are distributed about the primary in a manner similar to that of the planets about the sun, leads one to suspect that Newton's law of gravitation is only a particular case of a more general law. Bode's law can no longer be regarded as fortuitous. Kepler's relation between planetary distances and periods may only apply at the distances given by Bode's law. If this is so, Newton's inverse square law only applies at those same distances—distances for which the actual law of force gives stable orbits.

It seems possible to have a law of force, other than that of the inverse square, which will give all three laws of Kepler, Newton and Bode for the stable orbits. If we take the force for a circular orbit as

$$P = \mu^2 \varphi(\mu),$$

it can be shown that for a stable orbit

$$\frac{\mu \varphi^1(\mu)}{\varphi(\mu)}$$

must lie between 0 and 1. But

$$\varphi(\mu) = \frac{4\pi^2}{\mu^3} \cdot \frac{1}{T^2},$$

where T is the period. Hence

$$\frac{\mu \varphi^1(\mu)}{\varphi(\mu)} = -\mu\left(\frac{2}{T} \cdot \frac{dT}{d\mu} + \frac{3}{\mu}\right).$$

For this to be 1,

$$\frac{dT}{d\mu} = -\frac{2T}{\mu};$$

and for it to be 0,

$$\frac{dT}{d\mu} = -\frac{3T}{2\mu}.$$

These expressions correspond to the limits of the band of stability between which an orbit can lie. Since the second expression agrees with Kepler's observation, all the planets occupy orbits on the outer edges of the bands of stability. In these positions, $\varphi(\mu) =$ constant, that is, Newton's law. But this is not the only value for $\varphi(\mu)$ which will give Kepler's law for the planets. There may be many such values. For example, if

$$\varphi(\mu) = \cos^2\left(\frac{1}{\mu}\right),$$

then

$$\frac{\mu \varphi^1(\mu)}{\varphi(\mu)} = \frac{2}{\mu} \tan\left(\frac{1}{\mu}\right),$$

which is 0 whenever $\frac{1}{\mu} = r = n\pi$.

If a shape for $\varphi(\mu)$ can be found which will make $\frac{\mu\,\varphi^1(\mu)}{\varphi(\mu)} = 0$ when $\frac{1}{\mu} = 3 \times 2^{(n-2)} + 4$, n being 1, 2, 3, etc., then a law of force giving Kepler, Newton and Bode will have been discovered.

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Feb. 8.

[1] NATURE, **141**, 245 (Feb. 5, 1938).

Interatomic Distances of $FCCl_3$ and $FCBr_3$

IN some early work we measured the interatomic distances of different methane and silane halides by means of the electron diffraction method. We wish to give here distances between atoms of $FCCl_3$ and $FCBr_3$ measured by the same method. These substances have been prepared and purified by Prof. F. Swarts. We are much indebted to him for giving us the opportunity of measuring these substances.

The values obtained (in A.) are:

$FCCl_3$: Cl–Cl = 2·94 ± 0·03; Cl–F = 2·56 ± 0·04; C–F = 1·44 ± 0·04; C–Cl = 1·76 ± 0·02:

$FCBr_3$: Br–Br = 3·20 ± 0·03; Br–F = 2·70 ± 0·02; C–F = 1·44 ± 0·06; C–Br = 1·91 ± 0·04.

One of these substances, namely, $FCCl_3$, has already been measured by Brockway[1]. His values (in A.) are :

$Cl–Cl = 2·91 \pm 0·03$; $Cl–F = 2·56 \pm 0·04$; $F–C = 1·40 \pm 0·04$; $C–Cl = 1·76 \pm 0·02$.

Thus they are very close to those found by us. The results show : (1) that the distance C–F remains very nearly constant in both compounds ; (2) that the distance C–Cl shows the same value in all compounds containing $C–Cl_3$ with the exception of $C–Cl_4$; the same conclusion is valid for C–Br ; (3) going from $FCCl_3$ to $FCBr_3$, the pyramid CX_3 expands with a factor 1·088. A factor 1·075 may be used in passing from $HCCl_3$ to $HCBr_3$, and also in passing from $HSiCl_3$ to $HSiBr_3$ [2].

A more extended discussion of these data will be published elsewhere.

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M. DE HEMPTINNE.

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[1] Brockway, L., *J. Phys. Chem.*, **41**, 2, 185 and **41**, 5, 747 (1937).

[2] de Hemptinne, M., and Wouters, J., NATURE, **138**, 884 (1936). Wouters, J., de Hemptinne, M., and Capron, P., *Ann. Soc. Scient. Brux.*, **57**, 25 (1937).

A New Type of Structure in the α-Copper-Zinc Alloys

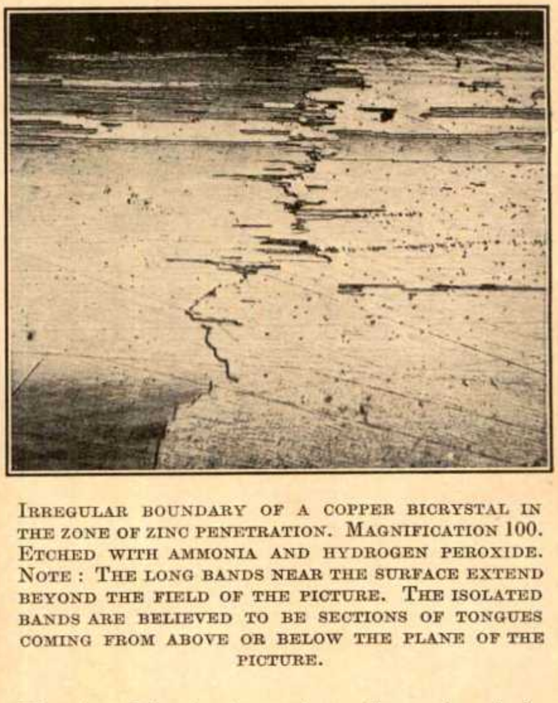
CERTAIN banded structures seen in cast α-brass after annealing have been identified by several investigators as true twins. Recently we have made an observation which suggests that there may exist structures that appear to be twins, but that are not twins. The observations were made upon two large cast copper crystals joined at a natural boundary which lay almost perpendicular to the external surface of the sample. Into this bicrystal, zinc was diffused by exposing it to the vapour from α-brass turnings at a temperature of 775° C. The system was enclosed in an evacuated silica tube. Zinc penetrated to a uniform depth over the entire surface of the specimen and gave a layer of perhaps half a millimetre of yellow brass.

Upon examination of a cross-section of the bicrystal, it was found that the grain boundary of the copper crystals had been disturbed within the zone of zinc penetration. In some regions along the original boundary, local recrystallization had occurred ; but in others a peculiar type of grain growth appeared with the complete absence of new crystal formation. In the latter case the two grains were seen to have grown into each other in long parallel finger-like bands, greatly resembling twins (see accompanying photomicrograph), and leaving a much lengthened boundary running back and forth in zig-zags nearly parallel to the external surface of the sample. The breadth of the fingers thus formed was irregular, but in general was seen to be least near the surface of the sample and greatest at the limit of the yellow brass zone, beyond which the original boundary remained undisturbed.

It was at first surmised that this remarkable structure might have resulted from the highly improbable occurrence of the two grains of the bicrystal in a mutually twinned relationship, with their orientations such that a twinning plane lay parallel to the external surface. This situation could conceivably permit the two crystals to grow into one another in long bands by the simple operation of twinning. By means of an X-ray determination of the orientations of the two crystals, it was shown that they did not bear a mutually twinned relationship. In fact, the nearest approach of octahedral planes (twinning planes) between the two crystals was eight degrees. The bands, therefore, are not twins, but simple projections of one crystal into the other.

In all probability this displacement of the grain boundary can be traced to a periodic crystal growth induced by the strains set up within successive layers of the copper by the expansion required to accommodate the inwardly diffusing zinc. Presumably, the direction of growth is a matter of chance in each successive step, for the projections are distributed about equally on the two sides of the original boundary. Upon the basis of this hypothesis, it is to be expected that the bands would be narrowest near the surface of the sample, because in that region the concentration gradient of the zinc would be the steepest.

To the foregoing observations it may be added that in the present studies recrystallization and grain growth resulting from diffusion have been observed adjacent to flat surfaces and at sharp corners, but not in samples having convex surfaces.



IRREGULAR BOUNDARY OF A COPPER BICRYSTAL IN THE ZONE OF ZINC PENETRATION. MAGNIFICATION 100. ETCHED WITH AMMONIA AND HYDROGEN PEROXIDE. NOTE : THE LONG BANDS NEAR THE SURFACE EXTEND BEYOND THE FIELD OF THE PICTURE. THE ISOLATED BANDS ARE BELIEVED TO BE SECTIONS OF TONGUES COMING FROM ABOVE OR BELOW THE PLANE OF THE PICTURE.

The banded structures have been found in a number of different samples. Whether or not its occurrence requires the existence of special orientation relationships between the participating crystals could not be determined from the few data at hand. Although it seems likely that the diffusion occurring during the homogenization of cast α-brass could establish conditions similar to those existing in the bicrystals, this structure has not yet been definitely identified by us in a polycrystalline brass. Some of the bands seen in technical homogenized α-brass may well be this structure !

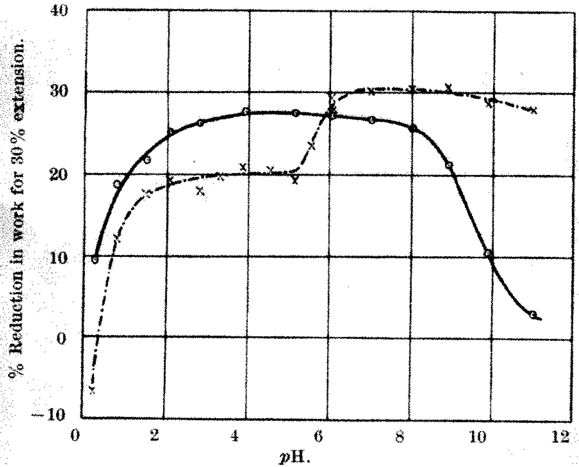
F. N. RHINES.
A. M. MONTGOMERY.

Metals Research Laboratory,
Carnegie Institute of Technology,
Pittsburgh. Jan. 10.

Constitution of the Keratin Molecule

DURING the past few years, much evidence has been accumulated in support of the view that the free acid and basic side-chains of wool are equivalent and form salt linkages between the peptide chains[1]. Although further proof of the salt linkage hypothesis may seem to be redundant in view of recent determinations of the amounts of aspartic and glutamic acids in wool[2], a proof based on the properties of deaminated fibres is essential to refute the erroneous conclusions drawn by Sookne and Harris[3] from a study of deaminated wool.

The resistance to extension of keratin fibres in acid and alkaline solutions is less than in water because of the breakdown of salt- and, above *p*H 10, sulphur-linkages between the peptide chains. A curve illustrating the reduction in the resistance of human hair fibres to extension in buffer solutions of varying *p*H, as compared with distilled water at *p*H 5·5, is given in the accompanying graph.



RESISTANCE OF HUMAN HAIR TO EXTENSION IN VARIOUS BUFFER SOLUTIONS; ⊙—⊙—⊙, UNTREATED; X—·—X—·—X·, DEAMINATED.

The undamaged root ends of human hair fibres were used in preference to wool because of the greater uniformity of the fibres, but the form of the curve, as well as the extent of the *p*H-stability region, are in conformity with the salt linkage hypothesis. When human hair fibres are deaminated, however, their resistance to extension should be sensibly independent of the acidity of the solution below *p*H 5, because there are then no salt linkages to be broken by acid. As the curve shows, within small limits, such is the case for single fibres deaminated by two treatments of 24 hours each in 40 c.c. of the van Slyke reagent at 22·2° C. in absence of air.

In terms of the salt linkage hypothesis, too, removal of the basic side-chains by deamination should free a corresponding number of acid side-chains for combination with alkali in the neighbourhood of *p*H 6. The fibre swelling thereby induced should reduce the resistance to extension, although to a relatively small extent because the reduction is due solely to swelling and not to breakdown of salt linkages. As shown in the graph, the resistance to extension of deaminated fibres decreases sharply between *p*H 5 and 7, in agreement with theory. Above *p*H 7, the resistance to extension is sensibly independent of *p*H until the sulphur bonds are attacked by alkali.

Thus the elastic properties of deaminated fibres are in strict agreement with the salt linkage hypothesis. The corresponding titration curve for deaminated human hair is now being determined.

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E. STOTT.

Textile Chemistry Laboratory,
University of Leeds.
Jan. 24.

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[1] Speakman and Hirst, *Trans. Far. Soc.*, **29**, 148 (1933); Speakman and Stott, *Trans. Far. Soc.*, **30**, 539 (1934); Speakman and Townend, *Trans. Far. Soc.*, **32**, 897 (1936); Speakman, *J. Soc. Dyers and Colourists*, **52**, 423 (1936); McMahon and Speakman, *Trans. Far. Soc.*, **33**, 844 (1937); Speakman and Townend, NATURE, **139**, 411 (1937).

[2] Speakman and Townend, NATURE, **139**, 411 (1937).

[3] *Bureau of Stand. J. Res.*, **19**, 535 (1937).

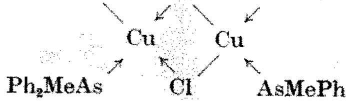
A Novel Type of Isomerism in a Co-ordination Compound of Copper

IF a warm alcoholic solution of cupric chloride is treated with diphenyl methyl arsine and allowed to stand overnight, two crystalline species (brown and blue) of identical composition $(Cu_2(Ph_2MeAs)_3Cl_3)$ are deposited. The separation of these two substances has already been described[1]. At that time the evidence put forward was insufficient to show whether the two compounds were really isomeric or not. Recently, however, it has been found that the two compounds are appreciably soluble in nitro-benzene, in which solvent the molecular weights of the two are of the same order (brown 878, blue 786). One form is therefore not a polymer of the other. Furthermore, these values, although somewhat lower than the theoretical (986), support the view that each form is binuclear.

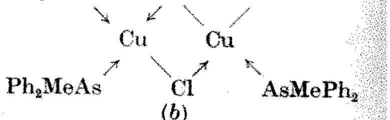
The brown form dissolves in thoroughly dried nitrobenzene to give a brown solution. This solution is quite stable at low temperatures and will deposit the brown crystals when cooled sufficiently; but if it is heated to 150° (or more) the brown colour will, during the course of half an hour, change to a greenish blue. The greenish blue solution will deposit crystals of the blue form on cooling. There is nothing to indicate that one form is a hydrate of the other. The fact that solutions of each form in the same solvent are differently coloured rules out the possibility of dimorphism. In confirmation of this it may be noted that the two forms behave differently towards ammonia and pyridine.

All the evidence available points to the conclusion that the two forms are isomers. Of the two, the brown form is the more stable. Even in the dry state the blue form has been found to revert to the brown over a period of several months. As would be expected, the transition of the blue to the brown form is more rapid in nitrobenzene solution. At room temperature, both forms are stable insofar as they show no tendency to lose the arsine even on long standing.

In order to account for the existence of two isomeric forms, the following structures attributing tetrahedral co-ordination to Cu^I and square co-ordination to Cu^{II} are suggested:

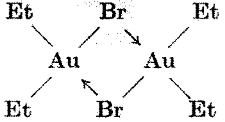


(*a*)

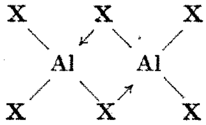


(*b*)

There is ample evidence from crystal structure analyses[2] that, in the bivalent state, copper is square co-ordinated, a finding which is also in accord with the results of Pauling's wave mechanical treatment of the question of bond orientation[3]. In both (*a*) and (*b*) therefore, all four bonds to Cu^{II} lie in the plane of the paper. On the other hand, univalent copper forms tetrahedral electron pair bonds as in Cu_2O, $K_3[Cu(CN)_4]$ and CuCl[4]. Thus the two bonds to Cu^{I} on the left of (*a*) and (*b*) lie one above and the other below the plane of the paper. If both Cu^{I} and Cu^{II} were tetrahedrally co-ordinated, there would be no possibility of isomerism, but with Cu^{II} square co-ordinated two isomers are possible as indicated in the proposed structures. Other instances in which two halogen atoms are considered as forming bridges between metallic atoms could be cited[5]. For example, diethylmonobromogold is believed[6] to have the following structure:



This is supported by crystal structure data for the compound. Further physical evidence that halogen atoms may function in this way is to be found in the results of electron diffraction investigations of the vapours of aluminium halides[7]. These indicate that the molecules have the structure:



(X = halogen).

So far, a study of the reactions of the isomers with pyridine, ethylenediamine and ammonia has provided no decisive evidence in favour of the structures. Work along these lines is, however, being continued and it is hoped later to test the structures by a physical method.

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[5] Werner and Pfeiffer, "Anorganischen Chemie" (F. Vieweg and Sohn, Braunschweig), pp. 56 and 172. Bann and Purdie, *J. Chem. Soc.*, 873 (1936).

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Electrophoretic Behaviour in Nucleic Acid-Protein Mixtures

SOME noteworthy observations have been made in the course of an investigation of the electrophoretic properties of pure thymonucleic acid and mixtures of it with electrophoretically purified seralbumin. The technique employed has been described by Tiselius[1]. The results as regards the electrical mobilities and the mutual interactions between the nucleic acid and the protein will be presented elsewhere in the near future. Here it may be of interest to point out the remarkable behaviour of the serum pigment.

The seralbumin as usual contained a yellowish pigment (bilirubin, etc.) which could not be separated from protein even after repeated electrophoresis at *p*H values ranging from 4·12 to 8·00 (cf. also Bennhold[2] and Pedersen and Waldenström[3]). When, however, the albumin was electrophorized in the presence of nucleic acid, it was observed that the pigment changed 'carrier' and migrated with the nucleic acid. On the negative side, a completely *colourless* albumin remained behind.

An experiment with urobilin showed that this substance alone had a very slight mobility (*p*H 4·9), but when mixed with nucleic acid it migrated at the same high velocity as the latter.

Recently a similar 'carrier shift' has been observed by Ågren and Hammarsten[4], who were able to purify carboxypolypeptidase preparations from tryptic activity by means of electrophoresis in the presence of protamin.

A related phenomenon of pigment displacement has been emphasized by Bennhold[2] in discussions on the *Vehikel Funktion* of the plasma proteins.

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Jan. 31.

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[1] Tiselius, A., *Biochem. J.*, **31**, 313 (1937).

[2] Bennhold, H., *Ergebn. d. Kinderheilk.*, **42**, 311 (1932).

[3] Pedersen, K. O., and Waldenström, J., *Z. physiol. Chemie*, **245**, 152 (1936).

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Blood Group Inheritance

J. Ffoulkes Edwards and Dr. I. M. H. Etherington[1] have continued the discussion initiated by R. Elsdon Dew[2], who quoted J. S. de Goldfiem's[3] figures for the blood group distribution among the French Soussoux. Of these, 89 per cent belong to Group *AB*, and Edwards and Etherington explain this obvious anomaly by re-advancing their quadruple allelomorph theory of group inheritance. This appears to be entirely unnecessary, nor does their theory fit the figures observed elsewhere, and before enlarging on this hypothesis, it seems pertinent to inquire whether there really are 89 per cent of the population in this group. In the original investigation, Vincent's whole blood technique of grouping was used, which is notorious for its high percentage of false results due to pseudo-agglutination. It would appear far more probable that the error lies in the technique adopted—either in the failure to differentiate between pseudo- and true iso-agglutination, or in a bacterial pan-agglutination from infection of the test sera—than that Bernstein's triple allelomorph theory of inheritance, which fits so well all the known figures, should be at fault.

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Feb. 12.

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[1] NATURE, **141**, 246 (Feb. 5, 1938).

[2] NATURE, **140**, 1066 (Dec. 18, 1937).

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Separation of Flavin and Phosphorylated Flavin

Greene and Black[1] have found that phenol, the cresols, aniline and benzyl-alcohol are suitable for the extraction of free flavin from water.

Using a solution of phosphorylated flavin (purified liver extract), I found that phenol also rapidly took up phosphorylated flavin from water.

It appeared, however, that practically no phosphorylated flavin was extracted by benzyl-alcohol when a solution of phosphorylated flavin in water was shaken with an equal volume of benzyl-alcohol (*p*H values from 5 to 7·4 and salt concentrations from 0·5 to 4·5 per cent NaCl). Under these conditions one benzyl-alcohol extraction removed 76–79 per cent of free flavin from water. Other aromatic alcohols (phenylethanol, phenylpropanol and phenylethylmethylethylcarbinol also permitted a separation.

Details and applications by these methods of separation (for example, urinary excretion) will be published elsewhere.

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[1] *J. Amer. Chem. Soc.*, **59**, 1820 (1937).

Biological Effects of Deuteron-Deuteron-Neutrons

THE biological effects of neutrons produced by a cyclotron have been reported by Lawrence and others. However, neutrons generated by a cyclotron, using beryllium targets, are accompanied by a great deal of γ-radiation, and the effect cannot be attributed entirely to neutrons. The purest neutrons ever known are D-D-neutrons, which are produced by bombarding 'heavy' ice (D_2O) with deuterons accelerated by high voltage, that is, by the reaction of

$$ {}_1D^2 + {}_1D^2 \rightarrow {}_2He^3 + {}_0n^1. $$

Since June 1937, through the kindness of the Nishikawa Laboratory of the Institute of Physical and Chemical Research, Tokyo, I have been examining the biological effects on young rats of irradiating them with D-D-neutrons. As the maximum range of recoil protons generated by neutrons is great, we have made a special ionization chamber with aluminium walls 2 mm. thick, lined with a 0·2 mm. layer of paraffin, and filled with methane gas, in order to measure the total ionization. By comparison with a known quantity of γ-rays from radium, we measured the intensity of neutrons, and the result showed that, at 250 kv. and 20 μ A., the ionization at 3·5 cm. from the source was equal to 1·3 r/hour. The following observations were made by irradiating young rats of about 20 gm. body weight with 10–30 r of D-D-neutrons.

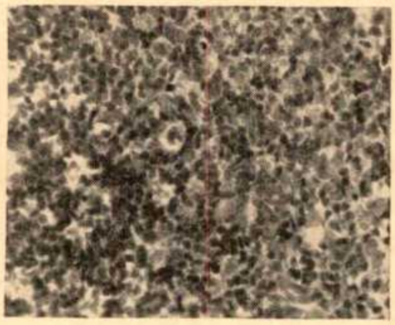

Fig. 1.
IRRADIATED THYMUS.

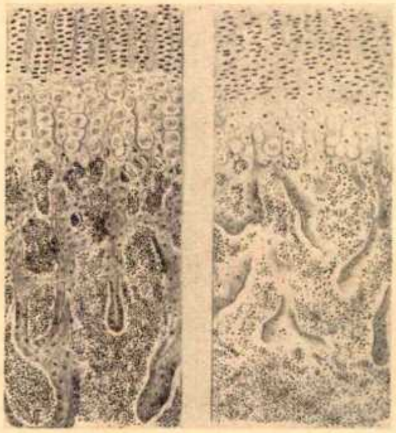

Fig. 2.
BONE AND BONE MARROW BEFORE (LEFT) AND AFTER (RIGHT) IRRADIATION.

The rats, irradiated with 30 r, did not increase in weight, and died in 5–10 days. With 26 r, rats showed no increase in weight for more than two weeks. About one half the amount of neutrons abovementioned allowed the rats to increase slightly in weight after a week, but they were still very poor in growth, even after four weeks. After irradiation with 12 r, the total leucocytes decreased to about one half, that is, 3,600–4,800. This state continued with or without further irradiation. The most conspicuous was the decrease of lymphocytes, which decreased from 70–80 per cent to 20–40 per cent, and their absolute number was so low as 1000 or less after two weeks. Neutrophil leucocytes, on the other hand, increased from 12–20 per cent to 40–77 per cent, and their absolute number also increased. Monocytes increased for a time, but afterward decreased, and eosinophil leucocytes gradually decreased and finally disappeared. Red cells and hæmoglobin gradually decreased, nucleated red cells appearing in the circulating blood in many cases.

At necropsy, anæmia of every organ was marked. Spleen, testis, ovary, thymus, bone, etc., were especially decreased considerably in size. Microscopically, the lymph follicles of the spleen were found to be most quickly affected, where destruction or decrease of lymphoid cells could be seen. Following this, the degeneration of megacaryocytes in pulp came about. Two weeks after exposure to 26–30 r, we found practically no lymphoid cells in the lymph follicles, reticulum cells remained withered in thread-like form, and infiltration of polymorphonuclear leucocytes appeared. Megacaryocytes in pulp having almost gone, many small round myeloid cells with positive oxidase reaction appeared. There were also hæmosiderosis and erythrophagia. Four weeks after, many megacaryocytes appeared, also many myeloid cells, showing bloomy myeloid metaplasia, but the regeneration of lymph follicles was still unsatisfactory.

In the bone marrow, decrease of myeloid cells could be seen immediately after irradiation. Two weeks after the irradiation with about 30 r, bone marrow cells became very scarce, and blood vessels much enlarged. Most of the myeloid cells were very small, as seen in the pulp of spleen, and megacaryocytes, normoblastes, etc., were scarce. Four weeks after, various myeloid cells increased very much, and vigorous hæmatopoiesis was observed. The irradiated lymph nodes showed destruction or decrease of lymphocytes at an early stage, and two weeks after irradiation with 30 r, lymphocytes were entirely gone, and marked infiltration of polymorphonuclear leucocytes appeared. Four weeks after, islands of myeloid metaplasia came out, but lymphoid cells did not yet appear. In the thymus also degeneration and decrease of lymphocytes were conspicuous (Fig. 1). Epitheloid cells also degenerated and became fewer as a whole. Medulla was more affected than was cortex. As to the bone, we found in enchondral ossification at the epiphysis of the femur, four or five days after irradiation, degeneration and derangement in the cells of proliferating, hypertrophic and carcificating zones. Cartilaginous processes decreased in number and became thin. The injury to osteoblasts was still greater, and the growth of bone cells was very poor (Fig. 2); in consequence the greater part of the bone remained in the state of primary ossification. In the testis no spermatozoa were seen, our rats being immature, but spermatids, spermatocytes and spermatogonia were degenerated or decreased in number in most irradiated animals, Sertoli's cells and interstitial cells, however, showing no marked change.

As to other organs, the hypophysis showed degeneration chiefly in the eosinophil cells of the anterior lobe; pineal, for the most part, degeneration of epitheloid cells: adrenals, marked decrease of cortical fat, and degeneration in zona glomerulosa, where alone was seen lipoid deposits (Sudan III positive); liver, peripheral fatty degeneration in some cases; and kidney, irregular lipoid deposits (Sudan III positive) in the principal division of urinary tubule.

I wish to express my thanks to Prof. S. Nishikawa, Dr. H. Yamakawa and Dr. M. Miwa for their kind advice and interest in this work.

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Points from Foregoing Letters

A GRAPH showing that the separation of the two components of the radio waves reflected from region *F* of the ionosphere increases with the frequency, is submitted by Prof. E. V. Appleton, Dr. F. T. Farmer and J. A. Ratcliffe. The new findings, the authors point out, agree with their view that the two components are differently polarized, but cannot be readily explained on the supposition of Martyn and Munro who, from their experiments in Australia, deduced that both components are normal, but one penetrates into an 'over-dense' stratum. The writers calculate that on this hypothesis the waves would have to 'leak' through a barrier of approximately 100 km. or about 400 vacuum wave-lengths—an unlikely occurrence.

Prof. E. Schrödinger proposes the name 'Eddington's constant' for the large dimensionless constant, of the order 10^{39} or 10^{40}, which recurs in physics and is believed by some to be the square root of the number of mass-units (protons and neutrons) in the universe. Assuming uniform distribution, Prof. Schrödinger calculates the mean free path of the particles to equal the circumference of the universe and the sum of their cross-sections to be about one sixteenth the cross-section of the universe.

Lord Rayleigh finds that granite contains neon and argon, the relative amount of the former being some 13 times as great as in the atmosphere. This affords some confirmation of the suggestion by Russell and Menzel that the atmosphere has lost most of the neon that it formerly contained.

An 'electron-multiplier' similar to that recently described by Prof. Z. Bay, has also been constructed by Dr. W. H. Rann, who states that it has enabled him to detect currents of the order of 10^{-14} amp. and to amplify currents of 10^{-12} amp. to 10^{-6} or 10^{-5} amp. so that they can be measured on a microammeter or milliammeter.

N. A. Haskell calculates that the land in the trough of the Ganges would rise at the rate of about 7·6 metres per century, owing to the 'negative gravity' effect, if the viscosity of the underlying 'asthenosphere' has a value agreeing with that deduced from the rate of post-Glacial uplift of the Finnish-Scandinavian region.

If the orbits of planets and of satellites about their primaries are specified by Bode's law, then, Prof. G. W. Todd suggests, the laws of Kepler and Newton are only special cases of a more general law of gravitation.

Prof. F. N. Rhines and A. M. Montgomery find that a banded microstructure produced at the junction of two copper crystals into which zinc vapour had diffused, though looking very much like twinning, is not in fact due to twin crystals, but seems to have arisen through the growth of long, parallel, fingerlike bands from one crystal into the other.

Curves showing the reduction in the resistance to extension of human hair fibres (normal and deaminated) in buffer solutions of different acidity and alkalinity are given by Dr. J. B. Speakman and E. Stott. The authors state that the observed behaviour supports the salt-linkage theory for the constitution of the keratin molecule.

The preparation of two crystalline addition compounds, one brown and the other blue, of cupric chloride and diphenyl methyl arsine ($Cu_2(Ph_2MeAs)_3Cl_3$) is described by D. P. Mellor, G. J. Burrows and B. S. Morris. The authors consider that these represent a novel type of isomerism.

E. Stenhagen and Dr. T. Teorell report that when thymonucleic acid is added to a solution of seralbumin containing a yellow pigment (bilirubin, etc.)—from which it cannot normally be separated—and an electric current is passed, the pigment changes its 'carrier' and migrates with the nucleic acid.

Benzyl alcohol may be used to separate flavin from phosphorylated flavin, according to A. Emmerie, since it extracts the flavin but not the phosphorylated compound, from aqueous solutions.

Research Items

Neolithic Settlements in Danubian Yugoslavia

RECENT archæological reconnaissance by the American Expedition to Yugoslavia in the Yugoslav portion of the lower Danubian Valley, that is, on the right bank from the Iron Gate to the mouth of the Timok, the left bank being Rumanian, has resulted in fresh data from a score of sites, of which five are extensive settlements with rich neolithic deposits. The investigation of these sites, situated in a region of which the prehistory is at present incompletely understood, has been described and the results analysed by Mr. Vladimir J. Fewkes (*Proc. Amer. Phil. Soc.*, 78, 2; 1978). Observation is facilitated by the fact that the settlements, being situated along the bank of the river, have suffered much from erosion, which has exposed vertical profiles of the deposits. Systematic excavation on an extended scale, however, is an urgent necessity. Recent reconnoitring has established fresh evidence of neolithic occupation consisting of deposits *in situ* revealing dwelling pits as well as floors, and secondarily placed material, both related and unrelated to the settlement deposits. Additional data of later periods, of Bronze Age, La Téne and Early Slávic date, have been found. The material of neolithic age is characteristic of the Danubian Valley at large, including the barbotine pottery, which is widely distributed in the Danubian region. This pottery provides material for comparison and chronological study. Locally it is associated with the initial occupation, to which belong the lowest deposits characterized by pit-dwellings only. These show no traces of posts, which occur only with the later remains of dwellings with packed floors and without sub-pits, where the characteristic pottery is no longer barbotine, but incised, fluted, burnished and hand-smoothed wares. The neolithic evidence is invariably clearly intrusive.

Effect of Heptylaldehyde on Spontaneous Mouse Tumours

Two years ago, L. C. Strong, working at Yale University, showed (*Amer. J. Cancer*, 28, 550; 1936) that the addition of a few drops of oil of wintergreen to the diet of mice with spontaneous mammary carcinomata produced a striking change in the tumours. They became dark owing to hæmorrhage, and this was followed by a connective tissue reaction throughout the tumour which led to a slowing of growth and a partial regression. Some of the regressing tumours, when examined on autopsy, were nothing but cystic masses containing fluid. Oil of wintergreen consists of methylsalicylate, but a repetition of these experiments with synthetic methylsalicylate failed to reproduce the results. This indicated that the effects observed with oil of wintergreen were due to an impurity. In a recent issue of *Science* (Feb. 11, 1938, p. 144), Dr. Strong records the fact that he has been able to identify this impurity as heptylaldehyde. The addition of a small amount of this substance to the diet of mice bearing spontaneous mammary tumours produced results even more striking than those observed after giving oil of wintergreen, namely, liquefaction and regression of the tumour. Out of 25 mice with spontaneous mammary tumours, complete regression occurred in five mice. Dr. Strong concludes his brief communication by stating that "his investigation opens up the question that spontaneous tumours, in mice at least, may eventually be controlled by chemotherapy". The comment may be permitted that mammary carcinomata in mice are particularly liable to spontaneous hæmorrhages and that the effect of heptylaldehyde may be to intensify this tendency. Further experiments on other types of animal tumours will therefore be awaited with great interest.

Noses and Genes

THE human nose shows variety of form in the individuals of the same family as well as stabilized differences in various races of mankind. C. B. Davenport tested the hypothesis that this variation was due to the development of noses along different lines, by measuring the growth-rates of various parts of the noses of babies and older children over a period of five to twelve years (*Proc. Amer. Phil. Soc.*, 78, 61; 1937). The results show that in the case of children with unlike noses the course of development is different, but even where no indication is given at birth the nasal proportions may be quite altered by excessive growth of a particular dimension. The author interprets his findings in terms of genes: "the development of the nose is under the influence of genes, but the active genes differ at different stages in ontogeny quantitatively (in functional output) or qualitatively due to the activity of new genes like those that determine the activity of endocrine glands. Where the total gene complex is the same, as in identical twins, the result is practical identity of nose form". It is not easy to see just what addition to the facts of the analysis of form is made by this hypothetical linking of noses with genes.

Habits of Migrant Birds in Winter Quarters

IN a detailed account of migrant birds in Tanganyika Territory, R. E. Moreau discusses briefly the ecology of some British summer immigrants during their absence from Great Britain (*Tanganyika Notes and Records*, Dar es Salaam, Oct. 1937). In general, the type of territory selected for winter quarters bears a similarity to the summer habitat; swamp-dwelling birds in swamp vegetation, grey wagtails on mountain torrents, blackcaps and garden-warblers in the edges of evergreen forest, nightingales in closed bush, wheat-ears on bare soil or eroded land. Practically all the others, from willow-warblers to kestrels, favour savannah or thorn-bush. It seems likely also that certain of the birds made definite climatic preferences; the author thinks that blackcaps, garden-warblers, and swallows winter only in highland country, usually above 4,000 feet, with maximum temperatures not exceeding 86° F. (30° C.). All the immigrants to Tanganyika encounter the hot season, but, according to district, they may live in the long rains or in a period which includes a dry spell in January and February. With these climatic differences are associated differences in the abundance of the insect food upon which the vast majority of the immigrants subsist; and the fluctuations of food supply make the wintering birds less a stationary population than a collection of wandering individuals. It is interesting that the garden-warbler, which in Great Britain feeds mainly upon insects, although it occasionally takes soft fruits and berries, in Tanganyika depends largely upon small berries and, apart from the birds of prey, is the only migrant to live upon a non-insectivorous diet.

Feeding Mechanism of Lepidoptera

THE actual mode of functioning of the proboscis of butterflies and moths has long needed proper study, and various suggestions have been offered as to how the organ is manipulated. Mr. J. B. Schmitt, of the New Jersey Agricultural Experiment Station, contributes a paper on this subject which forms No. 4 of vol. 97 (1938) of the Smithsonian Miscellaneous Collections. According to this observer, the coiled proboscis of Lepidoptera is extended by means of blood pressure exerted in the stipites of the maxillæ. The pressure is brought about by the action of three pairs of muscles which, by their contraction, compress the stipites against the cranial wall. Two pairs of these muscles have their origins on the anterior arms of the tentorium while the third pair arises from the gena. By the action of these muscles, the blood becomes forced from the stipites into the cavity of each component of the proboscis, which thus becomes extended in front of the head. The coiling up of the proboscis in its characteristic manner is brought about by the relaxation of the pressure alluded to and by the contraction of diagonal muscles which cross the cavity of each component half of the proboscis. That blood pressure might be the agency for extending the proboscis has been suggested by Snodgrass who, in his "Principles of Insect Morphology", points out the mechanical analogy of the organ with the toy paper snake which a child uncoils by blowing into it. The food liquids are imbibed through the channel of the proboscis by means of a kind of sucking pump derived from the pharynx, buccal cavity and cibarium—a conclusion which is evidenced by the relationships of the muscles concerned. The details and variations in different families of the musculature of the proboscis and sucking pump are described for a number of different familes. The paper concludes with a short account of the labium and its muscles.

Studies of Brackish-water Fishes from Madras

MR. S. JONES in his paper "Observations on the Breeding Habits and Development of certain Brackish Water Fishes of Adyar, Madras" (*Proc. Indian Acad. Sci.*, 5, No. 6; 1937) gives very interesting notes on several fishes, the investigations being part of a scheme proposed for the study of the brackish water fauna of the Adyar River. Parental care has been noticed in *Etroplus suratensis*, *E. maculatus*, *Acentrogobius neilli*, *A. viridipunctatus* and *Petroscirtes bhattacharyæ*. The eggs of the two species of *Etroplus maculatus* are laid on stones or shells, the young emerging from them having cement glands on the head by means of which they fix themselves head downwards into small pits dug by the parents, which place them there after hatching. The feeding habits of the 'mud-skipper' *Boleophthalmus boddoerti* (Pallas) are described. This fish, contrary to the usual idea that it is predaceous, eats only micro-organisms, chiefly diatoms, but occasionally copepods. *Aplocheilus melanostigma* and *Panchax parvus*, on the other hand, are well known as insect larvicides. These two exercise no parental care, although the eggs in *Panchax* adhere by mucus to the ventral side of the mother.

Timber of *Eucalyptus astringens*

A FURTHER paper has now been published on the properties of Australian timbers (Pt. 2. Brown Mallet (*Eucalyptus astringens*) by I. Langlands. Div. For. Prod. Tech. Paper No. 23, Melbourne, 1937). It is stated that brown mallet has in the past been solely exploited for its bark, which is one of the richest in tan among the raw materials used in the tanning industry. It has suffered from reckless exploitation, to replace which the Western Australian Forestry Department commenced extensive plantations in 1929. The timber had not been used to any extent. The tests dealt with in this pamphlet appear to indicate that the species has outstanding mechanical and physical properties. It has comparatively small shrinkage, is almost the equal of American hickory in toughness, and is said to excel that species in static strength, though less resilient. It is considered, therefore, that it should prove a good substitute for the American timber save for the most exacting purposes.

Solanums immune to Potato Blight

POTATO growers in the plains of India are dependent upon supplies of 'seed' from Assam and the foothills of the Himalayas, in the same way that English growers rely upon Scotland, Ireland, and parts of Wales for the provision of vigorous stocks. The lowlands of India are not usually visited by the late-blight fungus *Phytophthora infestans*, but the crops upon the higher ground are often prone to its depredations. Such infestations curtail production, but have the even more serious effect of diminishing the seed potato supply to the plains. Messrs. B. B. Mundkur, B. T. Pal and Pushkar Nath have investigated the disease (*Ind. J. Agr. Sci.*, 7 (4), 627–637, Aug. 1937) with the view of controlling it by the propagation of resistant or immune host plants. Useful degrees of resistance have been found in several Indian, European and South American varieties of *Solanum tuberosum*, whilst the species *S. demissum*, *S. neoantipoviczii*, with its variety *Reddickii*, and *S. antipoviczii* were immune from the disease. They should therefore provide a promising parentage for the introduction of immunity into stocks of the potato by crossing.

Bibliography of Seismology

WITH the simultaneous issue of the last two quarterly numbers, Dr. E. A. Hodgson completes his valuable list of more than five hundred memoirs on earthquakes and allied subjects during the year 1937 (Pub. Dominion Observatory, Ottawa). As might be expected in a work so extensive, the titles as a rule are alone given, but occasionally, as in the case of Miss E. F. Bellamy's "Index Catalogue of Epicentres for 1913–1930", a useful, if brief, account is added. Lists of notes appearing in various journals, such as NATURE, *Science*, the *Engineering News-Record*, etc., are given. A welcome addition to last year's list is Mr. D. C. Bradford's bibliography of microseisms, containing the titles of 120 memoirs, the forerunner, it is to be hoped, of many similar lists. The volume ends with a subject-index, under more than fifty headings, of the year's memoirs.

Synthetic Motor Spirit Production

Political reasons continue to foster interest in methods of synthetic motor spirit production, particularly in those countries where underground petroleum resources are lacking. Low-temperature carbonization and destructive hydrogenation processes have been brought into considerable prominence during the past few years, and a great deal of time and money have been expended on their improvement. Recently a third process, known as the Fischer-Tropsch process, has begun to attract the attention of technologists, financiers and politicians alike. H. G. Shatwell, in a paper presented to the Institute of Fuel on December 7, laid particular emphasis on this somewhat revolutionary method. The origin of this process was a discovery by Fischer and Tropsch some fifteen years ago that if water gas, freed from sulphur, is passed over an alkali-iron catalyst at 450° C. and a pressure of 150 atmospheres, an oily product is formed which is known as 'Synthol'. By cracking, this can be converted into hydrocarbons known as 'Synthene'. Later, it was discovered that the oxygen content of the product could be eliminated by operating in the presence of hydrogenating catalysts at low temperatures and pressures. Improvements in technique followed as a result of detailed laboratory and large-scale research, with the result that several plants are now in process of erection on the Continent. It remains to be seen how it will compare with other processes of synthetic motor-spirit production from a financial point of view.

Reactions in Gaseous and Solid Mixtures

In accordance with the arrangements made between the Anglo-Batavian Society and the University of London, a lecture entitled "Reactions in Gaseous and Solid Mixtures" was delivered by Prof. W. P. Jorissen of the University of Leyden at the Imperial College of Science and Technology on February 21. Prof. Jorissen dealt with the limiting mixtures capable of propagating reaction in gaseous mixtures of two, three or more components and also in solid mixtures of several components. He illustrated how the behaviour of such systems could be exhibited by triangular diagrams; the different types of diagrams for the limit mixtures obtained in gaseous systems are also representative of many of the systems of solid reacting substances investigated. Similarity, for example, was shown by the diagrams illustrating the behaviour of hydrogen, chlorine, and nitric oxide mixtures with those of the systems ammonium dichromate, sulphur and iron, and the effect of nitrogen and of silica respectively on such systems. Similar relationships hold for the velocity of propagation of reaction in gaseous and in solid mixtures. In some cases, an enclosed elliptical region of reaction is obtained, in others hyperbolic curves bound the regions. Prof. Jorissen deduced from le Chatelier's equation relating to the combustion of limit mixtures that such behaviour would be expected. Among the many observations which form the experimental basis for the formulation of the behaviour of the systems investigated, may be mentioned the influence of small quantities of isoamyl bromide, 1·5 per cent of which is sufficient to prevent the combustion of methane-air mixtures under the conditions of these experiments; on the other hand, at certain concentrations, propyl bromide tended to induce oxidation of such mixtures.

Diffraction Effects due to Axial Obstructions in Telescopes

Mr. H. E. Dall has published an important paper with the above title (*J. Brit. Astro. Assoc.*, 48, 4, February 1938), in which he gives the results of his investigations on the obstruction of central rays by the prism or small mirror in the case of reflecting telescopes. He constructed artificial stars and artificial planets, making use of a low-voltage lamp for this purpose, and experimented with four types of diffracting apertures. These were as follows: that with no central obstruction, and three with central obstructions one fifth, one third, and one half the diameter of the reflector, respectively. The second and third are commonly employed for reflecting telescopes, half-diameter obstructions being rather rare. Mr. Dall supplies a considerable number of photographs for various cases, and these bring out very clearly the changes in diffraction rings, spurious disks, etc. When the central obstruction does not exceed one fifth the diameter of the aperture, there is no serious loss of detail contrasts; but in the case of close unequal double stars there is some loss of visibility. When the obstruction exceeds the above amount there is a noticeable falling off in crispness of detail, and in addition, there is an increase in spurious detail and diffraction haloes.

The Masses in Single-Spectrum Binary Systems

Prof. H. C. Plummer has recently published a paper with the above title (*Mon. Not. Roy. Astro. Soc.*, 98, 2; December 1937), in which he objects to the view expressed by Dr. R. G. Aitken in "The Binary Stars". Dr. Aitken states that the function $m_1^3\sin^3 i/(m+m_1)^2$ is frequently omitted by the computors of orbits because it gives very little definite information. Prof. Plummer is convinced that valuable information bearing on the masses of the systems can be derived in the work of obtaining orbits from single-spectrum stars, and carries out a very full investigation of the problem in his paper. The mass function determined from a single spectrum binary can be regarded as a function of $m\sin^3 i$ and the mass ratio $f = m_1/m$. It is assumed in the investigation that, within a limited range of spectral type, the mass of a star tends closely to a typical value, and no distinction is drawn between giants and dwarfs. While the adopted values of $m\sin^3 i$ are rough estimates and are systematically too large in so far as they are based on double-spectrum binaries, this is not a serious objection for the limited object in view, unless they are excessive. This latter contingency has not arisen because it would be shown in the discontinuity between the double- and single-spectrum system, and continuity in this respect is clearly brought out in the investigation. It seems a rash step to assume standard values of $m\sin^3 i$ and to apply them to individual systems, but, as Prof. Plummer points out, the results speak for themselves, and though in the lengthy Table iv they may be faulty in detail, nevertheless in broad outline they appear fairly correct.

'Spawning Urge', 'Homing Instinct', and 'Waiting' in Salmon Return

By Dr. A. G. Huntsman, Biological Board of Canada

NOT infrequently we misinterpret the mental processes of our closest friends—why they do certain things—and have to be corrected by them. If we misinterpret the mental processes of salmon, we can have no hope that they will correct us. From certain facts we may infer that salmon under the impelling force of a 'spawning urge' travel to their natal rivers by virtue of a 'homing instinct', and 'wait' at the mouths of the rivers until the conditions are right for their ascent, but we can have no hope of knowing these things, which are unverifiable assumptions. It is true that these conceptions are of very distinct value in presenting a readily appreciated picture of salmon behaviour, but are they the best for the scientific investigator? There can be no objection to them if, known for what they are, they are in quite full agreement with the facts. I do not wish to be an iconoclast, since 'images' have value, but, if they make us blind to realities, it seems desirable that we should see them as they are, even if we do not get rid of them. What are the realities?

Some years ago 'sea trout' (*Salvelinus fontinalis*) were trapped for hatchery purposes when ascending the Margaree River in Cape Breton Island during mid-summer. At spawning time, about forty per cent of these fish failed to yield spawn. We have examined this summer run and have seen that it consists in part of fish well along toward sexual maturity and in part of fish that are quite immature. To save the theory of a spawning urge, it is customary in such cases to make another unverifiable assumption—that the immature fish are carried along by the example of the others. In the Atlantic salmon (*Salmo salar*), very occasionally an immature fish is taken in summer with those that are maturing, but in the Saint John River of southern New Brunswick there is a condition in which the runs of maturing and immature fish are distinctly separated in time, so that no influence of example can be given as the explanation of the entrance of the immature into the river. There are three principal lots of fish entering the Saint John: (1) the grilse (1 + years in the sea, about 6 lb. in weight), practically all males and maturing, which enter in summer; (2) the fall or winter fish (1 + years in the sea, about 9 lb. in weight), practically all females and immature, which enter from November to January; and (3) the ordinary salmon (2–2 + years in the sea, averaging 10–15 lb. in weight, and increasing as the season advances), mostly females and maturing, which enter from May to July or August. However these facts may be viewed, there is no agreement between sexual maturity and entering the river. The gaspereau (*Pomolobus pseudoharengus*) spawns in the spring, and the mature fish enter the Margaree River at that season. But later, first the two-year-olds and then the yearlings also enter the river and pass through the estuary to fresh water, yearlings being taken even some distance above the head of tide. The conception of a 'spawning urge' inevitably obscures whatever may be the proper explanation of the return to, and ascent of, rivers by anadromous fishes.

There is a fascination in the wonderful. On the basis of certain facts and absence of facts, there has developed the view that the salmon migrates with almost unerring instinct from some distant feeding place in the sea, where salmon have never or rarely been taken, to its natal river. It is now clear that there is no known instance of a salmon making such a journey, whatever might be its mental process in doing so. It has been observed that the Atlantic salmon of the two Apple Rivers at the head of the Bay of Fundy, with a common narrow estuary, are in the outer part of the estuary, which never drains, and along the neighbouring coast, during the summer season when they are active. When sluggish in winter or when busy feeding they would not be seen. There is nothing to indicate that they have ever been in the open ocean or even out in the Bay of Fundy. They are thus more or less within the influence of the water issuing from their rivers. Under certain conditions of river discharge, usually starting in September, they go with rising tide up the estuary and into one or other of the two branches. We do not know whether each fish chooses its own branch when it reaches the fork in the estuary, but there is no necessity for its doing so, since by entering the branches at random, it has merely to remain in the right one. Certainly in the branched Miramichi estuary of northern New Brunswick, a salmon caught and 'tagged' in the Northwest Miramichi on September 24, 1930, was recaptured four days later in the Southwest Miramichi[1], having travelled nine miles down one branch of the estuary, fourteen miles up the other branch to the head of tide and twenty miles farther up above the head of tide. In any event, the salmon of Apple estuary have in an experiment shown relation to their own rivers[2]. Those of East Apple River were definitely recognizable, having been marked when descending as smolts. Traps were operated on both rivers just above the head of tide when the fish were returning. From the time when they began to ascend until close to spawning time, only marked salmon ascended East Apple River and no marked salmon ascended West Apple River. Later, however, even more marked salmon ascended the latter river than the former, so that no relation was seen near spawning time. This is the most precise experiment of the kind that has yet been reported. There is no evidence of the salmon doing anything more definite in 'homing' than to remain in the water of its own river if it happens to reach it.

Certain facts have given rise to the belief that salmon, on reaching the mouths of their rivers, 'wait' until the conditions are right, before venturing to ascend. There is no doubt that their failure to ascend is one of the great worries of the angler, and also that at times they have been seen congregated at a river mouth. While the latter observation quite fulfils the idea of 'waiting', it is only inference that they do anything more than remain there for a time, and this may be essentially the same as the behaviour of trout in a trout-pond, which congregate where the water supply rushes in. Turbulent current causes salmon to remain quiet, as a precise experiment performed this past summer clearly showed. Salmon parr in the bottom of a tank were moving about when the water was still and immediately became quiet when a current was started, resuming their to and fro movements when the current was stopped. Indeed, the usual behaviour of salmon that will ascend the river under proper conditions seems to be to go to and fro. The capture of salmon in drift nets in and near river estuaries, such as Avon River, N.S., the Petitcodiac River, N.B., and the Saint John River, is dependent upon such movements of the salmon[3]. A to-and-fro movement with a range of at least fifty miles has been demonstrated in tagging experiments[4]. The conception of 'waiting' is not in agreement with the facts.

[1] Blair, A. A., *Ann. Rep. Biol. Bd Canada*, 1933, 16 (1934).
[2] White, H. C., *J. Biol. Bd. Canada*, 2, 391 (1936).
[3] Huntsman, A. G., *Bull. Biol. Bd. Canada*, 51, 5 (1936)
[4] Dahl, K., *Salmon and Trout Mag.*, 88, 229 (1937).

British Industries Fair

TO anyone who has visited the British Industries Fair over a period of many years two features must have become increasingly evident. One is the extent to which scientific knowledge, methods and equipment are being used in industry, and the other the birth and growth of new industries which are the direct offspring of scientific discoveries.

At Olympia this year, the exhibits of plastics present a very good illustration of the second feature. The range and the variety of the finished plastic products available for all sorts of industrial and domestic purposes seem to increase each year. Indeed, in the prolific character of the researches into synthetic resins and kindred investigations, one is almost inevitably reminded of the fertility of the investigations into coal tar which gave birth to the vast aniline dye industry. The exhibits of plastics, indeed, now constitute one of the major features of the Fair at Olympia. Among the new products to be seen this year was a cast, phenolic resin, known as 'Catalin', which was exhibited for the first time by Catalin Ltd. The material is non-inflammable, odourless and tasteless, resistant to alcohol and oils and to most of the common acids. It is claimed, moreover, to have high di-electric and compressive strength. Catalin is not a moulded product, so that moulds, presses or dies are not required. It is supplied to the customer in cast, solid form and can be converted into the finished product by the use of standard machinery, tools and manufacturing equipment. Mouldrite Ltd. showed several samples of modern plastics, including phenol-formaldehyde, urea-formaldehyde and acrylic moulding powders and resins. The transparent synthetic product, 'Perspex', to which reference was made in the review of the Fair last year (see NATURE, 139, 380; 1937), was a prominent feature of this stand. This material is being widely adopted for use in aircraft as windscreens, cockpit coverings, cabinet windows and gun turrets. Combined Optical Industries Ltd. exhibited several examples of plastic lenses produced by special moulding processes. These included ophthalmic lenses, simple lenses, opera oculars and objectives, and camera view finders and meniscus objectives. The synthetic, plastic product used as the raw material for these optical elements is said to have optical properties that compare favourably with those of glass. In refractive index and dispersion it resembles crown glass, and it has a higher transparency than glass, especially in the ultra-violet. One most interesting feature of this new product is the number of new possibilities it creates for the use of aspherical lenses. These plastic lenses are practically unbreakable, less than half the weight of corresponding glass lenses and chemically inert.

The exhibits of chemicals were under the auspices of the Association of British Chemical Manufacturers and this section shared pride of place with the scientific instrument section. It is interesting to note that, according to the Board of Trade official statistics, home products are increasingly replacing imported chemicals. The main increases in British exports of chemicals during the past year have been in respect of bleaching powder, sodium carbonate, caustic soda, ammonium sulphate, fertilizers, dyestuffs, cresylic acid, tar, creosote oils and copper sulphate. Among a number of products, which are either new or are being offered in new form, the following may be noticed: sodium alginate—a reactive colloid used for controlling viscosity; terpeneless oils, which are invaluable in fine grade perfumery products; and a range of dyes for anodic colouring of aluminium.

The exhibit of Imperial Chemical Industries, Ltd., this year was confined to a display constituting an historical survey of the manufacture and uses of 'alkali', from the time of ancient Egypt, when it was used for glass-making and embalming, through its agricultural production in the Middle Ages, through the development of the Le Blanc process at the end of the eighteenth century, down to the introduction of the ammonia-soda process in the middle of the nineteenth century. A number of interesting historical exhibits was appropriately included in this ingenious display which, with the various notes attached to the several exhibits and with a leaflet entitled "The Story of Alkali", constituted a really fascinating and informative lesson for the visitor who had time to give careful attention to it. Attention was directed to the technical service of the alkali group of Imperial Chemical Industries, Ltd. One of the latest successes in this service has been in the refining and desulphurization of iron.

Among other exhibits in the chemicals section we may note that British Drug Houses, Ltd., showed specimens of plant hormones reproduced by synthesis in the laboratory. The Gas Light and Coke Co. showed a non-toxic tar for use on roads in the vicinity of fishing streams—an interesting example of an attempt to meet special needs.

The combined exhibit of the scientific instrument manufacturers, to which reference was made in NATURE of February 26, p. 362, was an imposing display which, as was said above, shared pride of place with the chemicals section. The layout and the arrangement of the several exhibits were dignified and effective, and those responsible for its organization are to be warmly congratulated. One general feature, which was evident at last year's Fair and still more evident this year, was the increase in the number of scientific instruments used for industrial purposes, either for routine testing, for the control of operations or in the field of scientific investigation. This tendency, it is safe to predict, will grow, and the extent to which it grows will form a fairly reliable indication of the extent to which scientific knowledge and scientific methods are permeating industry in general.

It is impossible, within the limits of an article, to do justice to all the points of interest in the combined exhibit of the scientific instrument manufacturers. Among the novel exhibits, C. Baker showed the 'Smith wear and lubricant tester'. This instrument has been designed and developed with the object of producing a reliable means of testing and investigating, by means of the same instrument, the hardness and wearing properties of various metals and also the lubricating and abrasive qualities of lubricants. Accordingly, the machine can be used to assist in the selection of the best lubricant for a given bearing or in the choice of bearing metal for a given purpose. The machine uses the principle common to certain other instruments, in which the revolving member wears a measurable impression in the flat surface of a test piece. It is, however, unique in many respects and particularly in that it employs as a wearing member a hardened steel ball of 1 cm. diameter, exactly as is used in the Brinell hardness tester. Cooke, Troughton and Simms, Ltd., exhibited several new designs of surveying instruments, in which the size and weight have been considerably reduced without loss of accuracy, and the ease of reading the circles and the general facility for handling have been increased. Among these instruments, attention may be directed to the 'geodetic Tavistock theodolite', which reads to half a second of arc. In this instrument, the mean of the readings at both ends of a circle diameter is automatically indicated. The circle graduations are permanently marked on optical glass and both circles are read from a position near the eye-end of the telescope, whichever face is being read. This firm also showed a Vickers projection microscope, for which very great stability and rigidity are claimed. It is capable of carrying specimens up to 50 lb. in weight without any risk of damage.

Adam Hilger, Ltd., showed the 'Spekker photoelectric absorptiometer'. The principal advantage of this absorptiometer over the colorimeter of the Duboscq type is that visual matching is entirely eliminated. This firm also exhibited a new large spectrograph for metallurgical spectrum analysis. It is of the Littrow type and is unique in this respect, that it is the only type of spectrograph in the world in which all the adjustments are made automatically, simultaneously and accurately. One handle only is needed to effect these adjustments. W. Watson and Sons, Ltd., showed, among other exhibits, a profile projector and the Watson-Symon 'enlarging calculator'. The latter instrument is used in the production of enlargements of the highest standard from miniature negatives. It is claimed that the instrument can be used in combination with any type of enlarger and for any size of enlargement. R. and J. Beck, Ltd., exhibited Dr. G. M. B. Dobson's 'ozone spectrometer'. It is claimed that by means of this instrument the thickness of the layer of ozone thirty miles above the earth can be measured and, from the measurement, a speedy and accurate weather forecast can be deduced. A comprehensive range of television receivers and equipment was shown on the stand of Baird Television, Ltd. The receivers incorporated a 'Cathovisor cathode ray tube', which is completely electro-magnetic in operation. A multiplier photo-electric cell was also shown and television lecture equipment for use in colleges and technical schools.

In view of the work on which the scientific instrument firms must be busily engaged in connexion with the great rearmament programme, it was no doubt difficult for many firms to exhibit at all and, for those firms who did exhibit, to give as comprehensive and detailed a picture of their industrial products as they would have liked. Nevertheless, as has been indicated, the scientific and optical instruments combined exhibit was a significant object lesson of the scope and vigour of this very vital industry.

Punjab Irrigation Research Institute[*]

The scope of the work undertaken by the Punjab Irrigation Research Institute, the director of which is Dr. E. McKenzie-Taylor, is illustrated in three publications, giving the results of different inquiries which have recently been pursued. In "The General Theory of the Gradient of Pressure under a Structure on Permeable Foundations" Mr. J. K. Malhotra and Dr. McKenzie-Taylor build up from first principles a general theory in conformity with the formulæ and values obtained by other workers for the rate of change of pressure in the direction of flow. Treating first the case of flow under a simple floor, a general expression for exit gradient is obtained, and this is extended to the case of flow under a complex structure, several specific cases being dealt with in order to show its applications.

The second of these publications takes us from the structural interests of the Institute to that of cultivation. In the Punjab, it has been the custom to regard land suitable for rice as unfit for other crops, but the improvement noted during investigations on reclaimed land tends to rebut this view. It is probable that land, which when first reclaimed is only fit for rice, can be improved to such an extent as to be capable of producing a normal rotation of crops. This is suggested in "The Soils of the Rice Areas of the Gujranwala and Sheikhupura Divisions of the Upper Chenab Canal" by Mr. M. L. Mehta.

In parts of the district referred to, the water table has risen considerably and, in consequence of the increased salt content and alkalinity, the land has gone out of cultivation. The objects of the investigation described were to determine the soil characteristics and the degree of deterioration of these lands as a first step towards their reclamation.

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[*] Punjab Irrigation Research Institute Research Publications. Vol. 2, No. 16. Pp. 10 3 annas, 4*d.* Vol. 3, No 2. Pp. 25+iii+4 plates. 10 annas, 1*s* Vol. 3, No. 3. Pp 47+10 plates. 1·3 rupees, 1*s.* 10*d.* (Lahore, 1937)

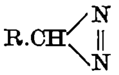
From the numerous examinations of soil samples taken, certain areas where salt and alkalinity are high were indicated as being fit, as yet, only for rice crops. Others proved to be of better quality, and it is held that the failure to appreciate this is due to lack of knowledge of the proper method of rotation, the essential feature of which is to introduce a leguminous crop immediately after the rice in order to restore the nitrogen balance. The anærobic soil conditions under which rice is grown have the result of reducing the nitrogen available for the succeeding crop. A study of the natural flora of the area showed that these gave reliable indications as to the state of the land.

This forms an interesting commentary on the third of these researches, which was suggested by the dominance of particular types of natural flora noticed in certain localities surveyed in 1931–32. The purpose of this investigation was to determine the class of soil favoured by each of the five types of vegetation selected, as a guide in future soil surveys. In "A Study of the Soil Profiles of the Punjab Plains with Reference to their Natural Flora" R. C. Hoon and M. L. Mehta deal fully with each case, and, in the result, show that four of the botanical types referred to—*Prosopis spicigera*, *Salvadora oleoides*, *Tamarix articulata* and *Capparis aphylla*—are reliable indicators of the soils they favour, and deductions may be drawn as to the crops for which they are suitable and the precautions necessary when under irrigation and treatment. In conjunction with grass (*Eleusine ægyptica*), however, a wide range of soils was found and from this type of vegetation, therefore, no index value was obtainable.

The Aliphatic Diazo Compounds

IN the forty-second Bedson Club Lecture delivered in King's College, Newcastle-upon-Tyne, Prof. J. Kenner discussed the aliphatic diazo compounds. The observation that the naturally occurring amide asparagine lost nitrogen when nitrous acid was present in nitric acid used for its hydrolysis led to the discovery of the general effect of this substance upon aliphatic amines. The work of Griess on aromatic diazo compounds was followed by the discovery of diazo acetic ester by Curtius, who turned to good account the suggestion of Baeyer that the acid part of glycine should be esterified whilst investigation of the amino group was proceeding. Together with Buchner, Curtius described the properties of the new substance which are responsible for the importance of its congeners to-day.

With regard to the formula of the aliphatic diazo compounds Curtius favoured the cyclic structure,



$$\mathrm{R.CH}\!\left\langle\begin{array}{c}\mathrm{N}\\ \|\\ \mathrm{N}\end{array}\right.$$

but Thiele was led by observations of Staudinger and himself to propose $\mathrm{R.CH} = \mathrm{N} \equiv \mathrm{N}$. Modern theory regards these compounds as examples of mesomerism, and the suggestion was now put forward that their formation from the diazo-hydroxides first produced, for example, in the preparation of diazomethane from nitrosomethylurethane, is due to the peculiar stability of the mesomeric state.

Prof. Kenner's active interest in the subject arose from his investigations of the tendency of the nitroso-group to pass whenever possible into the oximino-group. This led to an improvement of the early von Pechmann preparation of diazo paraffins, consisting in brief in the alkaline decomposition of the N-nitroso derivative of the addition product of mesityl oxide and a primary aliphatic amine.

On the larger scale, certain difficulties were encountered. Loss was occasioned by the liberated diazoparaffin combining with the mesityl oxide simultaneously formed, but was reduced by working at lower temperatures and by separating mesityl oxide from the distillate by a fractionating column. In the case of higher homologues the boiling points of which approximate to that of mesityl oxide, pulegone can with advantage be substituted for the latter, in the preparation of the nitroso compound. Ether, first used to carry away the diazo compounds, was recognized by Meerwein to inhibit their reactivity, but a very satisfactory technique was developed in which anisole is used as solvent and nitrogen as a carrier gas under reduced pressure.

Vinyldiazomethane and its methyl derivative exhibit a comparatively feeble reactivity towards acids; this was attributed to internal saturation, and in agreement with this the vinyl compound readily passes by monomolecular reaction into pyrazole.

After a discussion of some of the properties of the aliphatic diazo compounds, their chemical behaviour was discussed and more particularly towards ketones. The inertia of these towards diazomethane was first overcome when Meerwein activated acetone by means of methyl alcohol. The initial attack of the diazo compound at the carbon atom of the carbonyl group is followed by loss of nitrogen and stabilization, either by formation of an ethylene oxide ring or by a Wagner-Meerwein type of rearrangement. This latter, in the particular case of cyclic ketones, results in ring enlargement; cyclo-hexanone, for example, gives on treatment with diazomethane, 46 per cent cyclo-heptanone. Similar reactions have been carried out with the homologues of diazomethane (which are more reactive than the parent substance), and numerous 6-, 7- and 8-membered 2-alkyl cycloketones have thus been prepared. The same products were prepared directly from the corresponding nitrosourethanes by a procedure applied by Meerwein to nitrosomethylurethane, and this has the advantage of applicability in cases in which it may not be possible to prepare the diazo compound itself. By this device also it is possible to introduce groups into a ketone which may be of use in further synthetic operations.

Science News a Century Ago

Colonel John Stevens (1749-1838)

COLONEL JOHN STEVENS, of Hoboken, New Jersey, who died on March 6, 1838, although not trained as an engineer was for fifty years one of the chief pioneers of the use of steam for transport on land and sea. The grandson of John Stevens, who as a youth of seventeen went from London to New York to serve in a lawyer's office, and the son of "the Honorable John Stevens, Gentleman", a successful business man and a figure in the American political world, Stevens graduated from King's College—now Columbia University—in 1768 and for a time studied law. He was always possessed of ample means, and during the Revolution he acted as treasurer of New Jersey, attaining the rank of colonel. In 1784 he purchased large tracts of land in New Jersey, including Hoboken on the west bank of the Hudson. His interest in steam boats was stimulated by the work of Rumsey and Fitch and in co-operation with Nicolas Roosevelt and Chancellor Robert Livingston he constructed steam boats himself. Of these, the most notable was the *Little Juliana*, 1804, which he fitted with a multitubular boiler and a high-pressure engine driving twin screws. This was the first practical screw-driven steam boat. The machinery of the boat is preserved in the United States National Museum.

In 1807, Stevens constructed a paddle wheel vessel the *Phœnix*, which made a trip from New York to Philadelphia, this being the first voyage by a steam boat in the open sea. Later on he started a steam ferry-boat across the Hudson. He wrote much on the improvements of roads and was a prominent advocate of steam railways. In 1815, he applied for and received from the State of New Jersey the first American railway charter, and when seventy-six years of age constructed the first locomotive in America and ran it round a circular track on his estate. He retained his mental vigour to the last. Of his family, John Cox Stevens, Robert Livingston Stevens and Edwin Augustus Stevens also did much for furthering transport in the United States, and the last, by his will dated 1867, provided for the erection and endowment of the well-known Stevens Institute of Technology, Hoboken, N.J.

Structure of Vegetable Tissue

ON March 8, 1838, the Rev. Joseph Bancroft Reade (1801–70), the chemist and microscopist, read a paper to the Royal Society entitled "An Inquiry into a new Theory of Earthy Bases of Vegetable Tissues". After briefly noticing his experiments described in two papers in the *Philosophical Magazine* of July and November 1837, he adverted to the theory of M. Raspail detailed in his "Tableau Synoptique" and "Noveau Système de Chimie". In opposition to some of the views entertained by Raspail, Reade found that in the bark of the bamboo and the epidermis of straw the silica incrusting these tissues is not crystallized, but on the contrary exhibits, both before and after incineration, the most beautiful and elaborate organization, consisting of an arranged series of cells and tubes, and differing in its character in different species of the same tribe and in different parts of the same plant. The observations of Mr. Golding Bird were referred to, and Reade stated in confirmation that, by employing caustic potash, the siliceous columns may be removed from the leaf of a stalk of wheat, while the spiral vessels and ducts which form the principal ribs of the leaf, as well as the apparently metallic cups, which are arranged on its surface, remain undisturbed. He proposed, therefore, to substitute, in the description of vegetable tissues, the term skeleton, instead of that of bases, whether saline or siliceous, of those tissues.

The Mass of Uranus

AT a meeting of the Royal Astronomical Society on March 9, 1838, a paper by Dr. J. Lamont was read on the "Value of the Mass of Uranus deduced from Observations of its Satellites made at the Royal Observatory of Munich during the year 1837". In the course of the year, opportunity of a few favourable nights was taken to observe the satellites with the view of calculating the mass of the planet. Though the object was not satisfactorily attained, the results were not without interest as it led to the conclusion that the true mass of the planet was considerably smaller than that generally adopted. The value he found was 1/24605, being less by one fourth part than that obtained by Bouvard, from the perturbations produced by the planet. Lamont remarked that in giving this value he was aware of the uncertainty of the data on which it rested. He was confident that the value of the mass of Uranus, then used in the theory of the planetary perturbations, ought to be greatly diminished, though the precise proportion in which this should be done could not then be assigned.

Lamont was born on December 13, 1805 at Muckle Inverey, near Braemar, Aberdeen, but at the age of twelve years was sent to the Scottish Benedictine Monastery at Ratisbon, Bavaria. He was made director of the Munich Observatory in 1835, devoting much of his time to terrestrial magnetism. He died at Bogenhausen, Munich, in August 1879. In September 1934, Princess Arthur of Connaught unveiled a memorial to him at his birthplace.

Whewell's "History of the Inductive Sciences"

IN a long review, in the *Athenæum* of March 10, 1838, of Whewell's three-volume work "History of the Inductive Sciences from the Earliest to the Present Times", the reviewer towards the end of his article proceeded "to endeavour to pronounce at once a distinct opinion on the merits of the work before us. We find," he wrote, "in that work abundant proofs of profound and varied knowledge, great power of language, impartiality of judgment, and even boldness of thought; but unfortunately the ambition of eloquence seems to have enticed the author into a style not always the most appropriate to his subject. His style is that of one whose mind is used not to originate, but to receive ideas—not to unfold, but to grasp them: in his efforts to express himself clearly he usually becomes sententious. He leans towards transcendental truths and expressions; and while from its want of elemental ideas and simple language, his work will be always unintelligible to the bulk of people, we fear that those who by their knowledge of physical science are capable of understanding it, may have reason to complain of its want of originality and acuteness, of breadth of view and insight into the reciprocal action of the various branches of human knowledge; or to lament that it chronicles the increase of science, without throwing much light on the history of the human mind."

University Events

Birmingham.—The Poynting Memorial Lecture will be given on March 11th at 5.30 p.m., at the University, Edmund Street, by Dr. E. C. Bullard, who has chosen as his subject "Geophysical Measurements at Sea". The lecture will be open to the public.

London.—Prof. G. M. Bennett has been appointed professor of chemistry tenable at King's College. Since 1931 he has been Firth professor of chemistry in the University of Sheffield (see also p. 403).

Mr. R. S. Pilcher has been appointed professor of surgery at University College Hospital Medical School. Since 1934, he has been first assistant in the Surgical Unit and, since 1936, assistant surgeon at University College Hospital.

The title of professor emeritus of pathology in the University has been conferred on Prof. A. E. Boycott, formerly Graham professor of pathology in University College Hospital Medical School.

The following doctorates have been recently conferred: D.Sc. in chemistry on E. D. Hughes, of University College, and W. Taylor, of the Sir John Cass Technical Institute; D.Sc. in physics (spectroscopy) on W. H. J. Childs, of King's College.

The following, among others, have been appointed fellows of King's College: Mr. E. R. Bolton, a member of the Chemical Engineering Committee; Lieut.-Colonel R. D. T. Alexander, president of the Institution of Engineers (India) in 1928.

Among those recently elected to the fellowship of University College, London, are: Dr. E. J. Allen, formerly secretary of the Marine Biological Association of the United Kingdom, and director of the Association's laboratory at Plymouth; Dr. H. L. Eason, principal (formerly vice-chancellor) of the University of London; Prof. E. Mapother, medical superintendent and professor of psychiatry at Maudsley Hospital; Mr. A. S. Quartermaine, assistant chief engineer of the Great Western Railway; Mr. C. C. Walker, chief engineer of the De Havilland Aircraft Company; Mr. C. S. White, senior obstetric surgeon in University College Hospital; Mr. J. A. Wilks, librarian of University College.

St. Andrews.—The following appointments have recently been made: H. G. Campbell to be the first professor of dental surgery; G. A. Cumming to be lecturer in geology and geography; J. Dewar to be lecturer in chemistry in the United College; Dr. D. Stiven to be lecturer in bacteriology and assistant director of the Bacteriology Laboratory.

Societies and Academies

Paris

Academy of Sciences, January 10 (*C.R.*, 206, 81–136).

Lucien Cayeux: The role of the Foraminifera and of calcium carbonate in the fixation of certain mineral substances.

Jean Cabannes and Auguste Rousset: The Raman effect in gases under pressure.

Marcel Godchot and Mlle. Germaine Cauquil: The menthadienic hydrocarbons obtained in the dehydration of the active and inactive 1-methyl-3-cyclohexylisopropyl pinacones.

Ernest Vessiot: The equations $F(x,y,z,p,q,r,s,t)=0$ to which the method of Darboux is applicable.

Henri Poncin: The commencement of flow of a viscous fluid.

Léopold Escande: Flow through a gate valve.

Pierre Dive: The impossibility of permanent barotrope rotations in a fluid star with ellipsoidal stratification.

Raoul Goudey: Measurements of the acceleration of gravity made in France during the year 1934. Values of g for 58 places in France are tabulated.

Henri Lacoste-Tayan: The aerial *permeance* of permanent magnets.

Mlle. Sylvanie Guinand and Jacques Nicolle: The rotatory power of mixtures of ascorbic acid and soda.

Frantz Perrier: The radiation emitted by solid dielectrics electrified by friction. The existence of this radiation having been doubted by Eichenberger, additional experiments made with further precautions as regards screens are described. The author still upholds the reality of the radiation.

Mlle. Yvette Wormser: The action of oxalic acid on a cobaltichloropentammine.

Marcel Frèrejacque: The identification of glucose. The acetolysis of the glucosides. The method is based on the production of β-tetracetylglucosylparatoluidine. This has definite and easily recognizable properties, and can be made from the products of hydrolysis of a glucoside without difficulty.

V. Dolejšek and M. Jahoda: The variations of the network of piezo-electric crystals produced by a static electric pressure.

Marius Dalloni: The Permian deposits of the Pyrenees with Angaride flora.

André Lenoble: The age and chronological order of the eruptive outbreaks between Mahanoro and Nosy-Varika (eastern coast of Madagascar.

Gaston Delépine and Branko Yovanovitch: The presence of Famennian grit and coralligenous limestones of the middle Devonian at Mechra ben Abbou (western Morocco).

Paul Deleau: Sudden variations of facies of the lower Cretaceous at Djebel Djaffa (Constantine).

Ottavio Munerati: The culture of the beetroot from seed to seed in a simple liquid medium.

Roger Gautheret: Transplanting cambium tissue cultures of *Salix caprea*.

Constantin Dawydoff: Asexual multiplication by laceration in *Ctenoplana*.

Marius Piéry, Jean Enselme and Mlle. Simone Petel: Researches concerning the influence of mineral waters on tissue respiration. Role of the ions Ca^{++}, Mg^{++} and Na^{+}.

Mme. Andrée Roche, Jean Roche, Mme. Simone Drouineau and Paul Passelaigue: Capability of a protein food to meet the nitrogenous needs of maintenance or of growth and regeneration of tissue proteins.

Serge Tchakhotine: Ultra-violet ultra-micropuncture: a new means of studying colloidal phenomena in the living cell.

Geneva

Society of Physics and Natural History, October 21.

Paul Rossier: (1) The apparent diameter of the star α-Leonis. The author shows that the various formulæ proposed for calculating the apparent diameter of a star agree with the results of observations made by Arnulf and based on the method of occultations. This result is the more remarkable since it has been obtained by examining a hot star. (2) The separating power of the prism objective. It is easy to prove that the separating power of the prism is slightly below that of the objective and that these two objects agree with each other if their diameters are equal. As the dispersion increases with the angle of the prism, it would appear to be advantageous to increase this angle as much as possible. In reality, for photometric reasons, this is made relatively small.

November 18.

Jean Louis Perrot : The descent of the ovocytes in *Helix Pomatia*. The receptivity of the ovocyte does not appear to be connected with a determined stage of maturation, but rather on its position in the genital tract. Whatever may be the state of nuclear division of the ovocyte, it is fertilized only when it has penetrated into the fertilizing chamber.

Max Perrot : Researches on the chromosomes of the *pulmonés stylommatophores*. The results of numerous counts of chromosomes carried out especially in the Helicidæ family leads the author to attribute to the sub-family of the Helicinæ the characteristic chromosome numbers 22, 25, 26 and 27.

Emile Cherbuliez, Jean Jeanneret and Kurt H. Meyer : Collagen A, collagen B and gelatin. A study of the fibres of calf's foot tendon has shown that in the passage from the original collagen to gelatin two sorts of transformations must be distinguished. First, a physical transformation consisting of a loss of the crystalline structure of the primitive fibres, and secondly, a chemical transformation characterized by a commencement of hydrolysis which splits up the long polypeptic chains. The usual collagen B is a product arising from collagen A by an intra-micellular fusion (transformation 1) accompanied by a beginning of hydrolysis of variable intensity depending on the treatment adopted. Hence collagen B is not a product showing constant properties.

December 2.

Arnold Lillie and Willy J. Schroeder : The Nummulitic of the valley of Chambres (Nappe de Morcles, Samoéns Alps, Haute-Savoie). The detailed study of a Nummulitic series shows (1) the presence of a fauna of foraminifera altered from the Upper Cretaceous ; (2) a Lutetian marine intrusion ; (3) a series of red intermediate layers between the marine Lutetian and a complex conglomerate series ; and (4) a complex conglomerate series intermediate between the Lutetian layers containing Lutetian nummulites and those containing Priabonian nummulites.

Augustin Lombard : Polygenic conglomerates of the base of the external Pre-Alps (Voirons, Pléiades, Collines du Faucigny). (1) Distribution, lithology. Conglomerates are found at Voirons analogous with those discovered in the external Pre-Alps. They are arranged in a series of lenses in contact with the molasse and the ultra-Helvetic flysch. (2) Problem of their origin. The polygenic conglomerates of Voirons are detritic Taveyannaz grits of Priabonian age transported over a distance of about 30 kilometres, and autochthonous formations identical with those of Clusaz.

Charles G. Boissonnas : The calculation, for a binary mixture, of the partial vapour pressures starting with the total pressure. The knowledge of the total pressure of the vapour in equilibrium with a binary solution, as a function of the molecular composition of the condensed phase, suffices for the calculation of the partial pressures.

A. J. A. van der Wyk : The viscosity of binary mixtures. It is impossible to describe the viscosity of a mixture without the introduction of a new magnitude called 'binary viscosity', some applications of which are indicated.

Madeleine Blanc and Jean Weigle : Simultaneous reflections and deflected action. It can be shown that the intensity of the apparent reflection of X-rays on planes with zero coefficient of reflection can be of the same order of magnitude as on planes with the coefficient not zero. The energy which flows in the originally inhibited direction cannot arise directly from the incident wave.

Jean Weigle : The double refraction of an atomically stratified medium. Waves propagated in a stratified medium give double refraction. The velocities of the resulting waves are represented by an ellipsoid and by a sphere which are the Fresnel surfaces.

Jean Patry and Jean Weigle : The conditions at the limits in problems of diffraction by periodic media. The authors have established the conditions at the limits, in a periodic medium traversed by waves, that determine those of the waves which will be excited by an external wave falling on the medium.

Rome

National Academy of the Lincei (*Atti*, 25, 679–746; 1937).

F. Severi : Systems of equivalence of any species on one algebraic variety, as rational systems (2).

G. Scorza : Algebras linked to groups of finite order.

S. Cherubino : Application of holomorphous functions of matrices to systems of linear differential equations (2).

M. Villa : Differential property of the cones of Veronese.

G. Colonnetti : Elastic equilibrium of systems in which non-elastic deformations also occur (4).

E. de Angeli : Some integrable cases of movement of a heavy asymmetric gyroscope.

F. de Franchis : Links and reactions in the most general scheme of Lagrange.

M. G. Fracastoro : Eruptive protuberance of May 29, 1937.

G. Boaga : Relationships between the deviations of the vertical and the gravimetric anomalies.

A. Baroni : Sulphur selenium protochloride. Determination of the index of refraction and of the surface tension of mixtures of sulphur in selenium protochloride Se_2Cl_2.

C. Perrier and E. Segrè : Some chemical properties of element 43.

G. Piccardi : Flame spectrum of europium and the persistence of three lines of low excitation.

P. Comucci : A singular rock from the Baltoro glacier (Karakorùm) (2).

E. Marchesini : Extension of the Oligocene in the region north-east of the Monte Judica group (Provinces of Catania and Enna).

T. Perri : Researches on the histological modifications of the thyroid in the guinea pig during the œstrus cycle.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, March 7

University of London Animal Welfare Society (at University College, Gower Street, W.C.1), at 5.15.—Dr. A. H. B. Kirkman: "The Disappearing Fauna of Africa: a Tragedy".*

University of Leeds, at 5.15.—Prof. E. K. Rideal, F.R.S.: "Some Recent Advances in Surface Action".*

Royal Geographical Society, at 8.30.—M. Hubert Carton de Wiart: "The Pan-American Highway Project".

Tuesday, March 8

King's College, London, at 5.30.—Prof. A. J. Allmand, F.R.S.: "The Drumm Storage Battery".*

University College, London, at 5.30.—Prof. P. Pruvost: "Some Problems of Sub-Surface Geology in Northern France" (succeeding lecture on March 10).*

Pharmaceutical Society, at 8.30.—F. W. Gamble: "Facing Realities" (Harrison Memorial Lecture).

Thursday, March 10

University College, London, at 5.—Prof. P. E. Verkade: "The Role of Dicarboxylic Acids in Metabolism".

Friday, March 11

Physical Society (at the Imperial College of Science and Technology), at 4.45.—Annual General Meeting.

University of Birmingham, at 5.30.—Dr. E. C. Bullard: "Geophysical Measurements at Sea".*

Institute of Metals, March 8–10.—Annual General Meeting to be held at the Institution of Mechanical Engineers.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned.

Assistant Engineer in the Roads Department of the Ministry of Transport—The Assistant Secretary, Establishment Department, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W.C.2 (March 7).

Head of the Chemistry Department of the Wigan and District Mining and Technical College—The Principal (March 8).

District Agricultural Organiser for the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the Council, County Hall, Chelmsford (March 11)

Lecturer in Mechanical Engineering in the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon (March 12)

Research Officers for investigation into contagious abortion and swine fever and necrotic enteritis at the Veterinary Laboratory, New Haw, Weybridge—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (March 14).

Agricultural Instructor in Wiltshire—The Clerk of the Council, County Offices, Trowbridge (March 15).

Lecturer in Charge of the Textile Department in the Belfast College of Technology—The Director of Education, Victoria Street, Belfast (March 21).

Assistant Director of Clinical Investigations and Research (University of Manchester) in the Manchester Royal Infirmary—The Registrar, University (March 27).

Lecturer in Biochemistry in University College, Dundee—The Secretary, The University, St. Andrews (March 28).

Deputy Water-Works Engineer to the British Municipal Council, Tientsin—Messrs. J and A. Leslie and Reid, Civil Engineers, 72A George Street, Edinburgh, 2 (March 30).

Assistant Keeper in Entomology in the Manchester Museum (University of Manchester)—The Registrar (April 20).

Lecturer in Biology (woman) and part-time Lecturer in Geography (woman) in the Southland Training College, Wimbledon Park Side, S.W.19—The Principal.

Professor of Chemistry in University College, Dundee—The Secretary, The University, St. Andrews.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Electrical and Allied Industries Research Association. Seventeenth Annual Report, October 1, 1936, to September 30, 1937. Pp. 138. (London: British Electrical and Allied Industries Research Association.) [12

Usk Board of Conservators. A Further Biological Study of the River Usk. By Dr. W. Rushton. Pp. 23. (Usk: Usk Board of Conservators.) [12

Department of Scientific and Industrial Research. Report for the Year 1936–37. (Cmd. 5647.) Pp. iv+195. (London. H.M. Stationery Office.) 3*s*. net. [12

Technical Publications of the International Tin Research and Development Council. Series A, No. 72: Discoloration and Corrosion in Canned Cream, Part 2. By C. J. Jackson, G. R. Howat and T. P Hoar. Pp. 10. (London. International Tin Research and Development Council.) Free [22

Twenty-eighth Report of the Commissioners of His Majesty's Customs and Excise for the Year ended 31st March 1937, being the 81st Report relating to the Customs and the 80th Report relating to the Excise. (Cmd. 5573.) Pp. 219 (London: H.M. Stationery Office.) 3*s*. 6*d*. net. [32

Committee of the Privy Council for the Organisation and Development of Agricultural Research. Constitution and Functions of the Agricultural Research Council. Pp. 18. (London: Agricultural Research Council.) [42

Other Countries

Smithsonian Miscellaneous Collections. Vol. 97, No. 1: Preliminary Report on the Smithsonian Institution—Harvard University Archæological Expedition to Northwestern Honduras, 1936. By William Duncan Strong, Alfred Kidder II, and A J. Drexel Paul, Jr. (Publication 3445) Pp. v+129+16 plates. (Washington, D.C.: Smithsonian Institution.) [291

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 18, 1936. Pp. 226+vii. (Rochester, N.Y.: Eastman-Kodak Co.) [291

Report of the Secretary of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ended June 30, 1937. (Publication 3449.) Pp. ix+123+7 plates. (Washington, D.C.. Government Printing Office.) 20 cents. [291

League of Nations. Bulletin of League of Nations Teaching. The Teaching of the Principles and Facts of International Co-operation. (No. 4, December 1937.) Pp. 218. (Geneva · League of Nations; London: George Allen and Unwin, Ltd.) 2*s*. 6*d*. [12

Chinese Materia Medica. Turtle and Shellfish Drugs. By Bernard E. Read. (Published by the *Peking Natural History Bulletin*.) Pp. 95+12 plates. (Peiping: The French Bookstore) 3 dollars. [12

Palæontologia Sinica. New Series D, No. 1 (Whole Series, No. 101): The Dentition of *Sinanthropus pekinensis*; a Comparative Odontography of the Hominids. By Prof. Franz Weidenreich. Pp. 121+36 plates. (Nanking and Peiping · Geological Survey of China.) [12

University of Lucknow. Abstracts of Publications by Members of the University (Department of Botany), 1933–1937. (Third Quinquennium.) Pp. 91–214. (Lucknow: The University.) [12

Publications of the Dominion Observatory. Vol. 12: Bibliography of Seismology. No. 15: Items 3566–3674, July, August, September 1937. By Ernest A. Hodgson Pp. 301–324. 25 cents. No. 16. Items 3675–3827, October, November, December 1937. By Ernest A. Hodgson. Pp. 325–352. 25 cents. (Ottawa: King's Printer.) [12

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 101, 4^{me} partie: Comparative Studies of the Fluctuations in the Stocks of Fish in the Seas of North and West Europe, 2nd Part; What Physiological Problems are of Interest to the Marine Biologist in his Studies of the Most Important Species of Fish, 2nd Part. Pp 24+8. (Copenhague: Andr. Fred. Høst et fils.) 1.50 kr. [32

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 16: Student Interests and Needs in Hygiene. By Dr. James Frederick Rogers Pp. vi+21. (Washington, D.C.. Government Printing Office.) 10 cents. [42

Tanganyika Territory: Department of Agriculture. Third Annual Report of the Coffee Research and Experimental Station, Lyamungu, Moshi, 1936. Pp. 90. (Dar es Salaam. Government Printer.) 3*s* [42

Catalogues, etc.

The Engineer Directory and Buyers Guide, 1938. Pp. 268. (London: *The Engineer*.)

The Jones Miller Small Scale Gas Calorimeter (Circular No. 338) Pp. 2. A New Viscometer suitable for Materials of High Viscosity. (Circular No. 340.) Pp. 2. (London: A. Gallenkamp and Co., Ltd.)

The Eighteenth Century. (Catalogue No. 546) Pp. 92. (London: Bernard Quaritch, Ltd.)

Laboratory Glassware with Standard Interchangeable Ground Glass Joints. (Catalogue No. 107A.) Pp. 28. (London: A. Gallenkamp and Co., Ltd)

The Story of Vitamin B_1. Compiled by Dr. C. R. Addinall. Pp. 56. (Rahway, N J. · Merck and Co., Inc.)

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Interpretation and Exposition of Scientific Research

ONE of the most important tasks of the Department of Scientific and Industrial Research, in the view of the Advisory Council, as indicated in the report of the Department for 1936–37, a summary account of which appears on p. 432, is to organize the conduct of research so as to promote contact with industry. Particular attention is given to this question of contact with industry in a number of the recent reports of the Advisory Council, and one reason for attaching importance to the development of the research association movement is the opportunity it affords for the industrialist to state his problems to the man of science and to determine the order of priority, in terms of their economic importance, of the objectives of particular proposals for research.

The success of the Department in fostering co-operation with an even wider range of industries and interests than is represented by the research associations is well illustrated by the work of the Water Pollution Research Board, the first ten years' work of which is reviewed in some detail in the latest report of the Advisory Council. In spite, however, of all that the Department has done to promote the application of results by industry, British industry still appears to lag behind industry in the United States.

Special attention is directed to this point by the Advisory Council in commenting upon a visit paid last year to Great Britain by a party of some thirty American business men and bankers who came to take stock of the conditions under which research is carried out here, and of the organization adopted to promote the practical application of its results. The visit was organized by the Division of Engineering and Industrial Research of the National Research Council of America, and after spending a fortnight in England the visitors proceeded to France and then to Germany, where they made similar inquiries. In Great Britain, the arrangements for visiting laboratories were made in close co-operation with the Department of Scientific and Industrial Research. The strenuous programme included visits to the Science Museum, the National Physical Laboratory, the Fuel Research Station, the Building Research, the laboratories of four research associations and of five representative industrial corporations as well as to the Cavendish Laboratory, Cambridge.

The tour was arranged primarily for the information of business men and bankers whose chief interest in the laboratories they visited was the utilitarian requirements of commerce and finance. The tour provided a striking object lesson in the keenness of industrial management in the United States to ensure that no opportunity is lost of turning science to the advantage of its business, and in commenting on the tour the Advisory Council refers to the necessity in Great Britain of giving more attention to the presentation of the progress of industrial research to what are described in the United States as the executives of business. What is here required is the presentation, not so much of scientific data, as of their industrial and financial implications, and in reviewing the various aspects of the publication policy pursued by the Department, the Advisory Council raises again the question of the interpretation of the results of scientific research which has an ever-growing importance.

A first objective in the publication policy of the

Department is, of course, the provision of the full scientific data of the researches carried out so that the technical man can judge of their value for himself and apply them in his own industry. To a large extent, this need is already admirably served by special reports published on behalf of the Department by H.M. Stationery Office, as well as by papers read before the learned and technical societies and by special articles contributed to technical and trade journals. Indeed, many of the reports and papers emanating from the Department set an admirable example of lucidity of exposition which could be followed with advantage by other scientific workers in presenting the results of their work.

Increasing attention is being paid by the technical Press to the activities of the Department, and this not only in itself promotes the dissemination of the reports themselves but also provides one means of presenting the work to the executive leaders of industry. There can be no doubt that in the last few years the interest of the general Press in scientific news has greatly increased, and already in the United States of America Science Service has been developed to render expert assistance to the Press in this field and particularly to overcome some of the difficulties encountered in presenting scientific news in a form which can be understood by the public.

Industrial research has its own special difficulties in this matter. The germ of an industrial advance is usually found in a discovery in the laboratory, but its development and final applications to industry may take a long time. Great caution is accordingly always necessary in the presentation of the initial discoveries before their industrial applications have been explored and tested. Apart from the hampering effect of premature disclosure on technical development, which is often much less serious than is supposed, unfulfilled prophecies are themselves liable to be detrimental to the general application of research. On the other hand, when the necessary reserve and caution are used in announcing the early stages of some new work the result often makes dull reading whether to the business executive or to the man in the street.

For these reasons, the Advisory Council attaches more importance to the fact that the Press is doing its utmost to stress the value of research in national development. It should be obvious, however, that the tasks of presenting results to business executives and also to the ordinary tax-payer, who provides the major part of the Department's expenditure and has every right to be told how the results are of benefit to him and to the nation as a whole, are by no means identical. For both purposes, the results must be expressed in non-technical language, but the content and emphasis required in the exposition are very different.

We have here a problem to which scientific workers, whether in industry or not, might well give more attention. Nor is it a problem for them alone. Fundamentally, it is one of co-operation between the technical or scientific worker and the Press, only to be solved as mutual understanding and respect are established. Although the Press in Great Britain has not moved anything like so far in the utilization of scientific men for the collection and editing of news as in the United States, and generally gives less care and thought to the presentation and accuracy of scientific news than to most other specialized activities, generally speaking it is much more alive than formerly alike to the significance and importance of scientific work and to the difficulties in the way of its accurate exposition or interpretation. In fact the first need to-day is probably for a greater response and willingness to co-operate on the part of the scientific worker himself.

Much is indeed involved in such co-operation. In the first place, there is still far too much jargon and loose expression in scientific or technical papers. It is true, of course, that the scientific investigator is entitled to use the same vocabulary as other workers in the same field when addressing himself to a scientific society, but unfortunately insufficient care is often taken in regard to the introduction of new terms even here. Moreover, many scientific workers are guilty of confused thinking and want of care in arranging their ideas in logical sequence or in expressing them concisely.

Such careless writing places difficulties in the way of the appraisement or evaluation of the work of the scientific investigator by his own colleagues and still more in its interpretation to the non-technical man or general public. The scientific worker has to remember that his work has not fully achieved its purpose until it is understood and can be integrated into the general body of knowledge of the science or industry.

This in turn demands from the scientific worker not only a much greater respect for accurate and lucid writing, and more whole-hearted attempts to see that the careless use of words does not invalidate accurate and painstaking experimental work but also an appreciation of the position and work of the expositor and in particular of the work which the Press is trying to do. High ability in research and felicity of exposition are by no means always linked in the same person, and investigator and expositor have each their place to fill and merit their own reward. The lack of regard of scientific men for some of the ablest expositors in their own ranks is probably one reason why science is not so widely and well served in that respect as is desirable.

If most scientific workers have little desire or capacity to transform the special vocabularies of their subjects into the simpler and not necessarily sensational forms required by the general reader, remembering these things, they should be more grateful for the service rendered to science itself by those who are able to present a scientific subject accurately and attractively in a literary style.

Fundamentally, therefore, this question of publication turns on education, both that of the man of science in the capacity to express himself in terse and lucid English, and that of the general member of the public, whether of the Press or not, so that he has a general scientific background against which to set scientific or technical progress as it is made known. Both aspects are of importance, but it would be a mistake to imagine that the printed word is the only means by which the results of scientific work can be brought before the community.

One such method is seen in exhibitions organized by the Department of Scientific and Industrial Research to show the results of its research. Already a number of such exhibits has been arranged: at the Smoke Abatement Exhibition in the Science Museum, at the Public Health Exhibition in the Royal Agricultural Hall, at the Engineering Exhibition in Greyfriars Hall, Cardiff, at the Building Centre and at the Exhibition of Testing Plant and Apparatus at the Institution of Civil Engineers and at the Engineering and Marine Exhibition. The Advisory Council considers that this activity provides an excellent means of forming contacts between the staff of the Department and those engaged in industry, and assists in making better known the facilities available in the Department for co-operative research and for dealing with special inquiries.

The method is of course already in use by many industrial firms both in connexion with their technical service work and to make known the results and scope of their research, as in that recently organized by Imperial Chemical Industries Ltd., in connexion with the opening of the new research laboratories at Blackley, Manchester. Other examples are to be found in the special exhibits arranged at the Science Museum and elsewhere, and the success they have achieved indicates that exhibits of this type offer a very valuable means of bringing the results of scientific and industrial research before the general community.

In connexion with the preparation for exhibits, the Department of Scientific and Industrial Research has recently begun to make short films dealing with the work. These films have already proved of great value in illustrating lectures given all over the country by officers of the Department and they are in some demand by technical societies. Here again is a medium of education and exposition to which scientific workers might well give more attention, while the series of talks which from time to time have been broadcast under such titles as "What more do you want of the scientist?" or Dr. Julian Huxley's talks on scientific research and social needs indicate yet another medium which science itself has placed at their disposal.

The reference to these matters in the Advisory Council's report is the more welcome because the lack of unity in the profession of science makes it difficult to utilize the opportunities of interpretation and exposition which are in these ways offered to the world of science. The Department indeed is probably in almost a unique position in its capacity and ability to interpret to the world of industry and to the community generally the results of both pure and applied scientific research. Already its publications indicate an attention to the art of exposition and interpretation which are seldom elsewhere paralleled in the scientific world, except in the technical publications issued by the publicity departments of a number of our more progressive industrial firms—publications themselves insufficiently appreciated by scientific workers. With a little more support and co-operation from scientific workers generally it should not be impossible for the Department to explore even more widely the possibilities not only of publications but also of such other media as exhibitions, the film or the broadcast talk in interpreting to the ordinary citizen the significance and meaning of the achievements of scientific and technical research. At least it may be hoped that the latest report of the Advisory Council will again direct the attention of scientific workers to a question which has far too often been neglected or disdained.

Science in Industry

THE twenty-second report of the Department of Scientific and Industrial Research*, which covers the period October 1, 1936–September 30, 1937, includes the report of the Committee of the Privy Council signed by Lord Halifax, and the longer report of the Advisory Council signed by Lord Riverdale, together with a summary of the work of the National Physical Laboratory and other research stations and research boards and brief reports from the various research associations. Both the report of the Advisory Council and of the Committee of the Privy Council pay tribute to the work of Lord Rutherford, whose last act as chairman of the Advisory Council was to shape the report which is now submitted. The present report once more displays the impressive contribution which the work of the Department makes to every aspect of our national life.

The expenditure of the Department in 1936-37 was £830,180 gross or £583,230 net as against £571,831 net in 1935–36. The largest single item of expenditure was £105,589 on the National Physical Laboratory, compared with £109,038 in 1935–36, the gross expenditure of £244,081 covering, however, the cost of work carried out at the laboratories of the Food Investigation Board, the Radio Research Board, the Road Research Board and other research boards of the Department. Against this gross total, receipts amounted to £138,492, of which £67,863 represents fees from industry for paid work. The total receipts from industry for the work of the Department, including contributions to co-operative research, amounted to £106,250, while a further £77,101 was received from other Government Departments for services rendered, £35,035 from the Road Fund and £9,543 from the Empire overseas for food investigation. Expenditure on fuel research was £105,660 gross or £92,809 net, on building and road research £87,957 gross or £32,264 net, on the Chemical Research Laboratory £21,146 net, on forest products research £39,382 net and on the Geological Survey and Museum £68,449. Almost the whole of the expenditure of £10,613 on water pollution research was covered by receipts amounting to £9,215, while £15,928 was received against the gross expenditure of £54,926 on food investigation. Grants to research associations, etc., amounted to £126,510 as against £108,951 in 1935–36 and £85,384 in 1934–35, and the report notes the formation of a new Research Association by the Pottery Manufacturers' Federation, to which the Department has made an annual grant of £5,000.

Special stress is laid in the report of the Advisory Council on the work of the Water Pollution Research Board, which has now completed ten years work and in that time has succeeded to a remarkable extent in bringing about a realization of the community of interest in all concerned and in establishing scientific research as the true servant of all parties. The intensive survey of the River Tees and of the effects of the discharge into it of large quantities of sewage and of industrial effluents has led to the discovery that the true cause of the killing of smelts in the estuary is cyanide in coke-oven effluent. Further, it has been found that this cyanide can be readily converted into the much less toxic ferrocyanide if it is treated with spent pickle liquor and lime. At the same time, the suggestion has been put forward that modified methods for cooling and washing coke-oven gas and the use of any remaining waste waters to quench coke would greatly reduce the quantity of the discharge. This suggestion has already been followed in a large installation of coke ovens recently erected at South Bank on the Tees.

This notable survey, with its demonstration of the possibility of reconciling the community's requirements in regard to pure water supply and the industrial disposal of effluent, has already led to a further investigation of the effect of crude sewage discharge on the navigability of the Mersey, which has just been completed. Successful work has also been carried out on the treatment of effluent from beet-sugar factories and from large dairies, while at the Chemical Research Laboratory the Board has sponsored studies of the softening of water, in which certain synthetic resins have given promising results.

This review of the work on water pollution well illustrates the cumulative effect of such investigations as a body of knowledge is built up which can be readily applied to the solution of allied problems as they arise, and the recent typhoid epidemics at Croydon and elsewhere emphasizes the importance of constant scientific control if a pure water supply is to be secured. So, too, in the field of atmospheric pollution the Department is steadily acquiring scientific data on the extent and distribution of pollution and is making a special survey of the city of Leicester which should ultimately provide the basis for effective action to diminish the toll at present taken of health and general welfare in industrial centres by this cause.

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* Department of Scientific and Industrial Research. Report for the Year 1936–37. (Cmd. 5647.) Pp. iv+195. (London: H.M. Stationery Office, 1938.) 3*s.* net.

Passing from water supply and air to food supply, we find the Department making equally significant contributions. The researches of the Food Investigation Board have ranged, for example, from the study of storage problems such as the value of ultra-violet light in prolonging the storage-life of meat, the effect of the concentration of carbon dioxide in the atmosphere in which eggs are stored, the diminution of 'store-burn' in the storage of poultry, the cold storage of herrings, the gas-storage of pears, strawberries and other fruits, to the chemical composition of wood smoke used in curing fish, the effect of muscular exertion on the chemical composition of muscular tissue and the keeping quality of bacon. Further trials have confirmed that freshly caught white fish can be brine frozen, glazed and stored so that after four to six months the fish is highly palatable, suitable for smoke curing and substantially unchanged. Of special interest are the results obtained from a further scientific expedition to Australia and New Zealand to study the performance of the new 'jacket' system of refrigeration developed at the Ditton Laboratory of the Department. The full data obtained are still being examined, but the new system appears to be working satisfactorily. In the great bulk of a stack of 50,000 cases of apples the temperature was uniform within 0·5° F., and with the new system about 3,000 more cases could be carried than with normal storage.

The bearing of these results on food supply and particularly in view of the increased importance of storage questions should be obvious to all whether in relation to national defence or to the questions of quality or public health. Equally important work is, however, being carried out in this field by a number of research associations. The Research Association of British Flour Millers has succeeded in developing a machine for measuring and recording graphically the baking quality of flours and a full-scale plant has now been erected for improving the baking quality of flour and the crumb quality of the bread by treatment with hot damp air according to the process developed in 1928. Other investigations of the Association have related to the nutritive value of bread and the place of bread in the dietary. The Research Association for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades has investigated the resistance of cacao butter to oxidation changes with the view of avoiding the stale flavours associated with such changes, as well as the mechanism of pectin jelly formation by fruits, and is making a special study of toffee manufacture as well as of the protection of cacao beans, nuts, dried fruits, etc., against storage pests. The Food Manufacturers Research Association has been responsible for investigations on the curing of bacon by a new method, the quality of gelatin used for meat products in glass cases, and the cause of white deposits on fish preserved raw by packing in salt.

Turning from food supply to fuel and lighting we find an equally impressive record of service rendered to daily needs. Besides the physical and chemical survey of the national coal resources and the study of the hydrogenation of coal with its bearing on the more effective utilization of coal whether primarily as fuel, as motor spirit or as lubricating oil, the work of the Fuel Research Board is making such incidental contributions as the study of possible improvements to the domestic grate, particularly from the point of view of smoke reduction and increased efficiency and the preparation of coal for the market including its 'dust-proofing' to eliminate the raising of dust when the coal is handled. In the field of lighting, the work of the Department touches the life of the ordinary citizen at many points both inside his home and out. Besides, for example, the investigations on daylight problems in clerical work and on the relative merits of light of different colours for various visual tasks, or the work of the National Physical Laboratory on the standardization of electric lamps, the work of the Department in this field has had a most important bearing on road safety. A report issued by the Department has shown that the claims made for a coloured headlight beam for motor-cars in place of a white beam cannot be substantiated, while an investigation concerned with the question of the best colour for street lighting has led to the development of a photographic means of reproducing the actual street scene in all the details affecting an observer's ability to pick out objects in the street which appear and disappear on the surface of the lighted street.

The motorist will indeed find much else that is of interest in the work of the Department, for the Road Research Board's investigations cover such problems as that of skidding, the testing of road surfacing materials, the stresses imposed by all kinds of tyres. For the study of skidding an ingenious apparatus has been developed for taking surface texture prints of a road, while another ingenious apparatus the 'wet road clock' has been developed for recording the periods during which a road was wet, in carrying out tests on the durability of a road. At the National Physical Laboratory, the Department is investigating, too, the noise of motor horns with the object of correlating offensiveness with special physical features, and important research on cylinder wear initiated by the Department in co-operation with the Institution of Automobile Engineers is nearing completion, while the Research Association of British Rubber Manufacturers has completed an investigation on the ageing of the inner tubes of motor tyres, in which the accelerated tests of ageing have been correlated with natural ageing.

The work of the Building Research Station makes many important contributions to the comfort of the home, both indirectly in its fundamental studies of the properties of building materials such as cement, asphalt, limes and plasters, bricks, roofing tiles, etc., all of which ultimately lead to the construction of more satisfactory houses and also through its studies on the efficiency of buildings from the point of view of the user. The new heating laboratory has carried out extensive tests with hot water radiators as well as on heat transmission through walls and the thermal conductance of windows and a definite programme of work on ventilation has also been undertaken, while jointly with the National Physical Laboratory the Station has initiated an investigation into the subject of noise in flats. Of equal importance to the householder from this point of view is some of the work of the research associations such as that of the British Non-Ferrous Metals Research Association the investigations of which have thrown much light on the corrosion in hot water installations in which copper circulating pipes and galvanized tanks are used in the same system. Experimental work on underground corrosion of lead water pipes, cable sheaths, etc., has also been initiated by the same Association, while the British Electrical and Allied Industries Research Association is making important contributions to public safety and comfort by its detailed investigations of fire risks associated with electrical plant, the protection of overhead lines against lightning by more efficient earthing and the properties required in overhead line wires, and the means of eliminating transformer noise. Again, the work of the Research Association of British Rubber Manufacturers on rubber floorings has led to the preparation of an appropriate British Standard Specification which should assist the general public to obtain a satisfactory article.

Other work carried out at the Building Research Station such as that concerned with methods of cleaning stonework with water without hard scrubbing, where a very promising process is now being tried, or on the failure of paints, bears directly on the amenities of buildings, and in this field the Research Association of British Paint, Colour and Varnish Manufacturers is also making important contributions often in direct co-operation with the Building Research Station. Conclusions from work on the preservation of iron and steel by means of paint have recently been consolidated in relation to practical needs.

No less interesting, however, is the work of the Department which touches upon questions of clothing, whether indirectly, as in the investigations of the British Cotton Industry Research Association on the sizing of rayon warps or on the spinning and cleaning of cotton or in those of the Wool Industries Research Association on the problems arising out of the treatment of wool to confer resistance to shrinkage which has led to a new process for reducing shrinkage, or directly, as in the studies of the British Launderers' Research Association on the washing of woollens or the fundamental properties of detergents. Mention can here only be made further of the Wool Industries Research Association's investigations on substitutes for olive oil for oiling wool, prompted by the shortage of supplies consequent upon the Spanish Civil War, and on the use of rubber in conjunction with wool; to that of the Linen Industry Research Association on spinning a new type of linen yarn; and to that of the British Boot, Shoe and Allied Trades Research Association on walking research, in which good progress has already been made in what is really a long range research. A number of interesting side issues are also being explored. For example, the importance of flexibility in the work has led to the development of a flexibility meter for measuring the flexibility of shoes and another machine is being developed to put shoes through the motions of walking and give soles the treatment they receive during wear so as to obtain an insight into the best combinations of materials and constructions to give maximum durability. In addition, the question of occupational footwear has come to the front during the year, and the Association is giving attention to the design and specification of boots and shoes for different occupations.

It is impossible to go into greater detail into the ways in which the Department, whether through the Research Associations or its special Research Stations or Boards, ministers to our daily needs. If the ordinary citizen is perhaps most likely to be interested in motoring as a means of transport, other forms of transport are equally served by the Department. Reference has already been made to research on the transport of food in storage by sea. Even more fundamental contributions to the design of all classes of ships are made in the William Froude Laboratory at the National Physical Laboratory, where a record number of ship designs were tested. Of the 1,180,000 tons of merchant shipping the construction of which was commenced in Great Britain in 1936, 78 per cent was based on tests in this Laboratory. Experimental work on the influence of waves on the resistance, propulsion and pitching of ships is already leading to improvements in design of different types of ship, while in the Aerodynamics Department of the National Physical Laboratory not only are new types of aircraft being tested but also important work bearing on the safety of flight has been carried out.

The National Physical Laboratory renders such significant assistance to the work of so many research associations and Government departments, quite apart from its direct scientific assistance to industry that it forms something of a keystone in the structure or organization of the Department. Nor should it be forgotten that much of the less spectacular work, whether in the collection of and dissemination of information, the testing and establishment of standards is of no less importance than work leading to advances or developments which catch the public eye. Indeed, without the foundation of knowledge thus accumulated and the network of services thus established, it is highly improbable that such advances and the important savings to industry and the community which have accrued from the work of the Department would have been achieved to anything like the same extent. The magnitude of these savings can only be illustrated here by reference to one example. The forty to forty-four per cent improvement in efficiency in steam-generating stations in the last two years is attributed largely to the work of the Electrical Industries Research Association, and on the output of units sold in 1935, the higher efficiency represents a saving in coal of more than £7,000,000. Even only ten per cent of this sum exceeds the total annual expenditure of the Association on all its researches, and it is doubtful whether any other expenditure in the national budget brings in anything like the same return as the £600,000 expended by the Department of Scientific and Industrial Research.

Relics of the Mt. Pelé Eruption of May 8, 1902

By Dr. C. T. Trechmann

THE uncouth and sinister-looking volcano of Mt. Pelé (or La Montagne Pelée) occupies the north end of Martinique and rises to about 4,400 ft. The rest of the island consists of lavas, tuffs and limestones which have yielded a fauna of Miocene, probably of Helvetian age. Mt. Pelé had minor eruptions in 1792 and 1852, but began to give warning near the end of April 1902. The great eruption or *nuée ardente* came at 8 p.m. on May 8, 1902. St. Pierre, the one-time capital of the island, with thirty to forty thousand inhabitants, six miles south of the volcano and just within the triangular zone of destruction, was overwhelmed. Further destructive *nuées* occurred during 1902 and 1903, and they were renewed during 1929 and 1930, when avalanches of incandescent stones, some of them as large as haystacks, were projected down to the sea at the Rivière Blanche.

Perret defines a *nuée ardente* as an "avalanche of an exceedingly dense mass of hot, highly gas-charged and constantly gas-emitting fragmental lava, much of it finely divided, extraordinarily mobile, and practically frictionless, because each particle is separated from its neighbours by a cushion of compressed gas."

The well-known spike or spine of hypersthene andesite which was protruded from the summit first appeared about November 3, 1902, but had fallen to pieces by July 1903. It was grooved on one side through squeezing against the sides of the aperture, and reached a height of 900 ft. An eyewitness at Morne Rouge said there were seven luminous points on the volcano's side just before it burst. This seems to indicate that gases were rapidly melting their way through the side of the cone.

These scorched and melted relics have often been attributed in part to the conflagration that burnt up the town after the eruption, but Perret records that bottles were softened and green mangoes converted to charcoal in places where no conflagration occurred. He also records that barefooted negroes entered the town on the afternoon of the day of the eruption, and photographs show quantities of wood and trees in all parts except those nearest the volcano. Reports of the conflagration are probably exaggerated. The sudden rain of intensely hot ashes would probably immediately drive off or distil a great volume of inflammable gas from the large quantities of rum, oil, wood, sugar, coal, etc., stored in the city and this would ignite immediately in contact with the oxygen outside the erupted gases. The only one of the seventeen ships in the bay that got away was the *Roddam*. Part of her cargo consisted of what appears to be china clay; this has been baked to brick and sprinkled with ash, which has combined with the material to form spots of brown melt.

We may safely conclude, therefore, that it was the direct action of the *nuée* that brought about the curious effects shown by these relics; as it certainly was the cause of the instantaneous death of all the inhabitants—with the possible exception of one survivor in the prison. On a shelf above the entrance of the prison cell, which faces away from the volcano, I found two completely carbonized ship's biscuits. If the prisoner had been equally well baked, there could not have been much life left in him. By some, he is regarded as a negro who had gone in to loot, and got badly burned, and when found made up the story for the benefit of newspaper reporters. It seems likely that no human being in the city survived. One does not like to spoil a good story, but the truth will never be known.

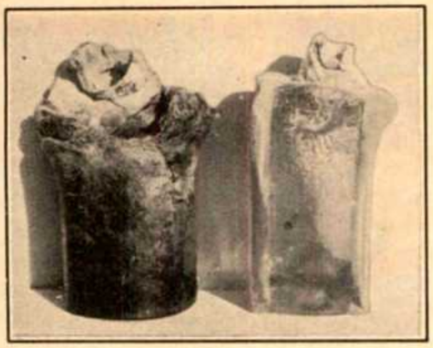


Fig. 1.

BOTTLES PARTLY COLLAPSED AND CONVERTED INTO PSEUDO-WOLLASTONITE. THAT ON THE LEFT HAD CARBONIZED LIQUID IN IT.

It is generally agreed that the erupted gases consisted mainly of superheated steam. Sapper says that hydrogen sulphide and sulphur dioxide were present, with only slight amounts of carbon dioxide and monoxide, but the actual composition and temperature of large-scale eruptions is very difficult to ascertain; 1000° C. may be a good moderate estimate. Bottle glass begins to soften at 670–700° C. Perret has estimated the internal temperature of the crater at not less than 1200° C. The fusion zone in a cement rotary kiln, a bright red heat, is about 1450°–1550° C., and the gases that reached St. Pierre were certainly less than this, but the action so far from the crater seems to have been that of shooting tongues of flame rather than a homogeneous blast. Many objects were not melted or only melted in one part.

Most glass objects are struck and collapsed on one side; lamp shades or bottle necks have been crumpled up while the ash was falling through, and it has been imprisoned in the folds. A bottle tends to split open, but immediately afterwards the ends of the crack are healed up again and the sharp edges are rounded. Ordinary bottle glass is frequently coated with a layer on both sides of fibrous pseudo-wollastonite, beneath which the surface of the glass shows a crackled perlitic-like structure. One can see where the impact of each grain giving off gas has started the devitrification. Bottles that have lain in the hot ashes are reduced to a boiled-up mass of the wollastonite-like material with wisps of unaltered glass here and there (Fig. 1).

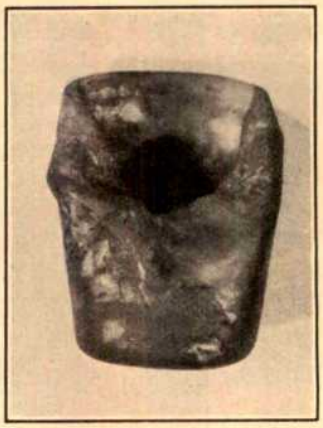


Fig. 2.

A SMALL CUT-GLASS LIQUEUR GLASS. THE EDGES AROUND THE COLLAPSED PART SHOW THE TEKTITE-LIKE GROOVES AND PITTINGS.

Heavy brilliant glass objects such as decanter stoppers, knife rests, etc., are often coated with a dull leaden coloured film which Dr. J. A. Smythe has determined as probably silicates of iron, lead, and copper. Blue copper-silicate glass receives a coating of dark red colour, cuprite or copper oxide among which minute glistening crystals of metallic copper can be seen with a lens.

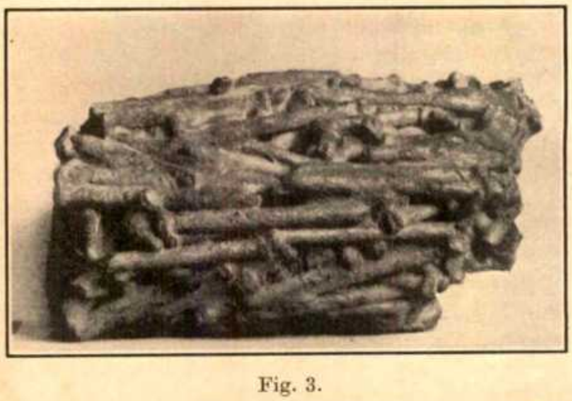


Fig. 3.

A BOX OR BAG OF NAILS CONVERTED TO MAGNETIC OXIDE OF IRON.

Some of these heavy or flint glass objects are eroded with pits or channels or burst bubbles of a very smooth or polished nature suggestive of the structure one sees on tektites or moldavites

(Fig. 2). A decanter stopper completely covered with this darkened film has the knob drawn out sideways and carries grooves resembling those one sees on some meteorites.

Smaller iron objects, nails, wire, locks, etc., are converted to crystalline magnetic oxide, sometimes with a core of metal left (Fig. 3). It seems to be galvanized objects that were most easily oxidized, and around the nails the layer of oxide is sometimes arranged in a spiral form as if the gases had whirled round and completed the oxidation instantaneously. Coins are fused together or become saucer-shaped or are partly melted into blobs or have swollen up, obliterating the design on them; some have a malachite-like coating resembling the patina on ancient coins. A gold Portuguese coin in the St. Pierre museum is merely distorted; gold melts at about 1075° C.

Organic material—biscuits, macaroni, coffee, wafers for religious purposes, etc.—are, when struck by the *nuée*, changed to glistening porous charcoal with little or no loss of outward shape. I have a bottle the upper part of which has been collapsed and 'wollastonitized', but when it was broken open the one-time liquid, which may have been oil, was found to be extremely porous charcoal, but the upper surface was level and intact.

In the St. Pierre Volcano Museum are bottles of perfume with the liquid sealed in them by the sudden impact of the gases. I have a glass door handle which has run like wax, but the part inserted in a silver frame that has been attached to the door is unmelted.

One can still find quantities of human bones in some of the old houses, and these are partly scorched black or partly remain white, indicating the incomplete scorching of the bodies as one sees in photographs. Instead of being burnt off, the flesh and skin seem to have been scorched on to the bones, a sort of mummification process. Hair and clothing are mostly unconsumed; and a box of matches that had not been ignited was found on or near one of these bodies.

These terrible gases, the negation of everything living, were pursuing their natural function of endeavouring to convert everything in their way into igneous material, but their effect must have lasted only a very few minutes.

The effect of such potent gases underground in altering the composition of rocks would bear further inquiry. In Jamaica, in a sea-cliff section below the Lazaretto near Kingston, the Tertiary white limestone has been altered in a peculiar manner. Quite independently of the bedding, the rock grades down into a layer of yellow dolomite, this is succeeded below by a layer 1–2 ft. thick of dense marble, while below this is a dome-like mass of dark splintery material which one can only term hornfels; associated with this or embedded in it are masses of a quartz porphyry. It would seem that gases at a high temperature had come up from below and melted their way into the white limestone. (*Geol. Mag.*, p. 261, June 1936.)

An Historic Mantelpiece at the Royal Institution

By Thomas Martin, General Secretary of the Royal Institution

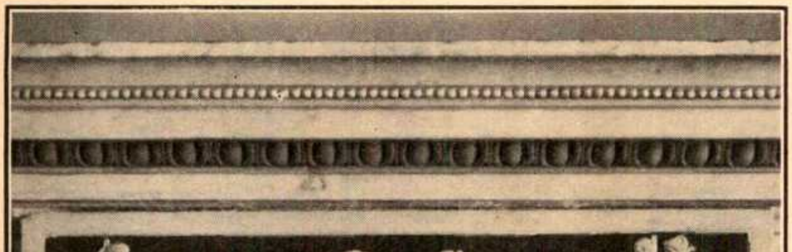
A FINE mantelpiece in the Adam style, an attractive example of the work of the late eighteenth century, has recently been acquired by, and erected in, the Library of the Royal Institution. It comes from the house of the botanist, Sir Joseph Banks, at 32 Soho Square, London, now unfortunately demolished, in which the Institution was founded. It is thus an object of historic interest in its new home. Moreover the recent vicissitudes of the mantelpiece, particularly of the central Wedgwood panel which forms its principal ornament, are not without interest.

When in 1771, Joseph Banks returned to England after his voyage to the South Seas with Captain Cook in the *Endeavour*, he found himself considerably 'lionized'. He, and his scientific associate, the Swedish botanist, Dr. Daniel Solander, were greatly in demand for the tale of wonders they had to tell. They had brought back a magnificent collection of new and strange species of plants and animals from the antipodes and much valuable information as to the natural resources and native races of the lands they had visited. The full story of their adventures may be read in Banks's "Journal"[1] and in Captain Cook's own "Journal" of the voyage[2].

The voyage of the *Endeavour*, which showed Cook to be the first navigator, no less established Banks as the first naturalist of his age. He had contributed liberally, from the fortune he had inherited, to the scientific expenses of the voyage; and he now became a public figure. In 1778, at the early age of thirty-five years, he was elected president of the Royal Society. In the following year he married, and in 1781 was created a baronet.

He needed a town house which would be convenient for his scientific activities and in which his valuable collections and scientific library, with Solander as their curator, could be installed ; and took No. 32 in the south-east corner of Soho Square. The design of this house has been attributed to Robert Adam. Probably the Adam brothers reconstructed it for Banks and added the façade ; but that it was their work has not been definitely established.

The home of Sir Joseph and Lady Banks speedily became a meeting-place for men of science and affairs in London. Her hospitality and his authority brought to their regular gatherings many of the most distinguished men of the day. At one period, according to Sir Henry Holland, who was later president of the Royal Institution, Cavendish, Wollaston, Davies Gilbert, Sir Humphry Davy, Thomas Young and Sir William Herschel frequented their rooms. Even John Dalton, in his Quaker dress, was seen there occasionally[3]. Committees met at the house. No doubt it was due to Banks's infirmity—for he was a martyr to gout, and in his later years could move about only in a wheeled chair—that even meetings on the business of the Royal Society were occasionally held at the President's home.



CENTRAL PANEL IN THE BANKS MANTELPIECE AT THE ROYAL INSTITUTION

The first meeting of Proprietors of the Royal Institution—those who had responded with a subscription of fifty guineas each to the appeal drawn up by Count Rumford and communicated to the public by the Society for Bettering the Condition and Increasing the Comforts of the Poor—was held under Sir Joseph Banks's chairmanship, in his house, on March 7, 1799. It was by the resolutions taken at this meeting that the Institution Rumford had conceived may be said to have been actually formed. Subsequent meetings of the Managers of the new body were held at 32 Soho Square, until the house in Albemarle Street was occupied.

Sir Joseph Banks had had his house specially arranged for the purposes of his scientific meetings and entertaining, as well as for accommodating his collections. In particular, on the first floor, he had constructed a large and lofty room, magnificently decorated, known as the 'council chamber'. The domed ceiling of this room was a triumph of design and the most beautiful decorative feature of the house. On the same floor was another smaller room, the drawing-room.

When, before the demolition of the house in 1937 (see NATURE, **139**, 280 ; 1937), the decorative fittings it still contained were sold by auction, the mantelpieces from the council chamber and the drawing-room were, by the generosity of Sir Robert Hadfield, purchased and presented, the former to the Royal Institution, the latter to the Royal Society.

The mantelpiece from the council chamber was found to have, as its central ornament, a white marble panel of a reclining nymph. It happens that *Country Life* had published, on September 27, 1913, a description of 32 Soho Square as it then was, including a photograph and description of this mantelpiece. The central panel was of different design, described as "a Wedgwood in green and white". It was obvious that the original had been removed and replaced by another.

It was disappointing to find that the mantelpiece was not now as it had been in Banks's lifetime, and efforts were made, without much hope of success, to trace the original panel. It was found, on inquiry, that in 1914, when the house was empty for a period, thieves broke in and stole the Wedgwood panel. They also loosened the whole mantelpiece preparatory to removing it on the following night, but were prevented, and left it undamaged.

Failing the original, it was hoped to obtain a replica of the panel. The help of Dr. John Thomas, of Stoke-on-Trent, who has made a study of the early Wedgwood designs, was solicited and generously given. Thanks to the willing co-operation of the directors of Josiah Wedgwood and Sons, Ltd., Dr. Thomas, who devoted much time and skill to the problem, was completely successful in tracing the history of the panel. He was provided with an enlargement from the *Country Life* photograph, and concluded, from a comparison of this with other designs, that the panel, which was of a 'sacrifice' type popular in the eighteenth century, was most probably made to the special order of Sir Joseph Banks by Josiah Wedgwood. It was a composite design of white jasper figures against a green, instead of the more common blue, background, composed of six separate groups worked up into one theme or ensemble representing a sacrifice to Flora. For each of the groups, consisting of vestal figures carrying offerings, and Bacchanalian boys, a separate mould had been used, and the six, when assembled, composed a tablet about 1 ft. 9 in. wide and 7½ in. high. The design may be taken to symbolize Banks's interest in flowers and his pursuits as a botanist.

Dr. Thomas crowned his success by discovering, after a search in the dusty mould rooms of Messrs. Josiah Wedgwood and Sons, the actual moulds which had been used for the tablet. From these, the firm undertook to prepare new working moulds and attempt the manufacture of a replica.

All hope of recovering the original had been abandoned, and the order for the replica had actually been given, when information was received from a firm of dealers in London, of whom inquiry had previously been made, of a panel which had come into their possession, which they believed to be the missing one. It was taken to the Royal Institution and closely compared with the photograph. It corresponded in every detail. It must be either the original or a duplicate made at the same time. It was compared for shape and size with the recess left in the stonework of the mantelpiece to receive it. It fitted exactly. There could be no reasonable doubt that it was the original.

Thus the panel, a beautiful original specimen of Josiah Wedgwood's art and in excellent preservation, as the accompanying figure shows, is restored to its rightful position after a lapse of twenty-four years, and the mantelpiece, complete as it stood in Sir Joseph Banks's council chamber on the day the Royal Institution was founded, finds a new and appropriate setting in the Institution's house in Albemarle Street.

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[1] "Journal of the Right Hon. Sir Joseph Banks". Edited by Sir Joseph D. Hooker. London: Macmillan, 1896.

[2] "Captain Cook's Journal during his First Voyage round the World". Edited by W. J. L. Wharton. London, 1893.

[3] "Recollections of Past Life". By Sir Henry Holland. London, 1872. Pp. 212–216.

Obituary Notice

Dr. C. Lallemand

Dr. Charles Lallemand died on February 1 at his country house in Bussy par Joinville (Haute-Marne), after a long and painful illness, in his eighty-first year. Few men of science of modern times have left a wider international reputation behind them, and fewer still so clear and definite a personal impression.

Lallemand was early in showing his marked ability. At seventeen years of age he was admitted to the Ecole polytechnique, from which he was posted to the Corps des Mines, and passed out first among his contemporaries. It is remarkable that he should have started at once on his final career, and should have done so as chief of his own department. He was immediately appointed secretary to the inter-departmental committee then sitting to discuss the formation, and terms of reference, of a department to undertake the first-order levelling of France. The circumstances of that time may be briefly recalled.

France had then no national levelling department, nor was the Service Géographique de l'Armée (responsible for the triangulation) charged with its execution. Twenty years after Prof. Whewell's levelling from the English to the Bristol Channels, and only two years before the Ordnance Survey was to complete the first-order levelling of Great Britain, the French Ministry of Public Works appointed that eminent geodesist, Bourdaloué, to level the main roads and canals of France (1857). His network of 15,000 kilometres was finished in 1864, but he left behind him no permanent arrangements for extension or upkeep. In 1878 an ambitious project of public works called for levelling much more general in extent, of a higher precision, and so continuous in policy and maintenance as to necessitate a responsible and permanent department.

The inter-departmental committee, of which mention has been made, was formed, sat for six years, and reported in 1884. As a consequence, the Service du Nivellement was inaugurated, and Lallemand, who had won the confidence and esteem of all his colleagues, was made director at the age of twenty-seven years. Much of the preliminary work he had already done. He had outlined, in detail, the methods to be followed, and the routine of computation. On his appointment as director, his first duty was to modernize, and indeed practically to re-design, French geodetic levelling instruments and staves. He perfected and introduced many semigraphic solutions for the computation of corrections of the minor orders, and his formulæ for the classification (in precision) of levelling nets were adopted (internationally) in 1912. His administrative and executive measures were as successful as his technical. The programme, as originally outlined, was to last for ten years and to include some 800,000 kilometres of circuits. There have, however, been many financial difficulties, and Lallemand has not lived to see its completion. Some idea of the precision of his first order may be gained from the final misclosure of 50 centimetres in his 4,000-kilometre circuit of France (1/8 M.). It is claimed for his administration that it reduced errors to a third of those prevalent in Bourdaloué's net, whilst it greatly reduced expense.

In 1898, Lallemand was called upon to reorganize the cadastral survey of France. The old communal system, originally introduced by Napoleon, rested merely upon chained triangles. The 1/2500 *parcellaires*, or property plans, had more in common with our tithe surveys than with the reliable Ordnance plans, and it fell to Lallemand to introduce a dependence on the triangulation of the Service Geographique, to advocate contouring, and generally to modernize a none too efficient regime.

It was a bitter disappointment to Lallemand, and a serious loss to France, when credits were cut off, and the cadastral survey was allowed to fall back into decay in 1907.

In 1910, Lallemand was elected a member of the Academy of Sciences, and in 1917 a member of the Bureau des Longitudes. Of both these bodies he was eventually to become president. In 1914, it may be said that Lallemand was as unquestionably the authority on levelling as was Helmert in geodesy generally.

In 1919, therefore, Lallemand, collaborating with the founders of the International Research Council, brought with him the reputation of first-class geodetic ability combined with proved administrative success. He was chosen, unanimously, president of the International Union of Geodesy and Geophysics, and it is in that connexion that he is best known in international circles to-day. He retained that position for fourteen years, and his great personal and scientific abilities made him a magnificent success. He was an astonishing linguist. At Rome, Madrid, Prague, Stockholm and Lisbon his presidential addresses were given largely in the languages of the countries concerned. As one would expect from so strong and able a man, he had his differences with his colleagues. Yet none who may have differed from him in detail would fail to pay the warmest tribute to the dignity, charm, scientific eminence and administrative ability which he put, whole-heartedly, at the service of international science. The Union of Geodesy and Geophysics, cherishing his memory with affection and admiration, knows that it owes to him much of its present position.

H. St. J. L. W.

News and Views

The Scientific Delegation to India

THE Council of the British Association has forwarded the following resolution to the Indian Science Congress Association and to Government authorities, institutions and individuals who helped to make possible the recent visit of the Scientific Delegation to India: "The Council of the British Association have learned with gratification of the complete success that attended the visit of the Scientific Delegation to India, the members of which through the invitation of the Indian Science Congress Association, were enabled to co-operate in its Jubilee Meeting in Calcutta, to visit many places of scientific and historical interest in India, to become acquainted with the work of many universities and other institutions, and to make or renew personal contacts with large numbers of Indian scientific workers and leaders of thought. The Council are glad to hear of the opinion, widely expressed in India, that much good would result from the visit, and this belief the Council heartily reciprocate. The Council desire to endorse the expressions of gratitude which have already been transmitted on behalf of the Delegation, to the Government of India, to all other participant authorities and individuals, and very specially to the executive of the Indian Science Congress Association."

Rearmament and Research: Comparative Costs

IN a White Paper issued in February 1937, it was estimated that Great Britain's total expenditure on defence during the five financial years 1937–41 would be £1,500,000,000; the estimate for 1937 was £278,250,000. According to the "Statement Relating to Defence" issued by the Government last week, the estimate for the present year is £343,250,000, and £8,500,000 is provided for air raid precautions services alone. Further, it is stated that the expenditure in 1939 is likely to be even greater, and that the total cost of the five years' rearmament will probably exceed the original estimate made in 1937. The Statement gives in general terms an outline of the ways in which the money is being spent and of the progress of the rearmament schemes on which Great Britain has embarked. This document will be read with mixed feelings, among them being dismay that the international situation should, in the opinion of responsible men, require the expenditure of such vast sums on armaments and defence. One cannot help contrasting this enormous outlay with the amount spent annually on scientific research, any item of which may eventually prove of outstanding worth. Elsewhere in this issue (p. 432) is an article on the work done during 1936–37 through the Department of Scientific and Industrial Research, based on its latest report. From the report, it will be seen that, for the very modest expenditure of £600,000 during the year, investigations on food, clothing, housing, transport, etc., have produced results of general value to the health, happiness and economic well-being of man. It is a sad commentary on the state of civilization that, as a result of national animosities, the Government of a leading State and world power should spend in one year some five hundred times as much on armaments and defence as on potentially productive scientific investigations.

Marble Mantelpieces from Banks's House

BESIDES being for thirty-six years (1821–1857), the home of the Linnean Society, No. 32 Soho Square, London, which was demolished in 1937 (NATURE, 139, 280; 1937) was historically connected with both the Royal Society and the Royal Institution. From 1777 until his death in 1820, it was the town house of Sir Joseph Banks. Traditionally, Council meetings of the Royal Society were held there, and although this has not been confirmed, there can be no doubt that, during Sir Joseph Banks's long presidency, meetings on the business of the Society were held at the President's home. The Royal Institution was founded there at a meeting held under Sir Joseph's chairmanship in March 1799. Before it was demolished, the decorative fittings of the house were sold by auction. Two marble mantelpieces were purchased at the sale and presented by Sir Robert Hadfield, one to the Royal Society and the other to the Royal Institution. That given to the Royal Society is to be placed in the Officers' Room of the Society's apartments in Burlington House in due course. The other, it was reported to the members of the Royal Institution at the General Monthly Meeting on March 7, has now been re-erected in the Library of the Institution. An account of No. 32 Soho Square, and of the mantelpiece at the Royal Institution, which has had a most interesting history, is given on p. 437 of this issue.

The Milk Problem in Great Britain

LIEUT.-COLONEL C. WALEY COHEN, in an article in the February issue of the *Nineteenth Century and After*, surveys and discusses the problem of the milk supply in Great Britain. He points out that the milk supply of England and Wales has been reviewed by no fewer than five Royal Commissions and Committees during the last twenty years, and has been the subject of several departmental orders and of legislation during the same period. All this has rendered the farmers nervous and the public bewildered, with the result that the consumption of liquid milk in Great Britain is low, and the price high, as compared with some other countries. A change has also taken place in the method of distribution and supply, for prior to 1900 supply of liquid milk to the consumer was mainly direct, by 1923 producer-retailers supplied only 40 per cent, and to-day only 20 per cent, of the total requirements, the remainder being bulked, often conveyed long distances, and then distributed. Bulking of liquid milk is the key to many of the difficulties surrounding the milk supply: it gives rise to the major problem of milk-borne diseases, and was the proximate cause of the necessity for, and creation of, the Milk Marketing Board. The Great War also created an impetus to the importation of cream, butter, cheese and other milk products from the Dominions and foreign countries.

BULKING of milk largely increases the danger from milk-borne diseases, for a small addition of infected milk will infect the whole of the milk to which it has been added, amounting, perhaps, to 2,000 gallons or more. This, together with the time that elapses between the milk leaving the producer and reaching the consumer, renders some form of heat treatment necessary. In the case of bulked milks, efficient pasteurization is therefore desirable, and a scientific system of pasteurization should be enforced. The risk of milk-borne disease in rural, and in less congested urban, areas is low, as bulking is rare. Efficient pasteurization in small urban, and in rural, areas is expensive, and would deprive these areas of the reduction of 4*d*.–6*d*. per gallon in retail milk price which they now enjoy. The grading of milk, and the accredited scheme, receive some criticism. Colonel Cohen desires the establishment of some better 'concordia' on the medical side between experts, practitioners, medical officers of health, bacteriologists and veterinarians; on the commercial side between producers, distributors and manufacturers; and generally between all these and administrative officials. Nothing should be done to restrict or discourage the production of milk in Great Britain, for the industry is outstanding in the agricultural economy of the country, and the income from milk and dairy produce forms no less than 28 per cent of the nation's agricultural income. Finally, it is suggested that there is much scope for the establishment of a permanent Milk Commission, with a real administrative competence.

Films and Folk-Lore

IT is remarkable that little use has been made in Great Britain of the cinematograph for recording systematically the survivals, now rapidly diminishing in number, of customs and festivals formerly observed among the people. British anthropologists were not slow to appreciate the possibilities of the cinematograph in field work: and more than thirty years ago the Daniels-Seligman anthropological expedition to New Guinea secured some striking records, as also did the late Sir Baldwin Spencer in the Northern Territory of Australia in an illuminating series of films of native ceremonial dances shown in London in 1914. In the home-field, however, notwithstanding more favourable conditions, this potential auxiliary of scientific study of folk-custom has been sadly neglected, although the commercial film has shown appreciation of the spectacular value of brief episodes of folk-dance and ceremonial for the news-reel. Familiar as these were, the value to the student of the film taken for purposes of scientific record only, and not as part of a public performance, was brought out by some of the Continental films, especially the instrumental films, shown at the International Folk-Dance Festival in London in 1935, which came as something of a revelation. It is satisfactory to note, therefore, that an attempt is to be made to remedy the deficiency in the equipment of folk-lore studies in Great Britain by an endeavour to secure a record of folk survivals, which will include not only folk-dances and folk-customs, but also folk-crafts, which are in danger of extinction. The proposal, it is announced in a communication to *The Times* of March 7, is put forward on behalf of the Folklore Society, the English Folk-Dance and Song Society and the National Film Library. Sound films, it is also suggested, might be made of such activities as the almost extinct art of hand-bell ringing and of folk-dances *in situ*. The expense of carrying out such a scheme obviously will be considerable, and it is hoped that private benefaction will be forthcoming. In view, however, of the scientific and historical interest of local custom, whether ceremonial or industrial, the local museum, especially where an attempt is made to illustrate local antiquity and history at all adequately, might regard a subsidy in aid of a local film as a legitimate charge on its financial resources.

The New Commonwealth

THE eighth in the series of broadcast talks on "The Way of Peace" was given on March 3 by Lord Davies, who spoke on the New Commonwealth. This is, he said, a voluntary, international society, composed of members living in forty-six different countries, who have banded themselves together in order to enlist the support of public opinion for the establishment of two institutions—an equity tribunal or commission, and an international police force—as part of the permanent machinery of the League of Nations. No Government could carry on for a single week unless it possessed institutions capable of effecting changes in its laws, and the means of upholding them. How then can we expect the League to inaugurate the rule of law if its members refuse to give it those institutions essential for carrying out the responsibilities they have entrusted to it ? War can only be prevented by establishing international law and order on the same principles, and by the same methods, which have been successfully applied in the development of every civilized community. Lord Davies then dealt briefly with the two institutions in the New Commonwealth programme. The task of the equity tribunal would be to deal with any disputes which the League Council fail to settle by the existing procedure of negotiation and conciliation. The aim of the second point of the New Commonwealth programme, said Lord Davies, is the substitution of co-operative for competitive armaments. This can best be done by means of a police force under the control of the international authority. Only in this way, he considers, can the rule of law be established and the downfall of Western civilization averted.

Gliding and Soaring Flight

AT the Friday evening discourse at the Royal Institution on March 4, Prof. D. Brunt discussed "Gliding and Soaring Flight". As the modern sailplane has a sinking speed in still air of 2–3 ft. per second, it will soar in an ascending current which rises faster than this modest limit. Three types of ascending currents occur in the atmosphere. Where the wind blows against the slope of a hill, it follows the contour of the ground, and if the air rises faster than the sinking speed of the sailplane, the latter can soar over the hill slope. Such a flight of 9 hours 48 minutes was carried out at the international competitions in Germany last summer, by Messrs. Fox and Murray in a Falcon III two-seater. When the air near the ground is heated until the rate of fall of temperature with height exceeds 5·6° F. per 1,000 ft., the air becomes unstable, and currents of warm air rise, and, if damp, give rise to clouds. Under the cumulus clouds then formed, the sailplane can mount in the rising air. When the wind increases with height the clouds are in long rolls, which have ascending air under their whole length, and in this air the sailplane can soar along the whole length of the cloud. In the rear of a depression, at the cold front, where the cold air pushes under warm air and forces it to rise, the rate of ascent of the warm air is often sufficient to enable a sailplane to soar. The British record for distance of soaring flight is 104 miles and was set up by Mr. Philip Wills. The world's record for distance, 405 miles, was set up by a Russian pilot in May, 1937.

Asymmetric Sideband Broadcasting

MR. P. P. ECKERSLEY in a paper read to the Institution of Electrical Engineers on March 2 said that the present methods of working permit few, except local radio broadcasting stations to be received without interference from other transmitters operating in contiguous frequency channels, unless the upper frequencies of modulation of the wanted station are severely attenuated. In this case the reproduction lacks intelligibility and naturalness. This can be mitigated without introducing audible harmonic distortion by utilizing the asymmetric sideband system of transmission to cut away with the aid of electrical filter circuits part of one sideband of the frequency spectrum radiated. In a previous paper, the author has shown how 'asymmetry', either of phase or of magnitude, between two sideband components is related to harmonic distortion. It is proportional to depth of modulation. He proved that as the sideband frequency becomes more and more removed from the carrier frequency, it may be more and more attenuated while the distortion can be made to remain constant and small. The author suggests that it is better to face the occasional minute deteriorations in quality given by the asymmetric system than to suffer from the continuous hissing and splitting sounds brought about by existing inter-station interference. The public insists that the radio-set exists to give pleasure. The attention that a user gives to a programme is determined partly by the quality of reproduction, but probably more by the freedom it enjoys from interference from extraneous sounds. It is primarily programme interest which pleases, but interference is very objectionable however good the programme. The author acknowledges his thanks to the B.B.C. for providing the funds for the construction of test apparatus. He also thanks the Countess von Zeppelin for her mathematical investigation, given in an appendix, resulting in a most useful expression for the distortion component.

Reclamation of Tidal Lands

IN a lecture delivered before the Royal Society of Arts on February 23, Mr. Oscar Borer described the process of land reclamation work as applied to the coastal frontages on both sides of the North Sea, tracing the origin of such operations to the time of the Romans under whose direction a bank was constructed across the Wash at some date prior to A.D. 359, and when other embankments were made between Lincoln and Norwich, aggregating not less than 50 miles in length and having a height of 10 feet. After the cessation of the Roman occupation, very little additional protection seems to have been undertaken along the British coastline until the seventeenth century, when during the reign of James I and afterwards, large tracts of marshlands, amounting to 35,000 acres, were excluded from tidal influence. During the eighteenth and nineteenth centuries, other areas approximating to 10,000 acres were reclaimed. Of the total quantity enclosed since Roman times, 8,000 acres was marshland in Norfolk along a frontage of ten miles, and 37,000 acres in the South Holland district of Lincolnshire with a frontage of nineteen miles, the remainder being in the North Holland district. In the Netherlands, from Roman times until the beginning of the fifteenth century, extensive areas were lost to cultivation through floods, the surface level of the land having sunk so that it was easily invaded. Early dikes made to offer defence against the sea broke down, and in this way the Dollart was formed in the twelfth or thirteenth century. The Zuider Zee, which had once been largely dry land, was inundated about the same time. The largest 'polder' recently reclaimed in this area is the Wieringermeer, in the north-west corner. It has an area of 48,000 acres and was dried in 1930. A second enclosure in the north-east corner was started in 1936, and it is expected that in due course another 110,000 acres will be available for agriculture. On the German North Sea coast, 8,000 acres has been embanked since 1900 in the province of Schleswig-Holstein.

The Disappearing Fauna of Africa

THE problem of the disappearing fauna of Africa formed the subject of a lecture before the University of London Animal Welfare Society on March 7. It has been common knowledge for years that the status of many of the big African animals was precarious. The last quagga died in 1882, and the three big pachyderms have been killed off at an alarming rate. Not only are the indigenous beasts being wiped out under the 'protecting' eye of a white civilization, but also the majority of many species are dying unnecessarily cruel deaths at the hands of the African native, working with old-fashioned guns and pitfalls and traps. Possibly only a few thousand gorillas remain alive to-day, in the Cameroons, where they are exploited by man, and in the Parc National Albert, where they are protected by the Belgian Government. The elephant has disappeared from most of its old haunts. In the three British dependencies a minimum of 6,000 a year are killed, chiefly in the 'control campaign'. Tanganyika and the lake swamps are the last haunts of the hippopotamus, and unless help is forthcoming this will eventually disappear. On November 8, 1933, the London Convention for the Protection of the African Fauna and Flora was signed. The first of a series of subsequent international conferences should have taken place before November 1937. No conference has been held, the reason given being that the British Government intends to summon a conference on tropical Asia and the western Pacific, certain of the experts interested in those regions being also interested in Africa. At the meeting, the Society passed a resolution calling upon the Government to take urgent steps for summoning the London Convention for the Protection of the African Fauna promised for November 1937.

Locust Outbreaks in Africa and Western Asia

THE recent report of the Committee on Locust Control is the sixth of its kind which deals with locust outbreaks in the regions mentioned. In the present instance it covers the year 1936 and the early part of 1937, and has been prepared by Dr. B. P. Uvarov and Miss W. Milnthorpe. The report is a survey of the conditions in the territory named and is based upon the accumulated data which has come to hand as the result of international organization. It appears that the general situation, in so far as the African migratory locust and the red locust are concerned, is steadily improving. Particular stress, however, is laid on the beginning of a new outbreak of the desert locust which has been definitely proved to be forming in the Sudanese-Arabian area. It has been due to the regular system which is operating for the recording and collection of all data relating to locusts, and its centralization in a single institution (the Imperial Institute of Entomology), that the first signs of this outbreak have been recognized and warnings issued to all countries likely to be affected by the locust in question. The concerted measures which are being undertaken in order to endeavour to fathom the causes of locust outbreaks merit every support. The elaborate organization which has been built up and got into working order at the prime instigation of Dr. Uvarov provides the only sound method of attack—mere remedial measures are temporary palliatives and leave the locust menace unimpaired. At the present stage of the work, no effort should be relaxed, and it is up to the countries directly interested to see that the necessary funds are maintained. The report is available, price 3*s*. net, and is published by H.M. Stationery Office.

Chronica Botanica

THE first re-organized number of *Chronica Botanica* (4, No. 1, February 1938. *Chronica Botanica* Co., P.O. Box 8, Leyden) has recently been issued. This international journal, which deals with all branches of botany, horticulture, agronomy and silviculture, is now bimonthly, and the annual subscription has been reduced from fifteen to seven guilders. Most of the contributions are in English. The present number opens with a short account of the new Association for the Study of Systematics in Relation to General Biology (see also NATURE, 140, 163; 1937) by W. B. Turrill. Sixteen pages are devoted to correspondence and eleven pages to discussions. Notes from contributions of botanical interest to other journals occupy five pages. The reports of recent international congresses and announcements of forthcoming congresses are full and informative. Of outstanding interest is the section of news of more general interest from botanical and related institutes throughout the world. In fact, this section is, so far as we know, unique, and should prove of inestimable value to botanists, especially those engaged in research. The obituary announcements and notices are very full, and several portraits are included. Similarly, recent appointments and resignations are announced. This journal has achieved a world-wide reputation in a very short time. For this, the editor (Dr. F. Verdoorn) is to be congratulated; but it is well deserved. He and his advisory editors must be indefatigable in their efforts to glean botanical information from all parts of the world, resulting in a journal of plant science which all interested in plants will find of absorbing interest and great utility.

The *Tree Lover*

THE editorial in the *Tree Lover* (vol. 2, No. 21; 1937) deals with several points in connexion with trees and forestry principles in the opening words "More and more do Trees become 'news' and the claims of forestry find mention in the Press". This is a position which NATURE realized more than a decade ago and has since kept in close touch with this important subject with the object of educating a public who had completely lost all 'forest sense'. The editor perforce alludes to the appalling dust bowls in process of creation in the United States and Canada. But he is equally concerned over the threatened final demolition of Milton's Elm, 500 years in age, at Chalfont St. Giles, the remaining 12-foot stump being in danger owing to the expressed intention of widening the road. As the editor states, "The crisis of Milton's Elm is typical of what is happening all over the Country. One can only hope that ere long there will be a reaction from the ruthless cult of speed". He mentions the several bodies who are taking up the campaign against the increasing vandalism of the builder and road-maker. This autumn quarterly number deals with such matters as Gloucestershire woodlands, Whiligh and its trees, evolution of the moor, and the Royal Gardens of Sandringham and Windsor.

Medical Research in South Africa

THE annual report for 1936 of the South African Institute for Medical Research, Johannesburg, of which Sir Spencer Lister is director, gives an account of the routine and research work pursued there. The bacteriology and epidemiology of pneumonia in local mine natives are continuously studied by Dr. Ordman. The use of prophylactic pneumonia vaccine is increasing in the mines, and a number of satisfactory results continue to be recorded. Routine specimens examined for plague infection numbered 144 from human sources and 1,908 from animals, positive results being obtained in 49 human cases and in 5 rodents. Strains of the plague bacillus maintained in the laboratory have been found by Dr. Pirie to undergo a steady diminution in virulence. Much work has been done by Dr. Mavrogordato upon mine dust and its relation to silicosis in miners' lungs, and Mr. Rabson has determined the size of the particles present in the dust. Ninety per cent of the mass of dust is found to consist of particles of 4µ and less. Malaria research and the prevalence and species of mosquitos in certain districts, the venoms of snakes, and researches on tumour agents, are some of the other subjects that have been investigated.

The Management Library

THE Management Library which was opened to general use by industry in June 1932 has issued a report on progress in the five years ended June 30, 1937. 1,000–1,500 books are now out on loan at a time, or a total of 15,000 volumes in the year, and 1,250 copies of the monthly review are issued to members, subscribers to which come from France, Belgium, Holland, Switzerland, Sweden, Norway, India, Japan and elsewhere. The reviews are now framed to outline the chapter headings, evaluate new contributions to knowledge and to indicate the departments or persons in industry to whom the book is of special value. Although serving various institutions and associations, the Library has no direct affiliation with any other organization. Income from subscriptions has grown from £150 in the first six months to £1,000 in 1936 and £684 in the first six months of 1937.

Education in the U.S.S.R.

ACCORDING to the Soviet Union Year Book Press Service the educational services budget this year shows an increase of more than thirty per cent compared with that of last year (13,916 million roubles), and 3,613 new schools are to be built to provide accommodation for more than a million pupils, namely, 663,740 in rural areas, 518,950 in urban areas, and 35,000 children of railway workers scattered throughout the country. Special schools for railway workers' children already accommodate more than a million. The total urban schools attendance is 8,800,000, the rural schools 21,200,000. The accommodation to be provided by the new schools will therefore increase the capacity of the present urban schools by 6 per cent and that of the other schools by 3 per cent.

(*Continued on p.* 469)

NATURE

SUPPLEMENT

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Pascal and Seventeenth-Century Physics

The Physical Treatises of Pascal

The Equilibrium of Liquids and The Weight of the Mass of the Air. Translated by I. H. B. and A. G. H. Spiers, with Introduction and Notes by Frederick Barry. (Records of Civilization: Sources and Studies, edited under the auspices of the Department of History, Columbia University, No. 28.) Pp. xxviii+181. (New York: Columbia University Press; London: Oxford University Press, 1937.) 16*s*. 6*d*. net.

THIS volume is a welcome and notable addition to the series entitled "Records of Civilization" published by the Columbia University Press. For the most part, the preceding volumes have concerned themselves with history-sources of very varied range and outstanding interest; in this, the twenty-eighth volume of the series, the editors have adventured upon a notable story in the history of science, and have performed their task in such a way that a reader who has 'preferences but no exclusions' will not readily exchange this volume even for the 'History of Yaballaha III'.

The title of this study is self-explanatory, and the editors have exercised a wise discretion in choosing for this first experiment a story which can be rounded off in comparatively small compass. Here we have, for example, in the space of about two hundred pages, not only the treatises on the equilibrium of liquids and on the weight of the mass of the air, and the "Story of the great Experiment . . . devised by Monsieur B. Pascal . . . and carried out by Monsieur F. P. on one of the highest mountains in the Auvergne, commonly known as Le Puy de Dôme", but also a series of records of certain barometric observations made simultaneously in Clermont, Paris and Stockholm, and an account of "New Experiments, made in England . . ." Following these come three carefully selected appendices. The first is a translation of the relevant portions of Stevinus's work on statics, wherein, following a delightfully formal set of carefully arranged definitions and postulates, one finds the theorems of elementary hydrostatics developed in a series of graduated propositions such as "A solid body *minugrave* to the water in which it lies is equiponderant to the water of which it takes the place". A second appendix gives a translation of Galileo's "Remarks on Nature's Abhorrence of a Vacuum", and a third gives a translation of the text of Torricelli's letter of June 11, 1644, to Ricci on the pressure of the atmosphere, an excerpt from Ricci's answer (". . . it seems . . . that one could exclude the action of the air . . . on the . . . surface of the quicksilver in the basin by placing on this vessel a cover . . . The air above the basin would . . . gravitate no longer on the surface of the quicksilver, but upon the cover; and if then the quicksilver remains suspended . . . the effect could no longer be attributed to the weight of the air . . . ."), and Torricelli's reply of June 28.

It seems, then, that the reader is provided with much of the material which will give him the background of the contemporary outlook and achievements which is so necessary in order to appreciate completely the magnitude and importance of Pascal's contribution to the advancement of knowledge in this particular region.

It is a privilege to have the opportunity of following Pascal's method in general hydrostatics, but the work on the weight of the air leads to a climax of surpassing interest, though, truth to say, it would seem that the worthy Monsieur Perier's contribution to the Puy de Dôme experiment has scarcely received the consideration which it merits. Perier, Pascal's brother-in-law, was "His Majesty's Councillor in the Court of Aids of Clermont-Ferrand", and to him Pascal wrote the letter dated November 15, 1647, in which he suggests that a barometer shall be set up "several times over in one day, with the same tube and with the same quicksilver, sometimes at the base and sometimes at the summit of a mountain at least five or six hundred fathoms high". He remarks that a fall in the barometric height will be decisive, "for it is quite certain that there is much more air that presses on the foot of the mountain than there is on its summit, and one cannot well say that nature abhors a vacuum more at the foot of the mountain than at its summit"; and he remarks further, "I say nothing about the means of performing the experiment, because I well know that you will omit none of the precautions necessary to carry it out with precision".

Perier certainly omitted nothing. He prepares basins and two glass tubes, sealed at one end, and each four feet long. He rectifies six pounds of quicksilver, and at eight o'clock of the morning of September 19, 1648, he proceeds to the garden of the Minim Fathers, where he sets up his two tubes side by side in the same vessel, and remarks that each records a barometric height of twenty-six inches and three and a half lines. He repeats the experiment twice, and sets up one of the tubes in the garden for 'continuous observation', requesting the Reverend Father Chastin, "a man as pious as he is capable, and one who reasons very well upon these matters, to be so good as to observe from time to time all day any changes that might occur". He then proceeds, accompanied by a miscellaneous assemblage of clerics, lawyers, and one general practitioner, to the summit of the Puy de Dôme. Here he repeats the 'vacuum experiment' and finds a barometric height of twenty-three inches and two lines.

Apparently the emotions engendered by a successful seventeenth-century experiment on the spring and the weight of the air find similar, if more vigorous, expression in France as in England, for the whole company is carried away with wonder, delight and surprise. He repeats the experiment six times in all, "once in the shelter of the little chapel that stands there, once in the open, once shielded from the wind, once in the wind, once in fine weather, once in the rain and fog which visited us occasionally". In all these experiments he finds the same barometric height—twenty-three inches and two lines. (It is to be remembered, that between each of these experiments, the apparatus is dismantled, and the tube refilled.) During the descent, the experiment is carried out thrice at an intermediate station, and yields a height of twenty-five inches. On returning to the Minims, he finds that the barometric height has there remained constant at twenty-six inches three lines and a half. He repeats the observation with the Puy de Dôme tube, first immersing it in the vessel in which the tube for the 'continuous experiment' was standing, and then in the vessel which had been carried up the mountain. In every instance the observed height was twenty-six inches, three lines and a half. The whole story affords an admirable illustration of a carefully controlled experiment and it detracts nothing from the originality of Pascal to say that Perier's attendant bark should certainly "pursue the triumph and partake the gale" of Pascal's immortal achievement.

The book is not over-annotated; it has a useful bibliography, and the production is excellent. It is to be hoped that the volume will be the precursor of many others devoted to the history of science—a proportion of one in twenty-eight scarcely expresses the relative importance of science in the records of civilization.

A. F.

Is the Universe Expanding?

The Observational Approach to Cosmology
By Edwin Hubble. Pp. viii + 68 + 7 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 6*s*. net.

THE present volume contains the Rhodes Memorial Lectures delivered at Oxford in the autumn of 1936, and is a sequel to "The Realm of the Nebulæ" based on the Silliman Lectures of the autumn of 1935. The earlier book was a record of what Dr. Hubble describes as a rapid reconnaissance of the extra-galactic nebulæ; the book under review presents, one year later, the results of a much more detailed and thorough observational survey, representing possibly the extreme limits attainable by the 100-in. telescope of Mount Wilson Observatory.

In the earlier book, there was expressed a guarded doubt of the current interpretation of the observations as evidence of the expansion of the universe; in the new volume this doubt is magnified into the central theme. The position can be described quite simply.

The observations are two-fold in character—photometric and spectroscopic. The former lead to estimates of the distances of the nebulæ; the latter give the red-shifts of the observable spectrum lines. If the red-shifts are *not* velocity-displacements due to the recession of the nebulæ in the line of sight, the distribution of nebulæ is inferred to be essentially uniform and the universe to be unlimited in extent. Moreover, with this original assumption the observations show that the red-shifts are simply proportional to the nebular distances, and this law of red-shifts implies a hitherto unexplained principle of Nature, namely, that the energy of a light quantum diminishes with the distance traversed.

On the other hand, if the red-shifts *are* true velocity displacements, the law of the red-shifts is no longer linear and the resulting picture of the universe reveals disturbing features as to its comparatively small scale both in time and space.

The formulæ in the two cases are respectively

$$d\lambda/\lambda = ar \quad . \; . \; . \; . \; (1)$$
$$d\lambda/\lambda = br + cr^2 \quad . \; . \; . \; (2)$$

where $d\lambda$ is the observed displacement for a wave-length λ, r is the distance of a nebula and a, b and c are constants obtainable from the observations. It might be expected that a direct test of the two hypotheses could be furnished by the observations, for, of two identical nebulæ at the same distance from us, one stationary and the other receding with a high velocity, the latter should appear the fainter. But apparent luminosity is, at present, the only practicable criterion for deriving the distances of the very remote nebulæ and so this direct test cannot be applied.

Now, irrespective of the interpretation assigned to the red-shifts, the apparent luminosity of a nebula is diminished as a result of the quantum relation, $E\lambda$ equals a constant, in which E denotes the energy of a quantum which leaves the nebula with wave-length λ and is observed as of wave-length $\lambda + d\lambda$. As a consequence of this relation, it is shown that the apparent photographic magnitude of a nebula is increased by dm, where dm is equal to $3d\lambda/\lambda$. If, in addition, the red-shift is interpreted as a velocity-displacement, the value of dm is increased to $4d\lambda/\lambda$. Making these corrections in succession to the observed photographic magnitudes of nine clusters of nebulæ, Hubble arrived at the formulæ (1) and (2) with evaluations of the coefficients a, b and c. The feature of (2) which we notice is that the coefficient c is found to be positive. This implies that the 'age of the universe' is considerably smaller than that derivable from the linear law (1). From the numerical value of c, Hubble suggests that the maximum permissible span is about 1,500 million years, and that the true value may be anywhere between this maximum and half of it, that is to say, less than the age of the earth as determined from geological and other considerations.

In the concluding lecture, Hubble examines the distribution of the nebulæ in space, the basis of the investigation being five great surveys of some 100,000 nebulæ, two made with the 100-in. telescope, two with the 60-in. (both Mount Wilson instruments), and the fifth with the Lick 36-in. reflector; the limiting magnitudes of the surveys range between 18·1 and 20·3, and the limiting distances between 150 and 400 million light-years. On the assumption of uniform distribution, the correction dm to be applied to the observed magnitudes is found to be $2{\cdot}94\ d\lambda/\lambda$, in almost exact agreement with the energy correction of $3d\lambda/\lambda$ mentioned above. If the red-shifts had been true velocity-displacements, the procedure should have produced a correction $4d\lambda/\lambda$.

An interpolation may be made here. Recently, Sir Arthur Eddington directed attention to the fact that Dr. Hubble had omitted to take into consideration the dispersion of the absolute magnitudes of the nebulæ in his statistical investigations (*Mon. Not. Roy. Astro. Soc.*, 97, 156; 1937); however, Eddington's amended value of the correction, $3{\cdot}06\ d\lambda/\lambda$, is substantially the same as Hubble's value quoted above. But he also points out that in view of the accidental errors involved in the estimation of magnitudes, the numerical coefficient of $d\lambda/\lambda$ has a large probable error and should read: $3{\cdot}06 \pm 0{\cdot}56$, "so that the difference from the expected value 4·0 (that is, on the assumption that the red-shifts are velocity-displacements) is scarcely sufficient to constitute a discordance".

Relativistic cosmology has identified red-shifts with velocity displacements and incorporated them into the scheme of the universe. But Dr. Hubble, with the instinct of the observer, believes that the problem of the interpretation of the red-shifts is yet to be solved. In his last sentence he writes: "We seem to face, as once before in the days of Copernicus, a choice between a small, finite" (and expanding) "universe, and a universe indefinitely large plus a new principle of nature."

It remains to add that Dr. Hubble's book is a fascinating study of a fascinating subject, written in a style that many scientific authors would fain achieve and with an authority that must inevitably influence astronomical thought and outlook in the years ahead.

W. M. SMART.

Studies in Human Behaviour

(1) Psychology of Personality

By Prof. Ross Stagner. (McGraw-Hill Publications in Psychology.) Pp. xi + 465. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21*s*.

(2) Factors determining Human Behavior

(Harvard Tercentenary Publications, 1.) Pp. viii + 168. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1937.) 10*s*. 6*d*. net.

(3) May the Twelfth Mass Observation Day Surveys 1937

By over two hundred Observers. Edited by Humphrey Jennings, Charles Madge and T. O. Beachcroft, Julian Blackburn, William Empson, Stuart Legg, Kathleen Raine. Pp. xv + 431. (London: Faber and Faber, Ltd., 1937.) 12*s*. 6*d*. net.

THE three books considered in this review, though differing considerably in their content, emphasize collectively the importance of the study of the social background of personality.

(1) Prof. Stagner's work begins in an atmosphere typical of academic psychology. He tells us that he has deliberately avoided, wherever possible, any reference to abnormal personalities, and that the book is a response to a student demand for a general text-book on 'normal' personality. The first thirteen chapters have been carefully designed in keeping with this policy, and consist largely of a résumé of some of the most important laboratory investigations in this field. This first section seems to be the weakest of the whole work, but nevertheless it should be of value to the student who wishes to find under one cover the best known experiments, theories and speculations. As a text-book, this part of the work has been well planned, and each chapter is followed by a summary and suggestions for further reading.

The second and more important part of the work, the last two hundred pages, is mainly concerned with social determinants of personality, and much of the material is drawn from the field of psychopathology. Many interesting and little-known investigations are brought together with the purpose of throwing light on various problems, such as the effect of unemployment on personality, the design of text-books for schools and their importance in the building of social attitudes and prejudices, and many other interesting and important matters.

(2) "Factors in Human Behavior"—a Harvard Tercentenary Publication—is a joint effort by eight men of science to define the forces determining human conduct. The authors are Profs. E. D. Adrian, J. B. Collip, J. Piaget, C. G. Jung, P. Janet, R. Carnap, A. L. Lowell and B. Malinowski. The value of the volume, apart from the intrinsic interest of each chapter, lies in the cross-illumination produced by the distinct viewpoints upon the central theme, each chapter discussing the problem from a different angle.

Not all the essays are of equal size or merit. First in order of magnitude and brilliance comes Prof. Malinowski's chapter. He disposes of current doctrines of mystical *Kulturgeist* and exposes the pseudo-metaphysical absolutisms masquerading as scientific anthropology. He emphasizes particularly the necessity for a strictly deterministic, functional approach to the study of cultural differences.

Prof. Collip gives us the latest results of endocrinological research. Prof. Janet expounds the interesting implications of his theory of psychological strength and weakness. Prof. Carnap reveals gaps and links between reason and unreason. Prof. Adrian gives a brief prognosis of neurological research. From Dr. Jung we get rather an operculative chapter in accordance with his well-known views, while Prof. Lowell brings a specially interesting example from British history showing the natural orderly growth of legislative integration.

All in all, this volume is an excellent instance of what scientific workers can achieve when they consent to attack the same problem from their own special points of view.

(3) "May the Twelfth", edited by Humphrey Jennings and Charles Madge, is the first of a series of 'mass observation' day surveys. The book is divided into two parts. The first part, which is the larger of the two, deals with Coronation Day and the events leading up to it. The second part deals with the general work of mass observation, of which the first part is a specific example.

The reports of the observers are given, but no generalizations are deduced from them. Throughout, one is favourably impressed with the manner of reporting events without excessive subjective bias. It would seem that even people with programmes for reforming society can be brought to distinguish between their own feelings on one hand and the objective events to be described on the other. Nevertheless, it must be clearly borne in mind that the observer will only record that which he thinks worth recording. Owing to this process of selection, any deductions based on the difference between the number of favourable and unfavourable comments recorded can have no meaning except in so far as they throw light on the reporters themselves.

The book as a whole is very readable. Criticisms of this particular approach to sociology cannot be made until it is seen how the observations are going to be interpreted. Many readers will await with interest, and perhaps some mystification, the further publications of this series.

A Jungle Tribe of Malaya

The Negritos of Malaya
By Ivor H. N. Evans. Pp. xiii + 323 + 54 plates. (Cambridge: At the University Press, 1937.) 25*s*. net.

OF the three jungle peoples of the Malay Peninsula, Jakun, Sakai and Semang, the last-named are probably the best known to the outside world. As a racial group of low stature and negroid appearance, they form a link in the chain of pygmy and pygmoid peoples extending with intermissions from West Africa to New Guinea, their nearest affinities in south-eastern Asia being the Andaman Islanders and the Aetas of the Philippines.

The distinctive physical characters and primitive culture of the Semang, as well as the question of their place in racial taxonomy, have offered a strong attraction for the interest of the anthropologist; but their reserved and elusive temperament has rendered investigation difficult. The most considerable record among those of earlier observers is that of Vaughan Stevens, a collector working in the Malay Peninsula in the nineteenth century on behalf of a syndicate of German anthropologists. Either his good fortune in his informants and his insight into Semang beliefs were exceptional, or his capacity for invention was above the ordinary. Be that as it may, the efforts of subsequent investigators, W. W. Skeat, Nelson Annandale and H. C. Robinson, Father P. Schebesta and Mr. Evans himself have been taken up to a considerable degree, either avowedly or by implication, in checking his remarkable statements—in most instances with but indifferent success.

Of investigators subsequent to Vaughan Stevens, Mr. Evans has by far the most extensive acquaintance with the Semang, or Negritos as he, more accurately and comprehensively, prefers to call them. He has been in touch with them at intervals over the whole of the twenty years of his official connexion with the Peninsula, and he has revisited them since his retirement in 1932. It is interesting to note that he is able to go further than any of his predecessors in accepting the statements of Vaughan Stevens as verified; but this does not apply to the more remarkable of the data referring to the magical meanings said by Vaughan Stevens to be attached by the Semang to the *motifs* of their decorative art. The fact that some magical meaning is attached to their decorative designs is not, of course, in dispute.

It may appear that too much stress is laid on the question of Vaughan Stevens's credibility. That question, however, is fundamental; and all the more in Mr. Evans's work, because in presenting what is evidently intended to be a definite account of the Negritos—and it is scarcely probable at this late date that much of value will be added—he has made Skeat and Blagdon's monumental "Pagan Races of the Malay Peninsula", in which in relation to the Semang the critique of Vaughan Stevens is an important element, his starting-point. To this he has added a digest of the work of subsequent investigators, extending and criticizing it in the light of the observations which he himself has made. This applies more particularly to the material culture and the involved and complex religious beliefs of the Negritos, to knowledge of which Mr. Evans has made notable contributions; but for linguistics and physical anthropology he has to rely mainly on Dr. O. C. Blagdon's masterly study of the languages of the Peninsula, and for physical characters on Lebzelter's analysis of the data collected by Schebesta, which is the most considerable body of material extant.

The Negritos are now said to number a little less than two thousand. They undoubtedly have been subjected to much racial admixture. They are very variable in physical character, unlike the Andamanese, who are strikingly uniform. Being a lowland and river valley people, they have been much in contact with the Malays, in relation to whom their present condition is described as "servile".

Mr. Evans describes the very primitive material culture of the Negritos in detail. It is interesting to note that the bow, the characteristic weapon of this people, has been superseded almost completely by the Sakai blow-pipe, and indeed among some of the Negrito tribes it has been entirely forgotten.

In elucidating the obscure religious beliefs, with the extensive system of divine beings, Mr. Evans arrives at the conclusion that these are ancestors; but he makes the interesting and instructive suggestion that the explanation given of the origin of these divine beings—that they were the individuals who escaped to heaven and became deities because their hair had not been frizzed in the battle between the monkeys—may be derived from the Ramayana. Attention may be directed also to his remarkable and fortunate record of the shaman in action, an interesting and important matter on which little or nothing in detail was known previously. Mr. Evans was the first European to be present at a shamanistic performance and the first to describe the shaman's hut.

On the broader question of the ethnological position of the Negritos, Mr. Evans has little to add to what has been said by others. From his archæological investigations, however, he makes one important contribution. In relation to the question whether the pygmy people represent the earliest entrants into the Peninsula, he points out that the skeletal remains of the inhabitants of the caves belonging to the palæolithic-neolithic transition period investigated by him were not those of a Negrito type, and that this type does not appear until relatively late in the archæological succession.

Culture-Contact in India

A Tribe in Transition:
a Study in Culture Pattern. By Dr. D. N. Majumdar. Pp. xi + 216 + 5 plates. (Calcutta, London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 10*s.* 6*d.* net.

DR. MAJUMDAR'S book aims at doing something more than merely giving us an account of the Hos of the Kolhan. This indeed he does not neglect, but his particular purpose is to show them as they have reacted and continue to react to the effects of contacts with their Hindu neighbours. He states as his methodological ideal a synthesis of Malinowski's approach in "The Argonauts" with that of Ruth Benedict in "Patterns of Culture", but his adherence to their methods is by no means overstressed. He gives a comprehensive account of the social culture of the Ho, who clearly retain a very great deal of their typical culture in spite of their many contacts with Hinduism, which have influenced in particular their marriage ceremonies and festivals.

Dr. Majumdar seems inclined to accept the view that the Ho originally migrated southwards from the Himalayas. He mentions that the language used in spells is non-Austric, but does not specify what language actually is used. Vestiges of totemism seem to exist, though repudiated as such by the author, and there has clearly been a megalithic cult, now so generally decadent that menhirs do not seem to be erected at all, though horizontal slabs of stone are still provided for the dead.

The institution of bachelors' dormitories is considered as definitely fostering homosexuality, and this is remarkable, since generally speaking the bachelors' dormitory system, both in Assam and in Chota Nagpur, does not seem to have that effect at all. One's confidence in the author is rather severely shaken by finding that he imputes the custom of marriage by capture to the Naga Hills, and he is surely wrong in supposing that the claim on the part of a married woman's patrilineal family to the half of her bones is something new, unless it is in their not demanding the whole. The custom of returning the woman's bones to her own clan is the more ancient, and in a Munda marriage there is always a formal stipulation by the bride's clan that the bones shall be returned, although it is not really intended by either party that the promise to do so shall be implemented; in Assam a 'bone-price' is paid as a quittance for the obligation to return them.

Zoological references are obscure and the Latin names unfamiliar: the corsac fox is surely not the one usually found in India, which is more familiar as *Vulpes bengalensis* than as *Cynalopex insectivorus*; the sambar (referred to as "saumer") is generally classified as *Rusa*, not as *Cervus* by genus, and one is left guessing what is meant by "grower" and by "red deer". A map is very badly needed, and likewise a glossary to explain to the English reader such words as *birdiring*, *ficca*, *sonta* or *hatu*. Material culture is poorly treated; tattooing is mentioned, but pigments and processes are not described; and with no illustrations to help one the descriptions of objects (for example, of a plough on p. 6) are very difficult indeed to follow. On the whole, however, the book is an important contribution to Indian ethnography, particularly in its estimate of the impact of Hinduism on the culture of the Hos, and marks a rather new departure in Indian ethnographical literature.

J. H. H.

Hunting by Scent

The Mystery of Scent

By Hugh B. C. Pollard. Pp. xix + 139. (London: Eyre and Spottiswoode, Ltd., 1937.) 10*s.* 6*d.* net.

THE vagrant nature of odours would seem to be symbolized by a word-errant in search of a meaning. Scent, for example, according to a dictionary, signifies "odoriferous particles, odour, smell, fragrance; a class or one of a class of sweet-smelling, aromatic substances used for perfuming; sense of smell; odour left by the animal on the ground or surface passed over". It is the latter meaning that is mainly implied in the title of Major Pollard's book. He discusses principally the relatively complex conditions which control the diffusion of scent, and has worked out a simple instrument which will tell the hunting man the chance of scent on any day.

It is claimed to be a practical book for fox-hunting people rather than a scientific discourse. However, a racy style does not altogether mask the large quantum of science lurking in its pages ready to engage the attention of the reader and to exact his interest. The expert in ballistics proves himself to be also an adept in firing data and problems, physical, chemical and biological.

The correlation between scenting and meteorological conditions was discussed from different points of view in "Hunting by Scent" by Mr. Budgett (NATURE, **133**, 548–549; 1934), and in a pamphlet on "Scent and the Weather" by Flight-Lieut. Veryard (NATURE, **136**, 60; 1935). Major Pollard explains the development of a relatively large volume of scent from the small amount secreted by the pad glands of the fox, by suggesting that fox scent is an extremely volatile compound with marked capacity for spreading on water as a monolayer and being dissipated on water vapour. There are good reasons for doubting that the foxy (fur or bedding) scent we know is what hounds really hunt. The true 'scent' or pad secretion at each footstep is small, but on a still day the emanation from a series of pad marks was observed to form a band 15–20 yards broad, and, on a windy day, hounds are able to pick up a line even on a broader front.

The best scenting conditions prevail when the evaporation near the surface of the ground is at its maximum. The range and variation of the meteorological factors on a normal hunting day are much wider than is usually realized. No one factor alone controls scenting. The 'Pollard scentometer' (Prov. Pat. No. 26346), which is now marketed by the publishers, raises the prediction of hunting conditions in the course of the day from intelligent guesswork to a reasonable degree of fore-knowledge. The instrument comprises a thermometer, hygrometer, and an arrangement of five circular concentric dials which are set to the temperature, degree of humidity, relative amount of cloud, quarter of the wind, and wind velocity. The lower part of each dial is provided with numerical values for scent, which are read between two parallel wires and added up from the bottom to the centre. The sum represents the percentage of scent to be expected within the next few hours.

Major Pollard has also much of interest to relate about scent in other animals, about scent and local conditions, and a number of other problems, new and old, and all discussed in a stimulating manner. His book should certainly stimulate further research on such problems as that of adsorption and on the electrical phenomena in odorous vapours, and also the comparative study of the role of pigments in the olfactory mucous membrane and cognate subjects. J. H. K.

Plant Physiology for Students

General Plant Physiology

By E. C. Barton-Wright. Pp. 539. (Williams and Norgate, Ltd.) 15*s.* net.

PLANT physiology—especially the teaching of it—has not been in a satisfactory state for decades, and though one is constantly looking for signs of improvement, prospects are not reassuring. It seems worthy of reflexion that the first-class plant physiologist of the future must be the almost exclusive enthusiast of the present; for few ordinarily promising students are being attracted to the subject.

Until recently, one of the apparent reasons for this was the dearth, in fact, absence, of text-book reading for elementary students. There were no British text-books of university first degree standard, and the few American books, though worthy, seemed quite unknown. Students were forced to depend on their lecture notes (hence on the educative powers of their teachers) and on the out-of-date English translations from well-known German texts. Now, this reason has gone, for during the past three years three text-books of the required standard by British botanists have appeared.

Two have already been favourably reviewed in these columns, and now the third, by Dr. Barton-Wright, can be received with equal favour; but only as a text-book satisfying the courses prescribed for first degrees in the universities. It is, as the author claims, "meant as a general survey of plant physiology". After having read the text, one agrees with this claim, yet with a feeling of misgiving as to the necessity for such a book. The other two text-books were surveys of the subject made by well-known authorities; in a third book appearing so soon after, one is justified in looking for a distinctive feature or features. It was with disappointment that we finished reading this survey, for no such distinctiveness could be found. From the student's point of view, however, it has the advantage of a comparatively modest price.

The book reviews the science of plant physiology very thoroughly, but, like the others, seems to be a morass of fact and theory, very loosely bound together, with little sifting or evaluation. Merely to state all relevant facts and to quote the most discussed theories, is, of course, a safe policy for the author. But what about the student? He is not reading a monograph, but rather feeling his way, and needs a hint now and then to avoid blind alleys. It is a pity that the academic plant physiologist does not seem to realize this. It is true that Barton-Wright has made a choice of matter here and there; but the choice is the same as has always been made hitherto. Theories of transpiration are considered, for example, in the usual way—mentioning, dismissing, mentioning, dismissing and culminating in a detailed consideration of Dixon's cohesion theory. It will be interesting to see how this topic will be treated in the next text-book in view of the work of Dr. P. R. White of the Rockefeller Institute for Medical Research, which has recently been recognized by the thousand-dollar prize of the American Association for the Advancement of Science. It will indeed be refreshing if White's work only causes a slight modification of the treatment of this subject.

These remarks are not directed against the book under notice specifically, except in so far as the author has allowed himself to be fettered by tradition. Indeed, at times, he does take a point of view, and talks to his readers instead of merely presenting a critical résumé of work done and theories propounded. Nevertheless, many physiologists would not agree that the "ultimate goal [of physiology] is to explain them [living processes] in terms of physics and chemistry". The statement is dangerously narrow to make to a young student. Also, whether the late Sir J. C. Bose was the head of a school of investigators which holds vitalistic views is a moot point. Bose's main theses were that response in the plant organism is identical with that of animal muscle and nerve, and that much in the living world finds its counterpart in the inorganic; this is not the same thing.

Barton-Wright is very thorough in his survey of the literature; in fact, all his publications have shown this characteristic, so that students may be sure that in following his text they are missing little of importance so far as reading for a degree is concerned. The book is good value for the money.

South African Earthworms

A Monograph of the Acanthodriline Earthworms of South Africa

By Dr. Grace Evelyn Pickford. Pp. 612. (Cambridge: W. Heffer and Sons, Ltd., 1937.) 25*s*. net.

It has been frequently pointed out that the advancement of systematic zoology is best served, in the present state of the science, not so much by the description of new species as by the revision and putting in order of the species that are supposed to be already known. Of the kind of work that is most needed, an excellent example is provided by this monograph by Dr. Grace Pickford. The laborious investigation of the very large collections made in South Africa by the author and by others seems to have been done with great thoroughness and care. The results are set forth in very clear fashion and—so far as a non-specialist may see—with sound judgment.

A volume of more than six hundred pages may seem a liberal allowance of space in which to deal with a single sub-family from a single geographical region, but, as is pointed out in the preface, there are very solid reasons for giving special attention to this particular group in this particular area. The Acanthodrilinæ represent the most ancient element in the earthworm fauna of South Africa, and their relations to the faunas of other regions in the southern hemisphere present important problems which have not yet, perhaps, been completely solved. Further, as the late Dr. Michaelsen pointed out long ago, they have, in South Africa, become differentiated into a large number of local forms, often with very restricted ranges.

In the present volume, 85 species and 44 sub-species and races are recognized. The delimitation of the areas inhabited by these and their relation to the phylogeny of the group and to the geographical and climatic changes in the recent geological history of South Africa are discussed in a series of chapters of great interest.

A mild protest may be recorded against some of the terminology used in this volume. It is doubtful if much is gained in brevity or in clarity by the use of such words as "speciation", "sub-speciation" and "raciation". The printing is not above criticism, and surely the printers' reader ought to have known how to spell "desiccation".

W. T. C.

A New Continent

Soviet Geography: the New Industrial and Economic Distributions of the U.S.S.R. By N. Mikhaylov. Translated from the Russian by Natalie Rothstein. Second edition revised by the author. Pp. xviii + 229. (London: Methuen and Co., Ltd., 1937.) 10*s.* 6*d.* net.

IN a foreword to this book, Sir Halford Mackinder describes it as "a political pamphlet of the indirect order". There is not much indirectness in its politics for scarcely a page omits to contrast the blessings of the Soviet régime with the backwardness of old Russia. The tables of figures, plentifully supplied, include, as if they were facts, the estimates of the second 'plan', and the reader is asked to believe that "the industry of the U.S.S.R. . . . works according to plan, and knows nothing of crises".

But when one has discounted the propaganda, there remains in this work enough of fact to arrest attention. M. Mikhaylov claims that the Soviet Government has discovered a new continent, and this is not far from the truth. Further, it is exploiting that new land as rapidly as it can profitably do so. New industrial centres have been set up, as for example in the southern Urals, with its new towns of Magnitogorsk and Khalilovo, or in the Kuznetzk basin of west Siberia. Old industries, such as the iron industry in Leningrad and the textile industry of Moscow, which formerly depended largely upon imported raw materials, are now drawing their supplies from within the Union. Irrigation works have been extended, and crops suitable for dry areas have been introduced where irrigation is not possible. Agriculture is being revolutionized through collectivization. "The fierce resistance of capitalist elements in the villages was overcome" and the "agricultural machines", the "organization of the sovkhozes" (large-scale State agricultural enterprises), and the financial support of the Government are completing the process. It is unnecessary to continue the catalogue of development. M. Mikhaylov sets it out with an insistence and a dogmatism that make the reader wonder if it is all as nice and as satisfactory as it is pictured. Between 1913 and 1934 the "individual peasants" were reduced from 65·1 per cent of the population to 22·5 per cent and the bourgeoisie and the Kulaks have been nearly eliminated. On the other hand, the numbers of industrial workers have been doubled. This process is inevitable if one accepts the author's dictum that "the development of backward agriculture and the general industrial development of the country could not be achieved on the basis of petty individual peasant farming".

Here is the clue to the new 'Soviet geography'. To a land of boundless resources is being applied a plan of exploitation which is none the less ruthless because it is scientific. Russia as it was known in 1913 is moving eastward and northward into desert, and forest and tundra; railways, aeroplanes and ice-breakers are helping the process. How much—and relatively how little—has been done is revealed by the map showing the distribution of population. But, as M. Mikhaylov says, "the new geography of the U.S.S.R. . . . is not a spontaneous development but the accomplishment of a plan". The million people now living in the north-east quarter may some day approach more closely in number to the eleven millions in the Moscow province or the thirty-one millions in the Ukraine; but for all his assurance one can legitimately doubt if even M. Mikhaylov really believes that their lot will be one of "abundance and happiness".

J. N. L. B.

Industrial Catalysis

Catalytic Processes in Applied Chemistry

By Prof. T. P. Hilditch and Dr. C. C. Hall. (Monographs on Applied Chemistry, Vol. 2.) Second edition. Pp. xxii + 478. (London: Chapman and Hall, Ltd., 1937.) 25*s*. net.

THE subject of industrial catalysis continues to develop rapidly; such processes are the rule rather than the exception. There is a vast literature dealing with them and a rapid increase in the number of special books relating to particular aspects of catalysis. It is all the more valuable, therefore, to have a more general treatise brought up to date, especially as the new edition is characterized by the same clarity of expression as the former.

Notable examples of new catalytic processes are those involving polymerization, for example, the production of petrol and even of lubricating oils from the small hydrocarbon molecules in 'cracked' gases; or those in which the higher fatty alcohols are made from the fats by high-pressure hydrogenation in presence of copper-chromium catalysts. This group of substances, previously largely unknown, is the basis of a new class of detergents.

The subject is so intricate that it has been found necessary to introduce classified lists of processes, products and catalysts, with page references at the beginning of the book.

The chemist is acquiring remarkable powers; with the aid of a variety of catalysts and variations in temperature and pressure, he is able, for example, to produce from the one raw material, water gas, either methane, pure methyl alcohol, higher alcohols, acetic acid or petrol hydrocarbons in a range extending from butane to waxes, and to vary the proportion of these; other catalysts enable him to remove the sulphur compounds from water or town's gas or the carbon monoxide from hydrogen. A single catalyst—copper—may be used for half a dozen different reactions under different conditions.

It is about a hundred years (1835) since catalytic changes were first so called by Berzelius, and about sixty years (1875) since Squire and Messel began to make sulphuric acid at Silvertown by the catalytic action of finely divided platinum. The Norman process of fat hardening was made a practical one by the firm of Crosfield's, at Warrington, about 1910—much the same time as the Haber-Bosch process for synthetic ammonia.

Since those days, there has been a spate of catalytic processes. Prof. Hilditch has worked in the industry, published important researches and taught the subject; so he has triple qualifications for providing an up-to-date work on it.

Primes and Factors

Factor Tables giving the Complete Decomposition into Prime Factors of all Numbers up to 256,000

By Dr. George Kaván. Pp. xii + 514. (London: Macmillan and Co., Ltd., 1937.) 42*s*. net.

DR. GEORGE KAVÁN was born at Prague in 1877. His parents were Francis Kaván, a musical conductor and a composer of merit, and his wife Miroslava, an ardent supporter of the civil rights of women. After studying mathematics, physics and astronomy, Kaván became in 1900 chief assistant at the Astronomical Institute of the Czech University at Prague, where he remained until his appointment in 1919 as director of the Observatory at Stará Ďala. The Observatory being at that time not fully equipped with instruments, it was found possible to use part of the publication funds to cover the cost of printing the present handsome volume of tables. The calculation was started in 1917, and after the author's death in 1933 his wife, Madame Kavánová, undertook the reading and correction of the final proofs.

The work is preceded by a preface in English by Dr. Šternbeck of Stará Ďala, an introduction by Dr. A. Beer, now of the University of London Observatory, a preface in Latin by Prof. K. Petr, and a foreword in Czech by Kaván himself explaining his reasons for making the present table, and another of Euler's function $\varphi(n)$ which gives the number of integers less than n and prime to it. The greater part of this latter is already in type and should be published shortly. It appears that Kaván was largely influenced by Cayley's expression, in the British Association Reports, of the need for these tables. Cayley, for example, makes the point that in the theory of numbers the decomposition of $p-1$ where p is prime is frequently required.

Given an integral number less than 256,000, this book gives *immediate* information as to its prime or composite character and, if composite, its complete resolution into prime factors. The emphasis is here essentially on the adjective "immediate", for tables (by D. N. Lehmer) are available giving the smallest prime factor of every integer, less than 10,017,000, which is not divisible by 2, 3, 5, and so allowing the factorization of any integer up to this limit. But the labour of producing the factors may still be very great, so much so indeed that the British Association Tables Committee issued in 1935 a table of complete decompositions of all integers less than 100,000, which was then the longest list of decompositions of consecutive integers. Kaván's work is more than two and a half times as extensive.

The tables are arranged to read horizontally from left to right across the page. The leading figures are found in the left-hand column, the terminal digit 0, 1, . . . , 9 being across the top of the page. This was the arrangement suggested by Cayley, and seems easier of reference than the Chinese method of vertical columns read downwards which has also been used in this type of table. In such tables the tabular value is only another aspect of the argument; we have in fact a table of x with x as argument. The printing is clear, and a bold clarendon type distinguishes the prime numbers; a captious critic might suggest that figures with heads and tails would have been even more appropriate for the tabular values.

The method of calculation is described in Dr. Beer's preface, and, what is more important from the user's point of view, the precautions which have been taken to ensure the greatest possible accuracy. All the decompositions were checked by re-multiplication. The decompositions were compared with those in the tables of Inghirami (1832), of Goldberg (1862), and of Chernac (1811). After printing, a last check was made by comparing the decompositions of all numbers x with those of $2x$, $3x$, $5x$. Those numbers which evaded this check were again compared with Chernac's values.

The table was used by Kaván as a basis to calculate the function $\varphi(n)$ mentioned above, in the course of which errors in the table would have been revealed. A list of 24 errors is given at the end of the book, together with a version of certain entries where the type impression is poor. It is therefore reasonable to suppose that the work will contain few, if any, undetected errors.

All those responsible may be congratulated on a fine piece of work, nobly conceived, ably executed and worthily printed.

L. M. Milne-Thomson.

Developments in Theories of Integration

Modern Theories of Integration
By H. Kestelman. Pp. viii + 252. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 17*s.* 6*d.* net.

THE author of this book complains that while Lebesgue integration is everywhere firmly established as an essential part of the theory of functions, its treatment in English text-books "remains unsatisfactory and uninfluenced by the simplified treatment of Carathéodory". The account of the Lebesgue integral he gives follows closely the lines of Carathéodory's "Vorlesungen über reelle Funktionen". The Lebesgue theory of measure forms the basis of a theory of integration from which the principal defects of the Riemann theory are absent. The Lebesgue integral is a generalization of the Riemann integral, and the Lebesgue theory of measure allows an enormous extension of the solution of the problem of areas only partially solved by the Riemann integral (or by the theory of Jordan content).

The author devotes a chapter to Riemann integration in order both to establish conditions in which it exists and to discuss its relation to problems such as the integration of derivatives and of limit functions in general. It is only by appreciating the circumstances in which the Cauchy-Riemann integral is insufficient that Lebesgue's achievement can be appreciated.

The extensions of the Lebesgue integral are traced from Hölder's definition to that of Denjoy; and the general Denjoy integral is developed without the use of transfinite numbers. This treatment is derived by the author from a paper by P. Romanovski. A chapter on Fourier series illustrates the application of Lebesgue theory to a branch of analysis for which it has been of the utmost importance.

The book begins with a chapter on the definitions and elementary theorems of the theory of aggregates, particularly of sets of points, and develops them so far as is necessary for an understanding of the theory of the Lebesgue integral. Here, proofs of several theorems depending on the existence of certain aggregates for which no rule of 'construction' was forthcoming, are legitimatized by the introduction of Fraenkel's axiom of selection. This axiom is specially invoked to prove that every infinite set contains a sequence of distinct points and it is often used implicitly in existence theorems.

A. v. Z.

Short Notices

Anthropology and Archæology

Chinese Fairy Tales and Folk Tales

Collected and translated by Wolfram Eberhard. Pp. xiv+304. (London: Kegan Paul and Co., Ltd., 1937.) 10*s*. 6*d*. net.

THIS collection of Chinese fairy and folk tales—'ghost', perhaps, would have been more accurate than fairy—differs from most with which the Western world is familiar in the fact that the collector has had them direct from the mouth of the people, and has eschewed the printed source. It may be doubted, however, how far the distinction is to be regarded as an essential difference, even though certain classes of story are absent. On Herr Eberhard's own showing, the Chinese folk-tale is the product of an attitude of mind towards the spirit-world, which is so far an effective element in every-day life, and not solely an attribute of children and the unsophisticated, as in Europe, that the product of the myth-making faculty can still be reported in a daily paper as a statement of fact. An example is quoted in the preface—a story of how a policeman became a city-god—which might equally well have appeared in the text.

Herr Eberhard states that he has made a very large collection of Chinese folk-tales, which will be published shortly. The present collection contains a selection only, and from the point of view of scientific study suffers from the fact that no indication is given of distribution or provenance. It must be regarded, therefore, as entertainment. The student of *motif*, however, will find much of interest. Early relations with India and the West must be held responsible for the appearance of Cinderella and the slipper, the three sons, and various forms of the task to be performed before marriage, inheritance, or other reward, especially in that in which it is familiar in the legend of Psyche. A number of other *motifs* which appear in European folk-lore will be found here but little changed in essentials, notwithstanding the Chinese setting. The "happy ever after" ending, however, is not invariable.

As literature, the collection is delightful and the translation lively and easy in style.

The Archæology of Sussex

By E. Cecil Curwen. (The County Archæologies.) Pp. xviii+338+32 plates. (London: Methuen and Co., Ltd., 1937.) 12*s*. 6*d*. net.

THE county of Sussex as a whole affords a more than fair sample of the characteristic cultures of an English lowland area; but its most famous contribution to the study of early man is unquestionably the Piltdown skull. Dr. Curwen records the circumstances of its discovery and the discussions as to its character and rank in the human line of descent which then took place; but presumably he regards later argument as a specialized matter scarcely falling within his province. In the earlier problems of prehistory, the county is also of importance for the evidence of the raised beaches of western Sussex.

In the mesolithic period, Sussex is notable for the discovery of microlithic implements so early as 1877 at Horsham. It includes within its boundaries a number of mesolithic stations on the greensand, which are especially significant as demonstrating mesolithic man's preference in the matter of sites for his occupation. This was also the first area in England to afford evidence, at Hassocks, of a mesolithic pit-dwelling.

Of other matters with which Dr. Curwen deals, attention may be directed more especially to his reconstruction of life on the downland in the neolithic period, for which evidence is afforded by flint mines, long barrows, camps and the like, and his admirable account of the late bronze age material, more especially the Plumpton Plain A site, where there appears the earliest known example in Britain of the introduction of the Celtic system of agriculture.

The volume concludes with a survey of Roman Sussex; the Anglo-Sussex period and the gazetteer, which have appeared in previous volumes, are omitted.

Astronomy

Sunspots and their Effects

By Harlan True Stetson. Pp. xv+201. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 8*s*. 6*d*.

THE whole life of the earth depends on the sun, and it follows that variations of solar activity should be reflected in terrestrial phenomena. In this book, Dr. Stetson gives a popular exposition of this thesis, and especially of the idea that changes in the sun associated with sunspots may have physiological or emotional effects on human beings which cause them to behave differently at times of many or few spots. This influence, if indeed it exists at all, is most probably related to the physiological action of great variations of ultra-violet radiation during the sunspot cycle, though the possibility of an electrical action is also considered. Changes of energy and confidence are reflected in various aspects of business, as shown by parallelism between economic indexes and sunspot numbers over the last few decades. The statistical basis is insufficient for proof, but the presentation is suggestive.

The author also has a good chapter on sunspots and radio, but the discussion of relations with weather and crops is brief and superficial. The second half of the book presents in a very readable way modern ideas on sunspots themselves—their causes, the migration of sunspot zones and the possible reasons for their quasi-periodic recurrence. The author is an astronomer, and for the general scientific reader this is the best part of the book.

Astronomy

By Prof. W. M. Smart. (The Pageant of Progress Series.) Pp. 158+24 plates. (London: Oxford University Press, 1937.) 3*s.* 6*d.* net.

THIS book provides an excellent summary of astronomical information which should be known by the average person interested in this science. It is written in simple and non-technical language, and will prove very readable to a large section of the public. Commencing with the earth, it extends its scope to the moon, planets, comets, meteors, the sun, and then to the extra-solar system bodies—stars, nebulæ, etc. In covering such a wide field it is inevitable that only a brief survey can be made of the various branches, but it is amazing how much up-to-date information Prof. Smart has condensed in such a small space. The book is illustrated with 24 plates and 38 diagrams, which greatly enhance its value and interest. Its modest price brings it within the reach of a large circle of readers, and we anticipate that it will be included in the category of 'best sellers.'

There are a few points to which reference might be made, though they are trivial. Dr. Jeffreys does not now believe that there is a layer of ice 16,000 miles thick on Jupiter (p. 52). It is implied that meteors move with parabolic velocity. The results of the Harvard College Arizona Expedition six years ago showed that most sporadic meteors were moving with high hyperbolic velocities, often as much as 120 miles a second (p. 75). On p. 130, line 10 from the top, the letter "C" should be substituted for "B."

M. D.

Biology

British Stem- and Leaf-Fungi (Cœlomycetes):

a Contribution to our Knowledge of the Fungi Imperfecti belonging to the Sphæropsidales and the Melanconiales. By W. B. Grove. Vol 2: Sphæropsidales, comprising Sphærioideæ, with Coloured Spores; Nectrioideæ, Excipulaceæ, and Leptostromataceæ; and Melanconiales. Pp. xi+406. (Cambridge: At the University Press, 1937.) 21*s.* net.

"UNFORTUNATELY the literature of mycology consists largely of fragments, memorials of splendid designs never prosecuted, of good intentions never fulfilled. We cannot but call to mind one after another the splendid works we might have consulted had they attained completion." Thus wrote M. C. Cooke, the noted English mycologist, in 1875, and the position remains much the same to-day. With the publication of this second and final volume, however, the late Mr. Grove joined the select company of those who have completed a flora of their country's Cœlomycetes, and has become, in fact, the first to do so in the English language; it is a crowning achievement to his long career.

This final volume follows the lines laid down in the first, and finishes with three indexes and an epilogue. In the latter the author explains his aim, which has been to give a panoramic view of Saccardo's classification, in so far as it is illustrated by the British species. He has successfully accomplished this aim, and in so doing has been led into a rather severely conservative treatment of large numbers of proposed new genera; the latter may, however, be traced in the synonymy of the various species. An index of Ascomycetes that have been proved (or thought) to represent the perfect form of various Cœlomycetes is an interesting and suggestive feature, and may perhaps attract fresh workers into a fascinating field that has been so unaccountably neglected by our university students.

British mycology is indeed indebted both to the indefatigable zeal of the author in completing the work and to the Cambridge University Press, which has provided a dignified and worthy setting.

E. W. M.

Practical Zoological Illustrations

Part 1: Vertebrates. By S. Lockyer and D. R. Crofts. 28 cards, 14½ in. × 9½ in., in Portfolio. (London: Macmillan and Co., Ltd., 1937.) 10*s.* 6*d.* net.

THE types chosen for this series are those used in the junior class, namely, the dogfish (10 cards), frog (9 cards), and rabbit (7 cards). One sketch of the sheep's heart has been added. The large, clear drawings have been admirably executed by the junior author, and are based on actual dissections. They represent faithfully the relative disposition of the organs, and will therefore be helpful for beginners who find difficulty in interpreting verbal directions. Whether it is wise to train a student of pure science by this means is very doubtful. Let him rather explore the unknown, even at the risk of early failure.

The interpretation of the dissections falls somewhat short of their execution and delineation. The following structures, all of which would be visible when the dissections were made, have been omitted: the pancreatic duct (I), the buccal branch of the facial nerve (IX), the ilio-hypogastric nerve (XVIII), the corpora cavernosa (XXII), the glosso-pharyngeal nerve (XXIV), and the moderator band (XXVII). Several mistakes should be rectified. The student who looks for the internal opening of the oviduct in the frog will not find it directed mesially as on Card XIII. The seminal vesicle has been wrongly labelled on Card XIV, the coeliaco-mesenteric artery does not arise from the dorsal aorta as shown on Card XVI (see Ecker, 1896, p. 301), the rabbit's *hepatic* portal vein has been labelled *renal* portal (XXV), and in the sheep's heart the hemiazygos vein has been converted into a left superior vena cava, a vein which is lacking in the sheep, as in the majority of mammals.

Fundamentals of Bacteriology

By Dr. Martin Frobisher, Jr. Pp. ii+474+4 plates. (Philadelphia and London: W. B. Saunders Co., 1937.) 14*s.* net.

BACTERIOLOGY is no longer an exclusively medical subject. Most of the bacteria are harmless, many of them are useful, and their study is of importance to students of botany, physiology, industrial processes and agriculture. Further, from a cultural and philosophical point of view, the study of bacteria as microscopic plants, broadens the student's interest in living organisms and deepens his appreciation of the intricacies of Nature.

It was with these considerations in mind that this volume on bacteriology has been written ; the treatment of the subject is unspecialized, and its various aspects—medical, industrial, agricultural and others —are discussed on broad and general lines, and anyone adequately grounded in elementary biology may study it with profit, and, we would add, with enjoyment. The book contains a wealth of reliable and up-to-date information, comprising classification and biology, cultivation and methods of investigation, descriptions of species and their connexion with processes, with final chapters on viruses, pathogenic Protozoa and the history of bacteriology.

The book is most readable and fully illustrated with figures and plates (some coloured), including reproductions of portraits of many pioneers, and of pictures illustrating processes and the like, which add to its interest. R. T. H.

A Guide to Veterinary Parasitology:

for Veterinary Students and Practitioners. By Dr. T. Southwell and A. Kirshner. Pp. x + 144. (London : H. K. Lewis and Co., Ltd., 1937.) 7*s.* 6*d.* net.

THE veterinary profession has made conspicuous progress during the last fifty years in education, usefulness, public estimation and consequent reward. No branch of the medical profession has been more quick and eager to make use of the discoveries of the age. At Onderstepoort and at Aberdeen, for example, veterinary science has great scientific institutions of its own, and this little book before us, prepared within the Liverpool School of Tropical Medicine, shows how the young veterinarians extend their experience and their education. The book needs no lengthy notice. It is a student's book, short and elementary, but lucid and sound. The pathogenic Protozoa are treated very briefly, but the introduction will serve; and the young 'vet.' who goes to South or East Africa will soon learn a great deal more. The parasitic worms are amply, though very concisely, described ; and the many illustrations, which seem to be all quite new, will hold their own against those in any text-book of zoology. D. W. T.

The Fauna of British India, including Ceylon and Burma

Edited by Lieut.-Col. R. B. S. Sewell, assisted by G. Talbot. (Published under the patronage of the Secretary of State.) Moths, Vol. 5 : Sphingidæ. By T. R. D. Bell and Lieut.-Col. F. B. Scott. Pp. xviii + 537 + 15 plates. (London : Taylor and Francis, 1937.)

A NOTABLE feature in the present volume of this well-known series is the amount of information it has been possible to give on life-histories and metamorphosis. A large number of Indian Sphingidæ, or hawk-moths, have been reared by the authors, who made careful descriptions of their early stages and habits. Something is now known of the metamorphoses of 66 per cent of the Indian species and of 85 per cent of the genera. Almost all the fifteen plates are given to illustrating larvæ, or in some cases, pupæ, while the imagines are for the most part represented in the text-figures. We look forward to the time when other volumes on the moths of India can provide an equal wealth of biological data.

The taxonomy followed is that of Rothschild and Jordan's "Revision of the Sphingidæ". This work, together with later writings of these authorities, has also been extensively drawn upon in other ways in the preparation of the volume. Valuable help has also been given by Mr. W. H. T. Tams, of the British Museum (Natural History). We need only add that the authors, and others concerned in its production, are to be congratulated on the publication of a volume which should long remain the leading source of information on its subject.

A Guide to Collecting Butterflies of India

By Lieut.-Col. H. D. Peile. Pp. xiv + 312 + 25 plates. (London : John Bale, Sons and Curnow, Ltd., 1937.) 25*s.* net.

THIS manual provides an account of those of the Indian butterflies most likely to be met with in the general course of collecting. It is intended for beginners, is of handy size and admits of easy reference. As many forms as possible are accurately figured from drawings made by the author, and notes on the habits, food-plants, etc., of numerous species are given. At the end of the book is a number of local lists of species found in various districts of India, and the nomenclature followed is mostly that used by Evans in his 1932 volume. The book should prove a useful aid for the novice, and perhaps do something towards inducing him to become something more than a collector of specimens.

More Songs of Wild Birds

By E. M. Nicholson and Ludwig Koch. (Bird-Lovers' Manuals.) Pp. viii + 104 + 29 plates. (London : H. F. and G. Witherby, Ltd., 1937.) With 3 double-sided gramophone records, 15*s.* net.

THIS little book supplements an earlier volume on "Songs of Wild Birds" noticed here a year ago (NATURE, 139, 132; 1937). Like its predecessor, it is a 'sound book'—illustrated both pictorially and by accompanying gramophone records, which are not obtainable separately. Mr. Nicholson having already given his general ideas on the subject of bird-song, the text on this occasion is largely occupied with incidental matters, such as the methods used and the difficulties experienced in securing records of birds singing in a wild state. There is also a chapter dealing with woodland, park and heath birds, including species which are not songsters in the ordinary sense. Some of the latter are recorded, and the reproduction of the curlew's cry is notably successful. The number of records has been increased from two to three, and the six sides comprise twenty-two items : the quality testifies to the skill, enterprise and patience of those responsible.

Chemistry

Laboratory Methods of Organic Chemistry

By L. Gattermann. Completely revised by Heinrich Wieland. Translated from the twenty-fourth German edition by Dr. W. McCartney. Pp. xvi + 435. (London: Macmillan and Co., Ltd., 1937.) 18*s*. net.

THAT German text-books ought to be translated into English is by no means certain; but of the value of translating a manual of practical organic chemistry there can be no doubt; for such a book is required in the earlier years of a student's life, usually before his knowledge of German is very profound.

Since its first publication in 1894, Gattermann's "Laboratory Methods of Organic Chemistry" has been the most widely used practical chemistry of the German universities, and it has been available since 1896 to English-speaking chemists in the American translation of Schober and Babasinian. Twelve years ago the book was rewritten by Wieland, and a translation by Dr. McCartney was published; since then it has again been revised, and it is this revised edition that Dr. McCartney has now translated.

The familiar lines have not been altered. After sections on general methods of manipulation and organic analysis comes the main preparative section, appropriately prefaced by two pages on the prevention of accidents. In each chapter of this section one or two preparations are first given, followed by several pages of explanation, which in turn lead on to further preparations.

This combination of theory and experiment makes the book a really excellent one for the teaching of organic chemistry. A possible criticism is that the price is rather more than most students expect to pay for a practical book; but then "Gattermann" is more than a practical book. B. K. B.

Toxicity of Industrial Organic Solvents

Summaries of Published Work compiled by Dr. Ethel Browning under the direction of the Committee on the Toxicity of Industrial Solvents. (Medical Research Council: Industrial Health Research Board. Report No. 80.) Pp. iii + 388. (London: H.M. Stationery Office, 1937.) 7*s*. 6*d*. net.

THE wide use of organic chemicals as industrial solvents has introduced certain complications, including a possible danger to health. Whilst the solvents are perfectly safe when used under proper conditions, their misuse, particularly over a continued period, may lead to trouble. There has been no definite knowledge as to which of the many compounds may be suspected before use, and thus a clear need for research into the possible effects of every material that seemed open to suspicion. The subject is receiving study at the instance of the Association of British Chemical Manufacturers and the Home Office, which have referred the medical questions to a special committee of the Medical Research Council.

As a first step, a full summary of the available literature has been prepared by Dr. Ethel Browning. It deals with the hydrocarbon group, including such familiar substances as benzol and petrol, the large class of chloro-compounds which have found wide application, the alcohols, and particularly the esters, which are becoming of increasing importance. There follow cyclohexane derivatives, ketones and glycols.

The report will undoubtedly be of interest to the large body of makers and users. A difficulty with such materials is the well-known one that, whilst the makers and large users observe the necessary precautions, small users, who often buy their materials under a proprietary name, neglect to do so.

Sterols and Related Compounds:

a Series of Three Lectures delivered at the Institute of Biochemistry, Cambridge. By Prof. E. Friedmann. Pp. ix + 100. (Cambridge: W. Heffer and Sons, Ltd., 1937.) 7*s*. 6*d*. net.

PROF. E. FRIEDMANN is a distinguished visitor in our midst, and it was possibly this fact, rather than any novel features of his lectures, that caused his Cambridge colleagues to persuade him to reprint them in book form. The subject has, after all, already been covered at various lengths by Heilbron, Windaus, Fieser, Butenandt, Lettré and Inhofer.

However, the excellent reproduction of formulæ in this book and its condensed nature help to show the close relationships of the compounds discussed, and give it a certain quality of its own. Prof. Friedmann has mastered the English language very well, and, with the assistance of Mr. T. R. Parsons, has avoided all major solecisms. There are one or two minor inaccuracies that, should a second edition of this book be required, will demand attention. On p. 50 he has confused Windaus's vitamin D_1 and the English workers' original calciferol. On p. 65 is perpetuated the statement made by Prof. Friedmann elsewhere, that vitamin D_2 contains fewer international units per gram than calciferol. Actually, the two substances, when both pure, are identical in activity, as was shown by Schenck two months before this book was published.

Nevertheless, of the physiological relationship of the steroid group, including bile acids, heart poisons, saponins, antirachitic vitamins, sex hormones and carcinogenic substances, this book remains—errors and omissions excepted—a useful and readable survey. A. L. B.

Principles of Chemical Engineering

By Prof. William H. Walker, Prof. Warren K. Lewis, Prof. William H. McAdams and Prof. Edwin R. Gilliland. (Chemical Engineering Series.) Third edition, revised and rewritten. Pp. xi + 749. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30*s*.

THE previous edition of this book has lasted a decade, a period during which chemical engineering has expanded enormously. New processes have been discovered, old ones improved, and a great deal of more accurate information has been established.

Dr. Walker, the initiator of the book, has passed away, and Dr. Lewis has taken little part in it, so that the work of preparing the new edition has fallen on the shoulders of the other two authors. The book has been fully revised, emphasis being placed as before on clarity in the presentation of the fundamental concepts. The most extensive changes are in the chapters on the flow of fluids and the flow of heat and on diffusional processes.

It will no doubt worthily replace the old edition on the shelves of the many who have found it of value.

Engineering

Combustion in the Boiler Furnace

By H. J. Hodsman. Second edition. (Leeds: Jowett and Sowry, Ltd., 1937.) 1*s*.

WHETHER the burning of coal in a boiler furnace shall be smoky or smokeless, or in other words, wasteful or efficient, is fundamentally a matter appertaining to the chemistry of combustion and, if the process is to be adequately understood by those employed in it, then, as a basis of rational practice, it is necessary that some effort should be made to elucidate the general principles. This has been recognized by the West Riding Regional Smoke Abatement Committee, which, as one of its activities, has established a scheme for the examination and certification of stokers and boiler attendants, for whom classes have been arranged by technical schools and colleges in the area.

The absence of suitable literature in a form and at a price to meet the needs of such students, led to the preparation of this booklet, which is issued with the approval of the Committee and has now reached a second edition embodying several alterations and additions. These deal more particularly with flue gases and the influence of their composition on efficiency, an aspect which presents some difficulty to this class of student. Beginning with an explanation of the combustion of carbon and hydrogen, in which chemical symbols and equations are freely introduced and simply interpreted, the author passes on to deal with the practical aspects of fuels and their combustion, describing from different points of view their composition and strongly emphasizing the magnitude and importance of the problem of air supply. At this point, the several methods of stoking are discussed and the influence of the character of the ash is referred to. The constitution of flue gases, the dependence of their volume and temperature upon the proportion of air supplied and the value of the carbon dioxide content are explained in straightforward terms. Their bearing on the operation and efficiency of the boiler and the practical considerations, which limit the best working proportion of carbon dioxide to a figure between 10 and 12 per cent, are set forth in terms which should readily appeal to a practically minded student.

The information presented here, in so clear and concise a form, is such as should be available in every boiler-room and in the possession of all responsible for the efficient combustion of coal, coke or other solid fuel.

Transient Electric Currents

By Prof. H. H. Skilling. (Electrical Engineering Texts.) Pp. xiii+349. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 25*s*.

THE title of this book, that of the series to which it belongs, and the first sentences of the preface, alike fail to convey a correct sense of the book's scope and aim. The preface says: "It is a book for engineers." This is only a partial truth; it is a text-book for engineering students (as indeed the preface goes on to explain), but it is not a handbook for working engineers and it is not a reference book. Much more is required before the author's hope that it "will help the student to attack any sort of transient problem with confidence" can be adequately realized. But as a text-book for students it is good; clear descriptions of the physical nature of transients take first prominence, the mathematical side being kept in its place as a necessary and important tool. Four introductory chapters are devoted to transients in simple series circuits of inductance, resistance and capacity. The next three deal with the indicial response of more complicated networks, the transient response to sinusoidal and non-sinusoidal voltages and transients in coupled resonant circuits. This last-named discussion is kept simple and illuminating by neglecting ohmic resistance. Then follows a chapter on solution of circuits with variable parameters by graphical and point-to-point methods. A clear exposition of travelling waves on non-dissipative and distortionless transmission lines leaves one to regret the serious omission of any discussion of standing-wave phenomena.

The last, and much the least satisfactory, chapter in the book gives a brief mathematical introduction to operational methods of analysis. Some faint breath of the fascination, the stimulation, the inspiration of these methods does penetrate the mathematic chill, but there is no illustration to suggest to the student the great power of these methods in the attack on otherwise difficult, laborious and intractable problems.

The book is well illustrated by figures, curves and oscillograms, and forms a good introductory text-book on the fundamental phenomena of transient electric currents.

Motion and Time Study

By Prof. Ralph M. Barnes. Pp. ix+285. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 18*s*. 6*d*. net.

THIS book by a professor of industrial engineering gives a comprehensive account of motion and time study from the days of the nineteenth century pioneers to the present day.

The large-scale development of many industrial operations during the last century has necessitated study of the most economical ways of doing the particular job, with the further object of determining the amount of work that should be done in a given period of time, and of fixing a wages scale.

The performance of manual work in an effective manner pre-supposes some understanding of the capacities and abilities of the human body. The writer reviews the work of Taylor and Gilbreth in this connexion, and shows how much later work is indebted to these early studies. He then applies the principles to various engineering operations and shows the use of these studies for the fixing of piece rates and wage incentives.

He avoids the error of believing that there is one best way that can be imposed on all workers, and he realizes that the output is affected by other factors than the method of the workers, for example, the conditions of lighting, heating, ventilation and vibration, and that the maximum comfort of the worker must be assured.

The whole book is written in a clear and systematic way, and it should be possible for the student of industrial psychology to apply these principles to very different operations.

Engineering Mechanics:

By Prof. S. Timoshenko and Prof. D. H. Young. Statics. Pp. xiv + 334.
Dynamics. Pp. xii + 323. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 15*s*. each.

THESE two volumes are intended by the authors to provide a thorough course in mechanics for the non-specializing engineering student. It is scarcely necessary, as one of the authors is so experienced a teacher as Prof. Timoshenko, to state that this aim has been well achieved.

Mechanics is a subject which can be really mastered only by the solution of a number of problems, and thus these two books contain instructive problems in abundance—more than three hundred in each volume (with answers), many of which are worked out in detail while for others hints are given as to the best method of attack. It is this well-selected collection of problems which will make these books valuable to the student. But he will probably also enjoy the text itself, which carefully and in simple language, and helped by a large number of excellent illustrations, leads him to the fundamental principles and to many of their interesting applications in modern engineering problems. A. B.

Television:

Theory and Practice. By J. H. Reyner. Second and revised edition. Pp. xi + 224 + 24 plates. (London: Chapman and Hall, Ltd., 1937.) 12*s*. 6*d*. net.

MR. REYNER'S revision of the 1934 edition has been extensive and entirely satisfactory. The television of 1937 is incomparably better than that of 1934, and this progress is fully represented in an edition in which every change has been an improvement. By discarding some descriptive matter, the author has, at the cost of some 15 per cent increase in length, and with substantial improvements in order and mode of presentation, given an up-to-date, accurate and absorbing account of present-day technique. It will appeal to a very wide range of readers, for the problem of combining accuracy, clarity and readability has been even more satisfactorily solved in this than in the excellent first edition.

Medical Studies

The Romance of Medicine

By Dr. John A. Hayward. Pp. xviii + 278. (London: George Routledge and Sons, Ltd., 1937.) 6*s*. net.

THE purposes of this little work, as we learn from the preface, is "to amplify the talks and lectures that have been given for King Edward VII's Hospital Fund, in the hope that it may stimulate interest in hospital work and public health". It is also hoped that it may be useful not only to young men and women who are thinking of taking up medicine, or nursing or allied professions, but also to older persons who wish to become acquainted with preventive measures against many diseases and the means of improving national health and physique.

The book is divided into two parts, devoted respectively to pre-scientific and scientific medicine. The first part consists of three chapters, in which ancient and modern medicine are compared, and a brief account is given of the surgery, midwifery, preventive medicine and tropical diseases in early times, and the deplorable conditions prevalent in the hospitals, which were notorious for their overcrowding and high mortality. The second part, which forms the bulk of the work, contains fifteen chapters, in which an excellent account is given of vaccination against smallpox, the discovery and later developments of anæsthetics, the germ theory of disease, with special reference to Pasteur, Lister and the antiseptic system, bacteriology, tropical diseases, biochemistry, vitamins, blood transfusion, physical science and medicine, Röntgen rays, radium and nursing.

The book is written in an easy style with occasional lapses into sentimental reflections, but we have found only three important omissions which might well be made good in a subsequent edition. In view of the not inconsiderable number of children and adolescents who become infected with venereal diseases, it savours somewhat of Victorian obscurantism to have omitted this important cause of ill-health, apart from a passing reference on p. 265, while the existence of alcoholism, with the exception of its prevalence among nurses prior to the advent of Florence Nightingale, and the remarkable improvement in the prophylaxis and treatment of mental disease, are not discussed.

With these reservations, we have nothing but praise for this little book, which deserves a wide circulation. The text is liberally interspersed with portraits, microphotographs, diagrams and other illustrations.

Blood Cultures and their Significance

By Hildred M. Butler. (Monographs of the Baker Institute of Medical Research, No. 3.) Pp. xiv + 327. (London: J. and A. Churchill, Ltd., 1937.) 15*s*.

A VERY complete survey of the subject of the cultivation of micro-organisms from the blood stream is given in this book. The method is one which is of considerable value as a diagnostic measure in certain diseases, and may be expected to throw light on various obscure disorders.

The history of the subject is dealt with in the first chapter, the technique of making blood cultures in the second, and interpretation of the findings in the third. In the remaining chapters, the findings in various diseases are described, and their significance is discussed, full bibliographies being appended to each chapter and at the end of the book. It is of interest how seldom micro-organisms seem to invade the blood stream in health—so infrequently that the few positive results obtained by the author (in only four of 106 individuals examined) might well be accidental contaminations. The author, in fact, is so sure of her methods that perhaps she scarcely stresses sufficiently the need for adequate skin disinfection in the technique adopted, and the possibility of aerial contamination of the cultures made.

This book has been compiled by one who has had great experience in this field of work, and the record of her investigations here presented must prove of much value to the clinician and clinical pathologist.

R. T. H.

Complement or Alexin

By T. W. B. Osborn. Pp. xi+116. (London: Oxford University Press, 1937.) 7*s.* 6*d.* net.

COMPLEMENT or alexin, present in fresh normal blood serum, is an 'agent' by means of which delicate specific tests may be performed for the laboratory diagnosis of many diseases and for the exact determination of various bacterial species. Although in daily use in the medical laboratory, and notwithstanding much research as to what it is, its exact nature still remains somewhat of a puzzle, and it has been variously regarded as being an enzyme, a manifestation of surface energy, a physical or physico-chemical state, a colloidal phenomenon. This book contains a most useful survey of the scattered but extensive literature upon complement and its action, and since Dr. Osborn has himself contributed to its study, he has been in a position to select the more relevant matter and to evaluate its trustworthiness. A bibliography, running into eleven pages, is appended. R. T. H.

Short Manual of Regional Anatomy:

Written for the Medical Student as an Aid to a Rapid Revision of the Whole Subject. By J. A. Keen. Pp. vii+167. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 5*s.* net.

THE author of this little work, who was formerly prosector and demonstrator of anatomy at King's College, London, deserves the gratitude of the student, whose labours he has done much to alleviate by his concise but lucid exposition. The English terminology adopted in 1933, in which eponymous nomenclature is omitted, is used throughout, but the older terms beloved of the medical historian are also given, and the Latin and Greek derivations, of which most students are ignorant, are appended to each chapter. The text is liberally interspersed with excellent figures and diagrams.

Appendicitis:

a Clinical Study. By W. H. Bowen. Pp. xii+202. (Cambridge: At the University Press, 1937.) 7*s.* 6*d.* net.

THIS little work, which Sir Arthur Hurst in his introduction declares to be the most satisfactory review of the subject in the English language, is based on the author's experience at Guy's Hospital and elsewhere. Special chapters are devoted to the etiology, diagnosis, prognosis, varieties of the disease, treatment and post-operative complications. A series of fifty-one cases is appended, classified in three groups according as the treatment was successful or unsuccessful, or other lesions were found at the time of the operation. The book should appeal alike to the physician, surgeon, general practitioner and senior student.

Miscellany

The Biology of Human Conflict:

an Anatomy of Behaviour, Individual and Social. By Dr. Trigant Burrow. Pp. xl+435. (New York: The Macmillan Co., 1937.) 15*s.* net.

IN this study of human behaviour the method and conditions of the inquiry upon which it is based are of no less interest and significance than the conclusions. The book is sponsored by the Lifwyn Foundation, a community formed for the purpose of this investigation at the instance, and under the inspiration, of the author. It consists of a number of individuals, male and female, socially and economically of varied but normal pursuits as ordinary citizens, who for sixteen years lived together as material for self- and communal-observation. The community was, in fact, the author's laboratory for the investigation of the fundamental causes which underlie the social maladjustments, of which insanity and criminality are among the most commonly encountered symptoms.

The point of view, or hypothesis, adopted by Dr. Burrow, which was thus submitted to examination, was based upon his previous experience of neuroses, suggesting that these and other evidences of conflict in behaviour are not abnormalities in a social environment which is predominantly sound, but indicate that the origin of the conflict is the elevation into a law of social conduct of the divorce between reality and the symbolism of the word by which reality originally was designated. The valid touchstone of behaviour is not the symbolism of the word, but the functioning of the organism as an integral whole. When, for example, the familiar dilemma of the relative character of the standards of good and evil is examined by an observer, who includes himself as material for observation and experiment, it emerges that, through symbolism, what is in fact secondary has been made the basis of judgment.

We Live and Learn:

Addresses on Education. By Sir Josiah Stamp. Pp. vii+214. (London: Macmillan and Co., Ltd., 1938.) 7*s.* 6*d.* net.

THE addresses printed in this volume cover a wide field. Consider their titles: graduation in social judgment, the management of mind, the limits of technical education, the development of post-primary education, education and the Christian view of the world, the tyranny and liberty of books, geography and economic theory, the institution in modern society, education and awareness. At first sight these nine themes appear unconnected. They turn nevertheless upon a three-fold conception of the aims and obligations of education, namely, that it should fit us to get a living, to live a life and to mould a world. If those aims, *in that order*, be accepted (and we doubt whether the acceptance is as widespread as the author believes) the link between the addresses becomes plain.

We hope the book will be read by educationists because it contains the kind of challenge they should expect when a mind as fresh and vigorous as Sir Josiah Stamp's examines their methods and purposes. His remark that he is "tired of people who pride themselves on their *general* ability and culture who have never been through the personal discipline of accurate and fine performance in some *particular*", might well be carefully studied by those to whom the word 'culture' represents something difficult to find in our modern industrial and commercial world. We hope, too, that the book will be read by scientific workers so that they may realize the danger to their own work if they lack awareness of the work of others, and of the interdependence of all branches of learning. J. W. M.

International Institute Examinations Enquiry

A Conspectus of Examinations in Great Britain and Northern Ireland. By Sir Philip Hartog, with the assistance of Grace Roberts. Pp. xiv + 182. (London: Macmillan and Co., Ltd., 1937.) 3*s*. 6*d*. net.

THE field (or jungle) covered by this bird's-eye view includes an amazing variety of tests applicable to examinees of all ages from ten upwards. The bird in question being Sir Philip Hartog, it is scarcely necessary to say that the view is comprehensive, keen, intelligent and lucid. It comprises (*a*) the Local Education Authorities', (*b*) the secondary school, and (*c*) the university examinations; also (*d*) those conducted under statutory authority for admission to professions or callings, and (*e*) a list of examining bodies classified under general subject headings—accountancy, advertising, aeronautics. . . . As regards (*a*), (*b*) and (*c*), the subjects of examination are set forth in detail. Incidentally, some light is thrown on methods. A glance through (*a*) shows that 'intelligence tests' are widely used as well as school records and interviews. In the university section, prominence is given to the growing practice of conferring degrees either wholly or partly for a thesis.

As regards (*d*) the various procedures adopted by Parliament in conferring authority to admit to certain callings are shown in brief without detailed lists of subjects of examination. This and the other publications ("English Bibliography of Examinations", "Examination of Examinations", "Essays on Examinations", "Marks of Examiners") of the Examinations Enquiry Committee (chairman, Sir Michael Sadler; director, Sir Philip Hartog) should be most helpful to all whose business it is to see that these multitudinous sifting processes function as beneficially as may be. The committee, and parallel committees in other countries, owe their existence to the International Institute of Teachers College, Columbia University and certain Carnegie endowments.

Science and Social Welfare in the Age of Newton

By Prof. G. N. Clark. Pp. vii + 159. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 6*s*. net.

A FACTOR in the growing concern of scientific workers with the social consequences of their work has been the realization that the extent of their work is itself largely determined by the nature of the society in which they work. In this interesting little study, Prof. G. N. Clark shows us, however, that this is no new phenomenon and that scientific progress was conditioned by the state of society as truly in the age of Newton as it is to-day. In a series of chapters dealing with science and technology, economic incentives to invention, the social and economical aspect of science and the social control of technological improvement, which represent the substance of four lectures delivered in the University of London in 1936, he gives a highly suggestive survey of the way in which not only has applied science influenced the whole structure of society but also science, and scientific methods, have been shaped and sharpened by what they took over from the arts and crafts and from the practice of merchants.

Prof. Clark traces five distinct groups of influence upon science, those from economic life, from war, from medicine, from the arts and from religion, all reinforcing or clearing the way for the sixth great motive, the disinterested love of truth, which it is the special social function of the universities to liberate from the pressure of other motives. In the final chapter he surveys the position of social science and shows that already at the beginning of the eighteenth century it appeared to have an established position and a great future. His little volume appears at an opportune moment and has claims on the interest of all those scientific workers who are concerned with the increasing co-operation of science and economic life. R. B.

Philosophy and Psychology

The Human Situation:

the Gifford Lectures delivered in the University of Glasgow, 1935–1937. By W. Macneile Dixon. Pp. 438. (London: Edward Arnold and Co., 1937.) 18*s*. net.

HOWEVER difficult and technical philosophy may be to-day, its purpose is still practical: knowledge and happiness are and remain fundamental urges of man, which cannot be brushed aside by a simple pronouncement of modern science that man is completely unimportant in the economy of the world. The only way to replace philosophy in that lofty station it should occupy in our interests, is to bring it back to the market place without stripping it of its academic dignity. This Prof. Dixon does with conspicuous success. In keeping with the intentions of the founder of the Gifford Lectures, the author discusses the evolution theory, personality, responsibility and determinism, relativity, quantum mechanics, original sin, Christianity and Buddhism, and all the major problems of thought and conduct in a 'popular' manner, by using words of daily speech in the sense to which we are all accustomed and with the purpose of being more easily followed.

The philosophical attitude of the author, which approximates that of Leibniz, makes his attempt the more sympathetic; while his co-ordination and criticism of the views held by philosophers, theologians and scientific workers, give his work an outstanding importance for our time, which suffers too much from extreme specialization.

T. G.

A Critical Exposition of the Philosophy of Leibniz: with an Appendix of Leading Passages.

By Bertrand Russell. Pp. xxiii+311. (London: George Allen and Unwin, Ltd., 1937.) 12*s*. 6*d*. net.

THE philosophy of Leibniz has achieved considerable importance in recent years, on account of the growth of mathematical logic, which is considered to be a development of it. Hence the interest of Russell's critical exposition of the great philosopher's views, and the justification for this second issue of the work. Though a reprint of the first edition (1900), the present book contains a preface in which Russell takes stock of Leibnizianism and points out where his own ideas now differ from those he held nearly forty years ago. In spite of the publication, in the meantime, of a wealth of small scripts of Leibniz which necessitate a readjustment of his views on some details, Russell finds little cause for altering his original estimate of the philosophy of Leibniz—an admission which gives an added interest to the re-issue of his masterly monograph.

Visual Perception

By M. D. Vernon. Pp. xi+247. (Cambridge: At the University Press, 1937.) 15*s*. net.

THIS monograph gives for the first time in a single volume a comprehensive and detailed account of the numerous experimental investigations that have been carried out on the nature of visual perception. It has been Miss Vernon's aim in this book to present a treatment of the subject as exhaustive as possible, while avoiding preconceived bias towards one or another hypothesis, and to record the essential results that emerge from the experimental work. The development of the process of perception, the relations between percept and observer and percept and object, and the development of perception in children, are dealt with in turn, and the work of the Gestalt school of psychologists is fully considered. An appendix contains descriptions of the most generally used tachistoscopes, and references to some four hundred publications consulted in the preparation of this monograph are contained in the bibliography.

Physics

An Introduction to Modern Thermodynamical Principles

By A. R. Ubbelohde. Pp. viii+132. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 8*s*. 6*d*. net.

A SERIES of lectures delivered in the Department of Thermodynamics at Oxford forms the basis of this book. The contribution which the Clarendon Laboratory has made to chemical thermodynamics is widely known, and the author has performed a valuable service in presenting the points of view of this school in such a readable form.

Nernst's theorem was probably better understood, in its early days at least, on the Isis than on the Cam: we find an adequate account of its successes and failures, though one might hesitate to subscribe wholeheartedly to the opinion—expressed in the preface—that thermodynamics is an essentially practical science. Carathéodory in his "Grundlagen" presumably thought much needed doing before that condition could be realized. The experimentalist, however, is often in a state of partial confusion between the various thermodynamic functions and the uses to which they may be put in the study of equilibria. This volume disentangles them with exceptional lucidity, and their practical value is always before the reader.

The discussion of the specific heat of solids follows conventional lines; it might, perhaps, have been more valuable if at least a mention had been made of Schaefer's analysis, which showed that in the immediate neighbourhood of the absolute zero Debye's T^3 law cannot be valid, and that a transcendental expression is demanded. Completeness apart, this result is exceedingly interesting on its own account as an example of the application of the theory of functions to a physical problem.

The chapters dealing with statistical mechanics are very well done, and give exactly the right amount of information, with no needless elaboration.

F. I. G. R.

Thermodynamics

By Prof. Enrico Fermi. (Prentice-Hall Physics Series.) Pp. x + 160. (New York: Prentice-Hall, Inc.; London and Glasgow: Blackie and Son, Ltd., 1937.) 3 dollars; 7*s*. 6*d*. net.

PROF. FERMI'S treatise is not so specialized as might be imagined from the fact that it is a development of a course of lectures given in 1936 at the Columbia University. It is classical in outlook and quite elementary in treatment, beginning with a close consideration of the definition of a thermodynamical system, about half the book being concerned with chapters on the first and second laws of thermodynamics and entropy.

A useful chapter on thermodynamic potentials where free energy is defined as $U - TS$ and the function $U - TS + pV$ is the thermodynamic potential at constant pressure, contains a clear, if condensed, treatment of the phase rule and the thermodynamics of the reversible cell. The two following chapters deal with gaseous reactions and with the thermodynamics of dilute solutions. The concluding chapter on the entropy constant and the Nernst theorem contains a few hints of quantum mechanical concepts.

The book is inexpensive and will form a useful addition to the shelves of the student of physics or physical chemistry. A. F.

Properties of Matter

By D. N. Shorthose. Revised edition. Pp. viii + 168. (London: William Heinemann, Ltd., 1937.) 4*s*.

THE author intends this book for higher school certificate and scholarship examinations. In the section on dynamics the general relations of mass and motion are assumed, as the book begins with a chapter on circular motion, followed by one on simple harmonic motion. It is doubtful whether the use of initials in place of the names of quantities is really an advantage. A few are, of course, well recognized, such as E.M.F. and H.P., but the use of M.I., P.E. and K.E. is questionable.

The chapter on gravitation follows the usual lines, but the fact that the attraction of a uniform sphere is the same as that of an equal mass at the centre is assumed. The chapter on surface tension is particularly good. Then follow friction and elasticity, omitting beams.

In the second edition a chapter on viscosity has been added for the sake of completeness. Throughout the book are numerous worked examples, and at the end of each chapter is a set of examples which the student will find extremely useful.

Travel

Stepping Stones from Alaska to Asia

By Isobel Wylie Hutchison. Pp. x + 246 + 20 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1937.) 12*s*. 6*d*. net.

THIS makes no pretensions at being a scientific compilation; it is merely "a little record of a happy summer". Nevertheless, it will delight the scientific worker with a taste for semi-adventurous travel not only because of its breezy narrative and vivid descriptions of new and noteworthy features offered by a little-known part of the world, but also because of the highly commendable (and unfortunately quite unusual) care with which the author has followed the dictates of specialists who have worked in the region concerned. This region is, primarily, the Alaskan-Aleutian Chain, which extends in graceful curve but treacherous seas nearly 2,000 miles westwards from north-west America towards Asia. Such notes as we are given on its flora and ethnology are right up to date, the theorizing being correspondingly restrained, with the result that we are presented with a record which will be of definite value to all who are interested in the life and surface features of the North Pacific.

The few small blemishes are in most cases unwarranted generalizations concerning other parts of the globe. Thus some places spoken of as being in northern Greenland are in reality far south on that great 'continent', even if their district is known to the inhabitants as "North Greenland", while the reviewer has seen Greenland (and also Baffin) Eskimo devour ravens with marvellous dispatch, and has even joined in the feast with no ill-effect or hint at a 'taboo'; he has also found *Spiranthes Romanzoffiana* growing wild in many places much nearer to the British Museum than Alaska or even Hudson Bay!

The author is an energetic Scottish woman, apparently of middle-age—an ardent and experienced, if technically untrained, botanical collector—with grit and perseverance as outstanding attributes. Now here lies a poignant indication; she has recently visited several of the least accessible regions in the world alone and without 'expedition press' or acclamation as a 'heroic explorer', which suggests once more that the epoch of such things and people is drawing to its natural close, and that its place is being taken by one of serious scientific investigation and honest travel.

N. P.

The Black Musketeers:

the Work and Adventures of a Scientist on a South Sea Island at War and at Peace. By A. J. Marshall. Pp. xiii + 329 + 35 plates. (London: William Heinemann, Ltd., 1937.) 15*s*. net.

MR. MARSHALL'S "Black Musketeers" are the Melanesian inhabitants of Espiritu Santo, the most northerly island of the New Hebrides group. The name by which he calls them is not so fanciful as it may seem. Their characteristic weapon, once the bow, is now the old Snider musket, a relic of the mid-nineteenth century.

Mr. Marshall, a young Australian, who had already won his spurs as an explorer and ornithologist on his own continent, joined Mr. Tom Harrisson, a member of the Oxford University Exploration Club's expedition to the New Hebrides. He was left behind by the expedition for a further year's observational work on the causes of a breeding season in animals and plants. The subjects of the investigation were birds, bats and lizards, of which specimens were collected for dissection at stated periods throughout the year. Meteorological observations were made and recorded daily. The routine work was certainly strenuous; but nevertheless the two colleagues had ample opportunity, as is shown in "Savage Civilisation", the book by Mr. Harrisson covering the same period, to make friendly and in some instances intimate contacts with the natives. Their most exciting adventure here recorded was an inter-village war, in which they barely escaped being involved; while a hurricane provided its share of thrills by partially wrecking their camp. Mr. Marshall is no less strong than Mr. Harrisson in his condemnation of the English-French condominium; but the work of the missionaries, however much it may have been misdirected in the past, is now accorded its meed of praise.

Forthcoming Books of Science

Agriculture, Horticulture and Forestry

Jonathan Cape, Ltd. Manavlins from My Garden—C. Elliott. Gardener's Nightcap—Muriel Stuart.

Cassell and Co., Ltd. Complete Poultry Keeper and Farmer—L. Pearce-Gervis. Ornamental Trees and Shrubs—H. H. Thomas and A. G. Forsyth. How Plants are Propagated—H. H. Thomas and A. G. Forsyth. Man, Bread and Destiny—C. C. and S. M. Furnas.

Clarendon Press and Oxford University Press. La Mortola Garden (Hortus Mortolensis)—E. Mario and Cav. L. Maurizio. German Forestry—F. Heske.

"Country Life", Ltd. Water Gardening—Frances and Amos Perry. Alpine House Culture for Amateurs—Gwendolyn Anley.

English Universities Press, Ltd. Principles and Practice of Animal Husbandry—T. Newman. The Fruit Garden—Dr. W. E. Sherwell-Cooper.

Leonard Hill, Ltd. Plant Growth-Substances—H. Nicol.

McGraw-Hill Publishing Co., Ltd. Forest Pathology—Boyce.

Methuen and Co., Ltd. Flowers of the Desert—H. A. Day.

Thomas Murby and Co. Principles of Soil Science—A. A. J. de Sigmond. Agricultural Analysis—C. H. Wright. Outline of Forestry—T. Thomson and R. M. K. Jerram.

John Murray. Our Daily Bread—Sir Daniel Hall.

Putnam and Co., Ltd. A Gardener's Progress—F. Stoker.

Frederick Warne and Co., Ltd. Experimental Garden Science—G. H. Holroyd.

Williams and Norgate, Ltd. Hardy Bulbs (Vol. 2. Amaryllidaceæ, Commelinaceæ, Hæmodoraceæ, Orchidaceæ and Scitamineæ)—Lieut.-Colonel C. H. Grey.

H. F. and G. Witherby, Ltd. Famine in England—Viscount Lymington.

Archæology and Ethnology

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New Fellows of the Royal Society of Edinburgh

At the ordinary meeting of the Royal Society of Edinburgh, held on March 7, the following ordinary members were elected: Mr. C. H. W. G. Anderson, head master and superintendent, Royal Blind School, Edinburgh; Dr. P. Bacsich, lecturer in human embryology, University of Glasgow; Dr. D. A. Bannerman, unofficial scientific worker, Department of Zoology, British Museum (Natural History); Mr. A. W. M. Beveridge, treasurer, Bank of Scotland, Edinburgh; Dr. G. B. Brook, district veterinary officer, County Council of Staffordshire; Mr. C. A. Carlow, managing director, Fife Coal Co., Ltd.; Sir Ian Colquhoun; Prof. M. M. Cruickshank, Madras Medical College, Madras; Mr. S. Cursiter, director, National Galleries of Scotland, Edinburgh; Dr. J. M. Dewar, Edinburgh; Mr. N. McOmish Dott, neurological surgeon, Edinburgh; the Right Hon. Lord Elphinstone; Mr. C. H. P. Gifford, Edinburgh; Dr. Cecil Gordon, lecturer in genetics, University of Aberdeen; Dr. W. S. Gordon, chief bacteriologist, Moredun Institute, Animal Diseases Research Association, Gilmerton, Midlothian; Dr. R. Kumar Goyal, research worker, School of Tropical Medicine, Calcutta; Dr. J. R. C. Greenlees, head master, Loretto School, Musselburgh; Mr. G. Hogarth, chairman, Fishery Board of Scotland, Edinburgh; Mr. J. D. H. Jamieson, lecturer in dental diseases, University of Edinburgh; Dr. A. M. MacGillivray, lecturer in clinical ophthalmology, University of St. Andrews; Dr. Alexander Mackie, science master, Trinity Academy, Edinburgh; Prof. W. H. McMillan, Hood professor of mining, University of Edinburgh and professor of mining, Heriot-Watt College, Edinburgh; Prof. Donald Mainland, Department of Anatomy, Dalhousie University, Halifax, Nova Scotia; Dr. C. A. Malcolm, librarian, Signet Library, Edinburgh; Sir John Maxwell Stirling Maxwell; Prof. H. H. Monteath, Conveyancing Department, University of Edinburgh; Dr. S. S. Munro, geneticist, Dominion Department of Agriculture, Ottawa; Prof. T. C. Phemister, Department of Geology, University of Aberdeen; Dr. A. M. Ramsay, formerly lecturer in ophthalmology, University of Glasgow; the Right Hon. Earl of Rosebery, lord lieutenant of Midlothian; Mr. J. Sandilands, lecturer in chemistry, Heriot-Watt College, Edinburgh; Mr. A. H. H. Sinclair, honorary surgeon-oculist to H.M. the King in Scotland, Edinburgh; Dr. James Stewart, chief biochemist, Moredun Institute, Animal Diseases Research Association, Gilmerton, Midlothian; Mr. J. L. Stewart, director of veterinary services, Gold Coast; Dr. A. Landsborough Thomson, principal assistant secretary, Medical Research Council, London; Dr. Robert Thomson, education officer, Air Ministry, Aylesbury, Bucks.; Dr. Andrew Topping, a senior medical officer, Public Health Department, London County Council; Prof. A. E. Trueman, Department of Geology, University of Glasgow; Dr. O. J. Walker, lecturer in chemistry, University College, London; Mr. Robert Wilson, master printer, Edinburgh; Dr. G. McCreath Wyburn, lecturer in anatomy, University of Glasgow.

Announcements

The Institute of Metals Medal "for outstanding services to non-ferrous metallurgy, whether on the practical or scientific side" was awarded to Sir William Bragg at the annual meeting of the Institute held on March 8.

The Bessemer Gold Medal for 1938 of the Iron and Steel Institute has been awarded to Dr. C. H. Desch, superintendent of the Metallurgical Department, National Physical Laboratory, Teddington.

The Keith Prize, for the period 1935–1937, of the Royal Society of Edinburgh has been awarded to Prof. H. S. Ruse, professor of pure and applied mathematics in University College, Southampton, for his paper "On the Geometry of Dirac's Equations and their Expression in Tensor Form" published in the *Proceedings* of the Society within the period, and for his other papers in the *Proceedings*.

At the sixtieth annual general meeting of the Institute of Chemistry, held on March 1, Sir Robert Pickard was re-elected president. The Meldola Medal for 1937 was presented to R. P. Bell, of Balliol College, Oxford, and the Sir Edward Frankland Medal and Prize was awarded to L. Smith, of the Sir John Cass Technical Institute.

Prof. Viktor Müller-Hess, director of the Institute for Forensic and Social Medicine in the University of Berlin, has been nominated a corresponding member of the Portuguese Academy of Sciences.

The Associated Voluntary Hospital Board has appointed a commission under the chairmanship of Dr. Arnold D. McNair to report on the investigation and treatment of cancer in the Liverpool area, and on the possibility of extending and improving the work. Particular attention is to be paid to the best way of using and co-ordinating the available hospital and research facilities. The Commission is also to decide whether a change is needed in the organization, policy or construction of a Liverpool radium institute and hospital for cancer.

The British Council has instituted twenty post-graduate scholarships, each of the value of £250, to enable foreigners who have graduated in their own country to pursue a year's specialized study at a British university. The scholarships have been allocated on the basis of either one or two for each of 14 countries. A wide choice of subjects is given, and include architecture, agriculture, engineering, trade, sociology, aviation, forestry, journalism, law, shipbuilding, textiles, Oriental languages, history, and English language and literature.

Erratum. After having been approved by the authors and finally passed for press, the block for the diagram illustrating the communication by Dr. J. B. Speakman and E. Stott in Nature of March 5, p. 414, was unfortunately inverted. The axes of the figure are, of course, correct; but the graphs should be inverted in relation to these axes.

Letters to the Editor

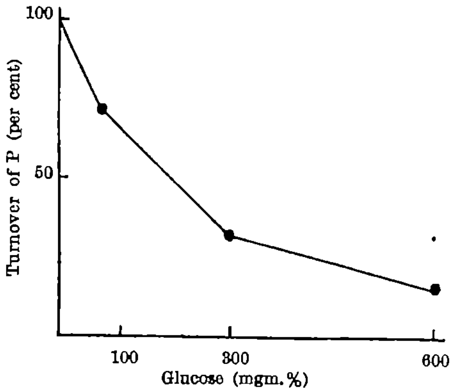
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 476.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Glycogen Breakdown in Muscle Extract and Yeast Juice

IT has been shown that the transport of phosphorus (P) between creatine and adenylic acid in muscle extract (Lohmann's reaction and its reversal) can be expressed as a chain of equilibria obeying the laws of thermodynamics and controlled by the pH[1,2]. Parnas and Ostern and their schools[3,4], have recently described another case of phosphorus transport in muscle extract in the formation of hexosemonophosphate from inorganic phosphate and glycogen. It appeared of interest to study the kinetics of this reaction.



INHIBITION OF GLYCOGEN BREAKDOWN BY GLUCOSE IN MUSCLE EXTRACT. 1 C.C. OF 10 DAYS OLD MUSCLE EXTRACT (AFTER MEYERHOF) FROM RABBIT + 2 C.C. ADDITIONAL SUBSTANCES CONTAINING 10 MGM. GLYCOGEN; 1·15 MGM. P AS PHOSPHATE BUFFER, pH 7·2; 200γ ADENYLIC ACID AS SODIUM SALT. 100 PER CENT TURNOVER WAS 0·51 MGM. P OF HEXOSEMONOPHOSPHATE FORMED.

It was first of all of interest to find that dialysed extract of yeast to which yeast adenylic acid was added behaved exactly like muscle extract; it phosphorylated only glycogen and not glucose. Willstätter and Rohdewald[5] showed that living bottom yeast condenses glucose to glycogen before phosphorylation occurs.

The reaction reaches in muscle extracts and yeast juice alike an equilibrium which may be expressed by the following equation, in which water cancels out and glycogen may be described sufficiently for this purpose as hexoseanhydride (n hexose $-$ ($n-1$) H_2O):

$$\frac{\text{Mol. Hexosemonophosphate}}{\text{Mol. Hexoseanhydride} \times \text{Mol. Phosphate}} = K \times 10^{-3}$$

At 37° and pH 7·2, K was between 0·02 and 0·08 and of about half that value when starch was used instead of liver glycogen. Hexosemonophosphate, the product of the reaction, inhibits esterification of glycogen. Of more general interest is the observation that the glycogen breakdown can also be suppressed by glucose.

The braking effect of glucose on glycogen decomposition is 50 per cent at a concentration equal to that of the sugar level in normal blood, and nearly vanishes at a concentration corresponding to hypoglycæmia *in vivo*.

Two suggestions may be made which account for these observations with muscle extract.

(a) Lactic acid formation from glucose (which needs no inorganic phosphorus and has glutathione as coenzyme) may be different[6] in its physiological meaning from the lactic acid formation from glycogen (which needs phosphorus, magnesium, adenylic acid and cozymase). The former reaction, prevailing, for example, in brain (Ashford and Holmes[7]), and in the embryo (Needham and Nowinski[8]) would serve for continuous functioning and would be kept up steadily by the glucose level of the blood. The latter reaction, most pronounced in skeletal muscle, would act as a reserve and increase the lactic formation, acting discontinuously as a 'second wind' where sudden heavy demands on the blood sugar cause local hypoglycæmia.

(b) Secondly, the phenomenon observed may help to make intelligible the mechanism of hypoglycæmic convulsions. Sudden increase in breakdown of muscle glycogen, which is connected with muscular contraction, should occur when the blood sugar is low. These convulsions are already known to be independent of the brain as they can occur in the decapitated animal[9], where a dehydration of the blood takes place which, as Olmsted and Taylor[9] have described it, "could be due to increase in molecular concentration within the tissue itself". Excess of hexosemonophosphate, a very active oxygen acceptor, could account further on for the extreme deoxygenation observed by the same authors in hypoglycæmic blood which in the arteries was already of venous appearance. Hypoglycæmic convulsions in insulin shock depend in their intensity on the previous diet of the experimental animal, and they are much more marked after a diet rich in carbohydrate (Abderhalden and Wertheimer[10]). This should lead to glycogen storage in the tissues.

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Jan. 25.

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Magnesium and Calcium Content of Hedgehog Serum during Hibernation

OUR knowledge of the mineral metabolism of hibernation is still very meagre. I have therefore investigated, among other questions, the magnesium and calcium content of hedgehog serum. Part of the animals were analysed in early October, about four to five weeks before the final onset of hibernation, and others in early January when the hibernation was at its deepest. Calcium was determined by Kramer and Tisdall's method; magnesium was precipitated as magnesium ammonium phosphate according to Rappaport[1], and the phosphorus was determined colorimetrically with a Zeiss Pulfrich-photometer according to the amidole method of Müller[2].

In autumn, before the onset of hibernation, the magnesium content of the hedgehog serum averaged 3·20 mgm. per cent. The series comprised seven animals, the magnesium content varying from 2·90 to 3·55 mgm. per cent. The calcium content of the serum of these animals averaged 10·0 mgm. per cent, with variations ranging from 9·2 to 10·6 mgm. per cent. The average ratio calcium to magnesium was 3·15.

In the beginning of January the hedgehogs were in deep hibernation. The magnesium content of the serum then averaged 5·43 mgm. per cent. The series consisted of six animals, the variations in the magnesium content being 4·90–6·05 mgm. per cent. The calcium content in the serum of these animals averaged 10·2 mgm. per cent, varying from 9·6 to 10·7 mgm. per cent. The average ratio calcium to magnesium was 1·88. It is seen that the magnesium content of the hedgehog serum has increased considerably during hibernation. In the above experiments, the magnesium value during the deepest hibernation in mid-winter was 170 per cent of the corresponding value in autumn, before the onset of sleep. On the other hand, the calcium content remains constant. This causes a decrease in the ratio.

It seems that the increase of the magnesium content of the serum during hibernation is an important phenomenon in general biology. Lustig, Ernst and Reuss[3] have recently shown that there is a considerable increase also in the magnesium content of the blood of Kursiv during winter torpor. It is known that the most striking effect of the magnesium ion is its power to produce anæsthesia. It has an anæsthetic effect on several invertebrates of sea and fresh water and, as shown already by Meltzer and Auer[4], also on vertebrates. The anæsthesia disappears if some calcium is injected into an animal previously treated with magnesium. In view of these results, it is interesting to note that, according to my determinations, there is not only an increase in the magnesium content of the serum of the hibernating hedgehog, but also a considerable change in the ratio calcium to magnesium.

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A Contradiction in the Present Clearance-Reabsorption Views of Urea Excretion

BEYOND a certain rate of urine flow, for man, dog, rabbit, etc., and provided the blood concentration does not exceed a concentration of about 200 mgm./100 ml., the following equation holds approximately:

$$\frac{\text{Output of urea}}{\text{Blood conc.}} = \text{constant},$$

and has been chiefly demonstrated by the work of Addis and Drury[1]. The constant of this equation has been interpreted as a volume of blood per minute by Van Slyke and Peters[2] and called a 'clearance', since it has also the dimensions of a volume. The interpretation is here particularly unsafe since a much better equation applying over the whole range of urine volume gives a constant with no such dimensions (a diffusion pressure equation).

The explanation given of the constancy is that there is a constant filtration rate at the glomerulus and that variations in the urine volume excreted are almost altogether due to different volumes of water reabsorbed. Since, however, the inulin clearance is about twice that of the urea[3] and inulin is not regarded as actively excreted by tubular action, it must necessarily follow that about half the glomerular output of urea is reabsorbed in the passage through the tubules. It is this view that contains an inherent contradiction.

To demonstrate this, we may suppose that the subject (human) is excreting at a rate of 200 ml. urine per hour and at a blood urea concentration of 20 mgm./100 ml., this being achieved by water drinking. After the water diuresis has passed, urea is administered so that the blood concentration reaches 80 mgm./100 ml. and the urine rate again reaches 200 ml. per hour. There is now a general agreement that—at least within 10 per cent—the average clearance value will be the same as before. This can only mean on the above view that four times the amount of urea is being reabsorbed back across the tubule, and hence the conclusion that urea is reabsorbed back in proportion to its lumen concentration is inevitable.

It may then be supposed that the subject drinks water so that his urine rate reaches 800 ml. per hour. The clearance will remain unchanged, so that the amount of urea reabsorbed is the same as before, but at the same time the lumen concentration has fallen to upwards of one fourth its previous value, from which we may conclude in turn that the back absorption of urea is independent of its lumen concentration. This contradicts our previous conclusion.

Put in another way, it may be said that from the present clearance-reabsorption views, the excretion of urea or urea clearance should rapidly and asymptotically approach that of inulin beyond a urine rate for the human subject of about 120 ml. per hour. Of this it may be said with certainty there is no sign; since even if recent work[4] has shown a rise in the urea clearance with increasing rate, it goes parallel to the inulin clearance, which has been regarded as a standard for measuring the glomerular filtrate.

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Decomposition of Organic Peroxides

IN order to study the influence of peroxides on the oxidation of hydrocarbons and to discover the part they play in the phenomenon of ignition, the mode of their decomposition and oxidation is being further investigated. It has been found by Neumann[1] that diethylperoxide decomposes with luminescence above pressure limits (p_0) which are connected with temperature according to the relation $\log p = A + B/T$. We find that A and B depend on the dimensions of the vessel in which the decomposition occurs. Up to the neighbourhood of the sharp pressure limits the peroxide decomposes unimolecularly with an activation energy 34 kgm. cal. The influence of foreign gases (such as helium) on the pressure limits appears to be small, and similar to the behaviour of such gases on the decomposition of azomethane[2].

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Meteoric Ionization in the *E* Region of the Ionosphere

IN a letter which recently appeared in these columns[1], T. L. Eckersley described the discovery of great numbers of short-lived ionic clouds in the upper atmosphere. He suggests that the responsible agents might be small meteors or high-speed particles of cosmic origin. His data support the assumption of a meteoric origin so strikingly as to warrant special emphasis.

These clouds appear in the *E* region of the ionosphere in which meteors are known to spend most of their energy and from which most of the meteoric reflections of radio waves have been obtained. They are apparently short-lived isolated clouds in which momentarily the ionization reaches a value much higher than the average. This is precisely the sort of thing to be expected from the passage of a small meteor. Since a very bright one (−1 mag.) left sufficient ionization to reflect 180 metre waves for 7 minutes after its passage[2], the short period (of the order of a second) during which reflections are received from these clouds is consistent with their magnitudes. For since there are many more of these clouds than there are meteors as seen by a single observer, the meteors producing them must be fainter than the sixth magnitude on the average.

On the basis of telescopic observations, it has been estimated[3] that 10^9 meteors (of eighth magnitude or brighter) enter the earth's atmosphere every twenty-four hours. One should thus expect about 180 such meteors in an area 500 km. in diameter in 40 seconds. Eckersley found for these conditions about 30 ionic clouds or 1/6 as many as the estimated number of meteors. The agreement is as good as could be expected considering the nature of the phenomenon.

Even ultra-short waves which are not ordinarily reflected by the ionosphere might be expected to suffer reflection by ionic clouds of meteoric origin. L. F. Jones[4] has reported observations on such waves which might have this same primary cause. Regarding television signals, which are not ordinarily received with usable field strength at the long distance over which he was working (284 miles), he states: "Sometimes the signal would burst through sharply for a short period . . . ," and again, "the signal . . . reaches momentarily an occasional maximum of great intensity".

Ionic clouds of meteoric origin must be discrete regions in which the ionization is very dense. The rate of recombination would therefore be high and the life of the clouds would be short. This reasoning is consistent with the observed short duration of reflections and again points to the meteoric origin of Eckersley's clouds.

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Jan. 11.

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Disintegration Processes by Cosmic Rays in Plates impregnated with Samarium

Blau and Wambacher[1] have recently described experiments in which it appears that a novel type of disintegration may be provoked by cosmic radiation. 'Stars' of tracks due to heavy particles were found in plates which had been exposed for some months at a high altitude. For two years we have been conducting experiments of the same type. We find stars of a similar kind, but there are important differences between our results and those of the Vienna workers, which are indicated below.

The experiments were commenced with the view of discovering whether the cosmic radiation has any influence on the radioactivity of samarium. Ilford *R* plates were used, and samarium was incorporated into the emulsion by soaking part of the area of each plate in a solution of samarium sulphate. After exposure and development the boundary of the impregnated area is visible on the plate. After preparing a number of plates in this way they were sealed in a small box, along with untreated plates for subsequent comparison. One such box of plates was kept for five months, May–September, at Gulmarg in Kashmir (latitude 34° N.). A similar box of plates was kept for an equal period in Bombay, being placed in a refrigerator to avoid the deleterious effects of the high temperature. After allowing for the thickness of the packing and the roof of the building, it may be assumed that the Kashmir plates were at an equivalent height of 8,000 ft. above sea-level. The Bombay plates were practically at sea-level.

In the first set of experiments carried out in 1936, some stars of tracks were found. The plates, however, were unfortunately rather poor, and we were not able wholly to exclude the possibility of some radioactive contamination. The experiments were therefore repeated in 1937, taking every possible precaution. This time good plates were obtained, which have yielded the following results.

(1) Both in the Bombay and Kashmir plates, we find practically no tracks in the untreated plates, nor in the blank areas of the treated plates. The only tracks found are those due to the natural radioactive content of the glass, such as were described in an earlier paper[2]. This result contrasts with that

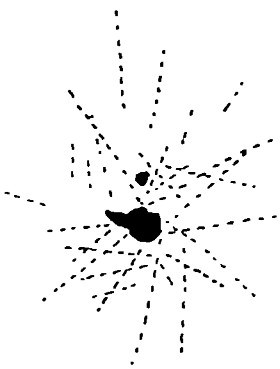
of Blau and Wambacher, who find stars in untreated plates. The difference may possibly be traced to the different sensitivity of the plates employed.

(2) In the treated areas of both Bombay and Kashmir plates, numerous tracks are found which are due to the short-range α-particles which are emitted by samarium. The number of such tracks gives a convenient indication of the quantity of samarium incorporated into the emulsion. The tracks of longer range, previously ascribed to protons[3,4], are also observed, with much the same relative frequency as in previous experiments.

(3) Numerous stars are found in the treated areas of the Kashmir plates. These stars comprise from two to six tracks. (It may be noted that contamination by radiothorium would only give stars of five tracks[5].) The ranges and directions appear to be distributed at random, and the maximum ranges do not exceed 5 cm. of air.

(4) The treated areas of the Bombay plates are apparently almost free of stars. Further search has still to be made, but in the considerable area already examined only one star has been found. In any event their relative frequency, as compared with the stars in the Kashmir plates, must be well below 1 : 100.

(5) We observe, in the treated areas of the Kashmir plates, but not in the Bombay plates, a phenomenon of an apparently different kind which we call a 'cluster'. This is best indicated by the accompanying sketch. Numerous tracks, up to about 40 in number, emerge from a limited area, but not from a point. Twelve such clusters have been observed. It has been pointed out previously[2] that *R* plates occasionally show a single very large grain of silver bromide, which appears on the developed plate as a black area having a diameter of perhaps 10 μ. We find that such a large grain is situated in the central region of seven out of the twelve clusters. As the large grains are relatively rare, it is clear that this cannot be fortuitous, and we must therefore conclude that the clusters, or some of them, are associated with the presence of silver or bromine.



(6) Both in the stars and in the clusters the individual tracks appear to be due to protons, judging by the density of grains along the track, but we cannot be certain of this conclusion.

It is perhaps premature to offer any interpretation of these results, of which we hope to publish a fuller account elsewhere. Further experiments are in progress.

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Jan. 29.

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Factors influencing Stability of Superlattices

In metallic solid solutions atoms of the different elements are usually distributed at random throughout the lattice. In certain cases, however, an ordered distribution, or superlattice occurs. The transformation from order to disorder has received considerable attention because the simplicity of the process renders it susceptible to theoretical interpretation. The entropy change is practically equal to the entropy of mixing, which can be calculated from first principles. The ordered state, which has the lower entropy, will be stable only when its internal energy is lower than that of the disordered configuration.

Two factors influencing the energy of ordering have been recognized, namely, forces between neighbouring atoms and lattice strains due to differing atomic sizes. It has not been emphasized, however, that both factors operate simultaneously. In the ordered state, atoms tend to be surrounded by foreign atoms. Hence attraction between unlike atoms stabilizes the superlattice. Hume-Rothery and Powell[1] point out the second factor that lattice strains due to differing atomic sizes will be less in the superlattice. The energy of ordering is thus due partly to interactions between neighbouring atoms and partly to geometrical strain. The latter factor is predominant in chemically similar atoms.

It occurred to us that these factors could be separated in studying the effect of silver on the gold-copper superlattice. When some of the gold atoms are replaced by silver atoms, which are practically the same size, the geometrical factor remains constant. Any change must be due to difference in attraction between neighbours.

The fifty atomic per cent gold-copper superlattice is most suitable for study since a change of symmetry, easily detectable by X-rays, occurs when the lattice becomes ordered. In the disordered state each gold atom has on the average six copper and six gold neighbours, while in the ordered state there are eight copper and four gold neighbours. The non-geometrical part of the energy of transformation is due to the breaking up of gold-gold and copper-copper pairs to form gold-copper pairs.

$$\mathrm{Au:Au} + \mathrm{Cu:Cu} = 2\,\mathrm{Au:Cu}$$

Silver atoms substituted for gold should go into the gold superlattice positions, and part of the above process now consists in the breaking of silver-gold pairs to form silver-copper pairs.

$$\mathrm{Ag:Au} + \mathrm{Cu:Cu} = \mathrm{Ag:Cu} + \mathrm{Au:Cu}$$

Deviation from Vegard's law of additivity of atomic radii has been proposed as a measure of forces between atoms in alloys[2]. Strong attraction should result in pulling atoms closer together, resulting in a negative deviation from Vegard's law, while positive deviation indicates a weak attraction. In the absence of direct measurements of heats of reaction, this is our best criterion.

Accepting deviation from Vegard's law as a measure of forces between atoms, the results of the above experiment may be predicted with confidence. Silver-gold has a negative deviation, indicating strong attraction, the copper-gold deviation is positive indicating weaker attraction, while the silver-copper attraction is weakest of all. Hence it is more difficult to break the strong silver-gold pairs to form the weak silver-copper pairs in the ordering process represented by the second equation above than to carry out the corresponding process in the first equation. Silver should thus decrease the stability of the superlattice, lowering the transformation temperature.

Our experiments give the predicted results. As silver is substituted for gold, the transformation temperature gradually decreases. For example, in an alloy of 46 atomic per cent gold, 4 silver, and 50 copper the transformation occurs near 360° C., while in the 50 gold-50 copper alloy the transformation temperature is considerably higher, best reports[3] placing it near 425° C.

Since the energy of ordering can be approximately calculated from the transformation temperature and the entropy change, this furnishes a semi-quantitative comparison of the energies of interaction between the pairs concerned.

We are also determining accurately atomic volume and axial ratios at different annealing temperatures. We confirm the existence of the orthorhombic phase reported by Johansson and Linde[4] and find that it persists after long periods of annealing at temperatures lower than they report. We hope to publish the complete results elsewhere after our work is concluded.

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Some Observations on the Rotating Pendulum

WHEN a simple harmonic pendulum is viewed binocularly with a neutral-tint filter in front of one eye, the pendulum, instead of swinging to and fro in a plane, appears to swing in an ellipse, first advancing towards and then receding from the observer[1]. The simplified but not quite true explanation of the illusion is that the 'latent period' of vision in the unobscured eye is shorter than that in the other eye, the brighter retinal image being followed by the shorter latent period. If with a pendulum swinging from right to left, both eyes fixate the true position in space of the pendulum, then the right eye will project the pendulum along a line to the right of the line of fixation whilst the left eye if obscured will project it along a line still more to the right of its line of fixation. The lines of projection will intersect at a point on the observer's side of the pendulum and this is the position in space which the pendulum will appear to occupy. Similarly it can be shown that the pendulum will appear to recede from the observer when passing from left to right and that its point will trace out an ellipse. Using a movable pointer beneath the pendulum, an observer can measure the apparent forward displacements with filters of varying densities in front of one eye and it is possible to calculate the difference in time (sec.) between the latent periods of the two eyes (ΔLP) for any given ratio between the retinal illuminations of the two eyes (I_u/I_o). I find that the relation is $0{\cdot}02 \log_{10} I_u/I_o = \Delta LP + c$, where c is a small constant depending on the difference between the latent periods of the unobscured eyes. The relation holds accurately for any one illumination of the pendulum, but with any given filter ΔLP becomes smaller if the illumination is considerably increased.

With the filter in front of the right eye the pendulum will seem to swing anti-clockwise, and provided the eyes are treated alike in other ways, we are probably justified in saying that because the right retinal image is less bright, the latent period is longer. It might be thought that a source of light shining into the right eye would lower the apparent brightness of the pendulum by simultaneous contrast. This in its turn might lengthen the latent period and the apparent motion of the pendulum would be anticlockwise. This, however, is not so, and with an illumination of 15 ft.c. on the pendulum, a small electric torch shining into the right eye from a distance will produce a considerable clockwise rotation. Contrary to expectation, the extraneous source of light shining into the right eye has decreased and not increased its latent period. This result is probably due to nervous interaction between various parts of the retina since the illusion decreases progressively when the angle between the pendulum and the light source is increased, finally disappearing at about 30°. In addition, the illusion is not obtained when the image of the light source falls on the blindspot.

The illusion also appears when one eye looks through a sheet of glass in which is reflected the light from the open sky, and it does not matter whether the reflection of the sky covers the pendulum completely or merely covers the field of vision to one side of it. The latent period always appears to be shorter in the eye with the additional illumination. It might be thought that these experiments could be explained by saying that scattered light within the eye adds itself to the retinal brightness of the pendulum's image and so shortens the latent period of perception. That this is not the true view can be shown by the following experiment. When the electric torch is held close to one eye for a few seconds, that eye still has the shorter latent period even after the torch is removed. To the dazzled eye the pendulum appears much darker than to the normal eye, showing that the latent period can be varied independently of brightness and that there is no rigid connexion between them. The dazzled eye has apparently gained in quickness of perception but has lost in other ways. Frank Allen[2], working on the critical frequency of flicker, argued that because the fusion frequency of a test patch was higher when other parts of the retina were illuminated, that, therefore, the apparent brightness was higher. A given visual brightness is not followed by an unvariable latent period, and it is doubtful whether Allen was justified in assuming that, because the fusion frequency was raised, the apparent brightness was also higher.

It is rather surprising that the pendulum appears to swing almost straight after one eye has been dark adapted for five minutes or so, and we must conclude that the retinal interaction is largely confined to the mechanism of photopic vision.

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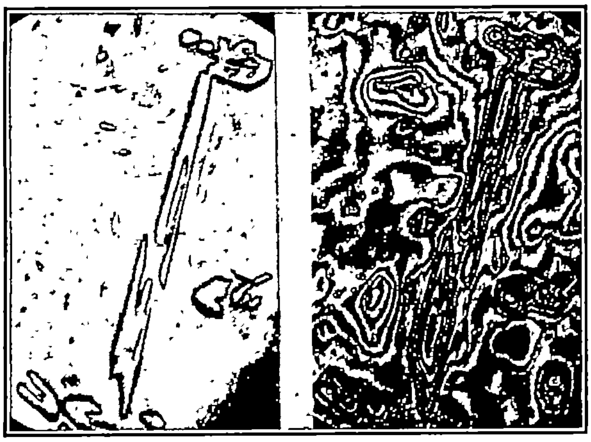
Metallography: a New Technique

The interference fringe technique for examining the topography of metal surfaces (previously used to study superficial irregularities in the coating of tin-plate[1]) has now been improved and its applications extended. The technique consists in observing or photographing the interference fringes that form between a partly silvered optical flat and the metal surface under examination. A detailed 'contour map' of the surface is thus obtained, the vertical spacing of the contours being one half the wave-length of the monochromatic (sodium) light used.


a *b*

Etched babbitt metal. (*a*) Vertical illumination; (*b*) interference fringes on the same field. (× 100).

A simple application of the technique is illustrated in the accompanying figure. The surface is that of a tin-base, tin-copper-antimony alloy (babbitt metal) which has been metallurgically polished and very lightly etched with 0·5 per cent nitric acid in ethyl alcohol. (*a*) is a photomicrograph taken with ordinary vertical illumination; (*b*) shows the fringe formation on the same field. It is apparent that the acicular structure of the copper-tin compound is at a level different from that of the ground-mass. The direction and extent of this difference can be easily determined.

In general, this technique can be applied to the study of any action which may give rise to characteristic differences of level in a surface. Irregularities caused by polishing a surface the constituent phases of which are not of equal hardness, or caused by differential attack of etching reagents due either to distinct phases or to varying crystal orientations of the same phase or to boundary effects, are all susceptible to study by the technique, and we hope to report more fully on some of these aspects in due course. The study of electro-deposited surfaces is also in hand.

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The Kurumi (Japan) Meteorite

Mr. Yasuake Iba, a well-known Japanese amateur astronomer, wrote to the Harvard Observatory on October 7, 1934, that he had examined a meteoritic stone which fell near Kobe, Japan, on May 27, 1930. No reference to this fall appeared in two recent bibliographies of meteorites[1]; and for the completeness of the records it appears advisable to make known the information supplied by Mr. Iba.

At about noon on May 27, 1930, in Kurumi, a village near the town of Miki, north-west of Kobe, Mr. Jitsuzo Kuriyama and his wife were about to take tiffin when a rumbling sound attracted their attention. Suddenly something fell on the roof of their house. They rushed outside and saw steam rising from a near-by ditch and from it they dug out the main portion of the meteorite, 38 gm., 4 cm. × 3 cm. On the ground under their roof was found a fragment of 8 gm., 2 cm. × 1 cm., which was too hot to handle immediately. "The roaring sound in the sky which lasted for some time was so striking that the mechanics, busily engaged in the making of farm implements amidst a boisterous clamour of running motors, had to stop swinging their hammers to listen to it. . . . For the sound and the mass of the meteorite the damage was very slight, only one tile having been cracked."

The photograph (as reproduced herewith) and description sent by Mr. Iba show the stone to be a chondrite of "light sky-blue tint with yellowish granular particles (small patches) intermixed". (Only the two fragments were recovered, although others surely fell.) The name adopted in Japan for this fall is Kurumi Inseki (Kurumi meteorite), and Kurumi is apparently the name which should be generally adopted. The depository of the meteorite was not communicated, but can probably be given by Mr. Iba, whose address is Ohte, Kobe, Japan.

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The Australian Aborigines

MAY I refer briefly to the important article on the Australian aborigines published in NATURE of December 18, 1937.

When Europeans took charge of the continent in 1788, there were, it is estimated, about 300,000 aborigines who had adapted themselves to the hard conditions of the Australian bush and had developed totemism and elaborate tribal customs. There are now none in Tasmania, about fifty in Victoria and a few in New South Wales. But in tropical Australia there are about 60,000, many of whom are afflicted with diseases, introduced by various races, and there are about 22,000 half-castes, European, Chinese, Japanese, etc., who are rapidly increasing.

The opinion of anthropologists seems to be that the pure aborigines will not survive unless they are placed on areas into which non-aborigines may not enter except on duty and where they may continue to live as they have always done. It is sometimes said by way of criticism that they have never cultivated an Australian plant or domesticated an Australian animal. This is, I believe, correct; but, in fairness, people must be reminded that the European has never succeeded himself in doing either of these things. Indeed, Governor Philip with his first party in Sydney in 1788 would in all probability have died of starvation where the aborigines thrived unless he had shipping resources at his disposal. Even then, he was hard put to it to save the settlement.

But biological historians remind me that the domesticated animals and cultivated plants, even in Europe, are prehistoric in origin though they have been developed out of recognition by skilled breeding. The Australian aborigine missed the opportunity, if it ever existed, of domestication and cultivation. As it is, the life of a European lost in the bush is usually very short. The feeling in Australia with regard to the preservation of the aborigine is growing steadily but the task is not easy. Medical care there must be, and I am personally of opinion that it will succeed only when either the aborigines or the half-castes are trained in medicine to some extent. Many of them can be useful on pastoral properties. The half-castes are often capable, and will, and must, be absorbed into the general population. It is in this direction that the missions can render great service and I believe in at least one instance are taking useful action.

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Points from Foregoing Letters

DIALYSED extract of yeast, to which yeast adenylic acid is added, phosphorylates only glycogen and not glucose, according to H. Lehmann. As in the case of muscle extracts, this reaction, in which hexosemonophosphate is formed from glycogen and inorganic phosphate, reaches an equilibrium. The breakdown of glycogen to hexosemonophosphate is inhibited by glucose, a fact which may have a bearing on the regulation of carbohydrate metabolism in the living organism.

The magnesium content of hedgehog serum increases from an average of 3·20 mgm. per cent in the autumn, before the onset of hibernation, to an average of 5·43 mgm. per cent in January, during hibernation. This increase in the concentration of magnesium ions, unaccompanied by a corresponding increase in the concentration of calcium ions, produces, according to Dr. P. Suomalainen, an anæsthetic effect.

Prof. E. J. Conway states that the view that there is a constant rate of filtration of urine at the glomerulus and that variations in the urine volume excreted are almost entirely due to different volumes of water reabsorbed in the passage through the tubules, leads to a contradiction: on the one hand, the average 'clearance value' after administration of urea (so as to increase its concentration in the blood) remains the same, which shows that urea is reabsorbed in proportion to its 'lumen' concentration. On the other hand, increased rate of flow of urine through drinking more water also leaves the 'clearance value' unchanged, which indicates that the amount of urea reabsorbed is the same as before, hence unaffected by its lumen concentration.

Prof. A. M. Skellett points out that the number of meteors of the 8th magnitude or brighter, estimated on the basis of telescopic observations, entering the earth's atmosphere could account for the 'ionic clouds' detected in the *E* region of the upper atmosphere from their effect upon radio waves. The ionic clouds produced by meteors would have high ionic density and short duration.

The presence of 'stars' and 'clusters' of tracks, apparently due to protons, upon photographic plates impregnated with samarium and exposed to the action of cosmic rays at a high altitude in Kashmir (equivalent height 8,000 ft. above sea-level) is described by Prof. H. J. Taylor, D. Fraser and V. D. Dabholkar. The clusters appear to be associated with the presence of silver and bromine. Control plates at Bombay did not show the phenomenon to any appreciable extent.

R. Hultgren and L. Tarnopol find that substitution of silver for gold in gold-copper alloys decreases the temperature of transformation from the 'ordered' state—in which a gold atom is surrounded by eight copper and four gold atoms—to the 'disordered' state —in which each gold atom has on the average six gold and six copper neighbours. The experiments were carried out to determine the 'energy of ordering' due to interactions between neighbouring atoms, as distinct from that due to geometrical strain and the results, the authors state, agree with the predictions.

Dr. R. J. Lythgoe, using Pulfrich's rotating pendulum, calculates the increase in 'latent period' of vision produced by a given decrease in retinal illumination. Contrary to expectation, 'glaring' sources of light decrease the latent period both at the time and afterwards. The phenomenon is probably due to nervous interaction in the retina.

Describing a new metallographical technique, B. Chalmers and W. E. Hoare show that microscopic differences of level in a metal surface can be accurately measured by examining the interference fringes formed between the surface and a partly silvered optical flat.

Research Items

Effect of Physical Culture upon Women

THE results of an experiment conducted at the University of Minnesota on the effects of physical education for women have recently been issued ("Measurement of Outcomes of Physical Education for College Women". By Elizabeth Graybeal. University of Minnesota Press). Freshly entering women students were divided into two groups, one of which participated in a course of physical education, while the other control group did not. It was found that during a one-year period of experimentation, the experimental group made significantly—that is, statistically—greater gains than the control in attitudes towards health and physical education activities, in knowledge of health and physical education, and in general motor ability. In contrast to this result, the Health Organisation of the League of Nations (*Bull.* of the Health Organisation, 6, No. 4, p. 551) considers that women less than twenty-one years of age are not fitted for strenuous athletic effort, that the female organism fails to respond to intensive training, and that the majority of light athletics should be banned for women, flat racing being limited to 60–80 metres. Long runs, fencing, boxing and wrestling are considered unsuitable for women.

Mental Hygiene of Intellectual Work

DR. C. S. MYERS points out that, owing to the wide range of individual differences, it is impossible to lay down definite laws of mental health with regard to intellectual work ("The Mental Hygiene of Intellectual Work", *Occupational Psychology*, 12, No. 1). Some intellectual workers have done excellent work under the influence of drugs, whereas others have found them detrimental. Some work best when living a strictly ordered life, others when extremely irregular. Some work best at night, and some in the daytime. In learning and thinking, the emotional and conative factors are of fundamental importance: irritation, worry, anxiety, obsessional tendencies, and the consequences of other maladjustments and conflicts are obviously detrimental. Therefore normal affective conditions and unobstructed volition must be our ideal; thus it is not enough to 'train the intellect', since the whole personality in harmony with its social setting must be developed. Nor can we rule out the importance of interest and native talents. No intellectual work can be successfully performed without intellectual discipline, which, however, must not be understood as synonymous with mere routine. Interesting exercises could be planned and practised in order to improve intellectual work, with the result that disturbing impulses will be better controlled, thereby facilitating concentration and voluntary effort. Again, intellectual work has to be performed by means of the body and in a particular environment. There is a real need, therefore, for adequate food, exercise and sleep, as well as for the necessary material environmental conditions, such as lighting, heating, ventilation, and so forth.

Periodical Fluctuations in Game

PERIODICAL fluctuations in the number of individuals of various species is now well known and has been attributed to various causes. Mr. J. Baashuus-Jessen discusses this in regard to the smaller mammals of Norway in recent years in *Norges Svalbard-og Ishavs-undersökelser* No. 36 (Reprinted from *Norges Jeger-og Fiskerforbunds Tidsskrift*, Hefte 2 and 3, 1937). In 1934 there was a superabundance of small rodents, especially voles. This led to an increase in the number of foxes, stoats, buzzards, eagles and hawks and even of wolves. By 1935, the abundance of small rodents had stopped and there was a reduction in the number of hares and game birds which the beasts of prey had devoured, and these beasts in turn had become numerous. The year 1936 was marked by a great scarcity of game, but now it is expected that this will cause a reduction in numbers of foxes, eagles, hawks, etc. Mr. Jessen, while admitting the possibility of epidemics in reducing numbers of rodents, or their absence in allowing increase, thinks that climatic causes are more potent. A sudden thaw causes the drowning of lemmings. Drought or sudden frost may diminish nutriment and cause the prevalence of deficiency diseases. Migration, reduced fertility and diminished power of resistance to virus diseases may also result.

Snakes of Yucatan

THE peninsula of Yucatan juts into the Caribbean Sea from the mainland of Central America, and at its opposite ends exhibits extremes of meteorological, faunal and floral conditions. The composition of its fauna is therefore a matter of unusual interest. A collection of snakes, made by E. Wyllys Andrews in the States of Yucatan and Quintana Roo in 1937, was found by him to include forty-two species. Of these, the majority (24) belong to widespread species, six to sub-species which are off-shoots of forms found in the regions bordering the peninsula, and twelve are distinctive forms not connected by intergradation with the inhabitants of neighbouring areas (*Zoo. Ser. Field Mus. Nat. Hist.*, 20, No. 25, 355). The last of these groups seems to represent the relic of an earlier fauna which has now in part disappeared in the territory adjacent to Yucatan; while the second may represent adaptations of a later fauna to the peculiar ecological conditions of the northern part of the Peninsula. Some of the characteristic Yucatan species have been found to extend southward in the peninsula beyond the limits of the scrub forest.

Breeding Peculiarities of Hornbills

R. E. MOREAU directs attention to the curious breeding habits of African hornbills (Bucerotidæ), the females of which are enclosed in the nesting hole for periods which range from about six to ten weeks (*Proc. Zoo. Soc. London*, Ser. A, 33; 1937). This lengthy imprisonment includes a long period of brooding inactivity, the incubation of the eggs, and the partial development of the young to within three or four weeks of fledging. It covers also the moulting period of the female when she undergoes so wholesale a change that not only is the power of flight lost, but her body becomes almost naked. It is unlikely that non-breeding females should be subject to a process so drastic and dangerous, but evidence in their case is lacking. Problems of sanitation, intensified by the crowding of nestlings and parent in a restricted space, are overcome by forcible defecation at the entrance of the nest, by the ejection of other rubbish, such as egg shells and feathers, and by the 'casting' of indigestible remains. During the period of incarceration of the whole family, the male is solely responsible for food-getting, but in *Lophoceros* the female helps to feed the young after her emergence. In this genus the young, whenever the female leaves them, at once elaborate plaster, re-seal the entrance to the nest, and undertake the scavenging work formerly carried out by the mother bird.

Shells of Mauritius

The Revised Catalogue of the Testaceous Mollusca of Mauritius and its Dependencies by R. Viader (Mauritius Institute Bulletin, 1, Part 2, January 1937. Published by the Board of Directors of the Mauritius Institute and Public Museum) is an important and valuable addition to conchological literature. So much more is known of the Mollusca of Mauritius since the publication of von Marten's catalogue that the present up-to-date work was greatly needed, compiled as it is in accordance with modern classification. It is hoped that it will pave the way for the proposed thorough revision of the local fauna with bibliographical references, critical observations and ecological and other notes. The marine species and varieties listed in this catalogue number 2096 univalves and chitons and 279 bivalves, making a total of 2375, which exceeds by more than 1000 the number of shells reported by von Marten from the Mascarenes, the Seychelles and Madagascar. A number of species from recent gatherings are still awaiting description, and these will considerably enlarge the list.

Woodlice of Iceland

Only five species of woodlice have been recorded from Iceland; of these one—*Oniscus asellus*—is included, on very slender grounds, and two others, species of *Porcellio*, have been found only once. The distribution of the remaining species, *Trichoniscus pusillus* and *Porcellio scaber*, is confined to the south of the island, with the exception of three northern records ("Zoology of Iceland", 3, Pt. 28; 1938). Thydsen Meinertz suggests that the explanation of this localized distribution may be that Iceland is on the northern limit of the range of these woodlice, and that the milder insular climate of the southern part may afford suitable conditions while the continental climate of the northern area is too severe to permit of colonization. The suggestion is supported by the absence of woodlice in Greenland and by the solitary record from Norway north of Lofoten.

Monocotylous Seedlings of Some Dicotyledons

Most dicotyledons, as their name implies, possess two cotyledons, whereas monocotyledons have one; but certain dicotyledons show only one cotyledon (at any rate, at later stages in germination). Sir Arthur Hill has made some interesting observations on some of these monocotylous dicotyledons, especially on certain genera of Gesneriaceæ, and has recently published his findings, considered with observations on other species of plants (*Ann. Bot.*, New Series, 2, January 1938). Miss E. Sargant's theory (*Ann. Bot.*, 12; 1903), based on observations on the cyclamen, lesser celandine, etc., that the single cotyledon of monocotylous dicotyledons represents two fused cotyledons is shown to be untenable. Evidence is brought forward that the second cotyledon is either rudimentary and capable of development as in cyclamen, or wholly suppressed as in certain other genera. In certain species of *Peperomia*, the second cotyledon is an absorbent organ and never leaves the testa. In all genera of Gesneriaceæ studied, one of the two cotyledons was shown to cease growth at an early stage, and abort. The comparative morphology of the later stages in development of these genera of Gesneriaceæ is also discussed. The paper is illustrated by three plates of photographs and 23 text-figures.

Factors affecting Protein Content of Leaves

In the first of a series of investigations on nitrogen metabolism in plants, A. H. K. Petrie and J. G. Wood have studied the relation between the content of proteins, amino-acids and water in leaves (*Ann. Bot.*, New Series, 2, No. 5, January 1938). Experiments were performed on pure-line grasses, *Phalaris tuberosa* and *Lolium multiflorum*. The results obtained suggest that, in certain respects, the protein content of leaves varies directly with amino-acid and water content, and evidence was also obtained that the protein content increases with the *p*H of the expressed sap. It is suggested that the rate of formation of protein from amino-acids decreases with a reduction in water content, though it has not yet been established whether this decrease is due to decrease in protein synthesis or increase in protein hydrolysis, or both.

Ice in Finnish Waters

The distribution of sea-ice on the Baltic coasts of Finland is the subject of an exhaustive memoir by Dr. R. Jurva entitled "Über die Eisverhaltnisse des Baltischen Meeres an den Küsben Finlands" (No. 114 Merentutkinuslartoksen Julkaisu Havsforsknings Institutets, Helsinki, 1937). A feature of the study is the discussion of the ice distribution in various years so far as past records are available. Since all the Baltic coasts of Finland are to a greater or less extent fringed with ice in winter and so largely inaccessible to commerce, the records of the past are fairly numerous. The memoir is accompanied by an atlas of some fifty pages of maps and graphs of the ice distribution at all times of the winter. The maps give a clear view of the duration of frozen waters along the coasts.

Isocholesterol and Isomeric Ethers of Cholesterol

In 1937, E. S. Wallis, E. Fernholz and F. T. Gephardt (*J. Amer. Chem. Soc.*, 59, 137; 1937) by the action of anhydrous potassium acetate on cholesteryl *p*-toluene sulphonate in acetic anhydride obtained a new isomer of cholesterol which they called isocholesterol, and suggested that the reaction is accompanied by molecular rearrangement. A close relationship was suggested between this new alcohol and the isomeric ethers of cholesterol obtained by Stoll in 1932. It was further shown by E. G. Ford and E. S. Wallis (*ibid.*, 59, 1415; 1937) that the abnormal ethers of cholesterol recently referred to in the literature as "*cis*-cholesteryl ethers" are really ethers of isocholesterol. E. G. Ford, P. Chakravorty and E. S. Wallis (*ibid.*, 60, 413; 1938) have now substantiated the formula suggested for isocholesterol by a series of reactions involving oxidation and reduction. It appears that the hydroxyl group in this compound is in the six position of the sterol molecule and hence during its formation from cholesteryl *p*-toluenesulphonate a molecular rearrangement occurs.

Tetrahedral Angles in Butane Derivatives

THE tetrahedral form for the gas molecules of the tetrafluoride, tetrachloride and tetrabromide of carbon has been proved by the method of electron diffraction. Many other molecules, such as methylene chloride and chloroform, have been shown to be only slightly distorted from tetrahedral symmetry. Because of the electrostatic and steric repulsions of the methyl groups it is to be expected that the C-C-C angle in isobutane will be slightly greater than the tetrahedral angle 109° 28′. In the case of tertiary butyl chloride and bromide the increased steric repulsion between halogen and hydrogen atoms will be expected to decrease the C-C-C angle below that in isobutane and possibly below the tetrahedral angle. The electrostatic attraction of the negative halogen atom for the positive hydrogen atoms, on the other hand, would tend to spread the C-C-C angle. J. Y. Beach and D. P. Stevenson (*J. Amer. Chem. Soc.*, 60, 475; 1938) have measured these angles by the electron diffraction method. They find that the C-C-C angle is never distorted more than 4°, the values being 113° 30′ ± 2° for isobutane, 111° 30′ ± 2° for *t*-butyl chloride and 111° 30′ ± 2° for *t*-butyl bromide. These results are in agreement with calculations. The interatomic distances are calculated as C-C 1·54 ± 0·02, C-Cl 1·78 ± 0·03 and C-Br 1·79 ± 0·03, A. units.

Allotropy of Mercuric Oxide

THE two forms of mercuric oxide, red and yellow, have been regarded both as allotropic forms and as the same form in varying states of division. A. B. Garrett and A. E. Hirschler (*J. Amer. Chem. Soc.*, 60, 299; 1938) have determined the solubilities of the two forms in water, alkali and alkaline salt solutions. The solubility of the two forms can be represented by straight lines up to nearly 1 molal alkali and there is no perceptible decrease from the solubility in pure water. On the assumption that a hydroxide $Hg(OH)_2$ is formed, which is amphoteric, this result shows that the basic dissociation constant is very small, whereas the results for silver and copper oxides and cadmium hydroxide have shown substantially complete ionization. The value $K = [Hg^{\cdot\cdot}] \times [OH']^2/[Hg(OH)_2]$ is calculated as $1{\cdot}8 \times 10^{-22}$. The solubility curves in pure alkali establish the amphoteric nature of mercuric oxide by the constancy of the equilibrium constant $K = [H^{\cdot}] \times [HHgO'_2]/[H_2HgO_2] = 1{\cdot}4 \times 10^{-15}$. The difference in free energy between the red and yellow forms is calculated as only 31 g.cal./mol, but this is not regarded as establishing the identity of the two forms. Microscopic examination showed that the particle size was 1–10 μ for the yellow and 10–30 μ for the red. A sample of red oxide finely ground had a solubility 5 per cent greater than that of the yellow oxide although its colour was redder than the latter.

Photochemistry of the Atmosphere

VARIOUS reasons may be given for supposing that the earth's atmosphere originally contained no free oxygen. Its formation may possibly be due to photochemical decomposition of water vapour and carbon dioxide, which were present in large quantities. W. Groth and H. Suess have investigated this assumption (*Naturwiss.*, 26, 77; 1938). They point out that astrophysical observations indicate that solar radiation is very rich in exceedingly short wavelength ultra-violet. This does not reach the earth owing to absorption by oxygen and ozone, but the fact that lines due to excited nitrogen atoms occur in the spectrum of the night sky shows that radiation of wave-length about 600 A. must be present (Saha, *Proc. Roy. Soc.*, A, 160, 155; 1937). When water vapour is irradiated with ultra-violet radiation of wave-length 1295–1470 A., obtained from a Harteck xenon lamp, it forms hydroxyl and hydrogen ($H_2O + h\nu = OH + H$). Similarly, carbon dioxide gives carbon monoxide and oxygen ($CO_2 + h\nu = CO + O$). If a mixture of carbon dioxide and water vapour is irradiated, the two reactions go on simultaneously and the products combine to form glyoxal or formaldehyde ($H + CO = HCO$; $2HCO = H_2CO + CO$, or $HCO.HCO$). Their presence was shown by Schryver's reaction. The process is clearly similar to that occurring in carbon assimilation by plants. Not only could this process explain the formation of free oxygen in the atmosphere, but also the production of organic compounds, from which organic life could develop. The fact that a process of this kind is still taking place in the atmosphere is shown by the work of Dhar and Ram (NATURE, 132, 819; 1933), who detected as much as 1 mgm. per litre of formaldehyde in rain-water.

Degree of Accuracy in the Reduction of Occultations of Stars

MR. FRANK ROBBINS has recently dealt with the problem of the accuracy obtained in occultation reductions by three methods (*J. Brit. Astro. Assoc.*, 48, 4, February 1938). These are, the method advocated by the late Dr. R. T. A. Innes, modified and adapted for logarithmic computation by the Computing Section of the British Astronomical Association; the new method described in "The Prediction and Reduction of Occultations", which is based on Dr. L. J. Comrie's paper in *A.J.*, 46, 6, 1937; and a method described by Rev. Dr. M. Davidson in *J. Brit. Astro. Assoc.*, January 1938. Mr. Robbins points out that discrepancies amounting to 0″·3 or sometimes more occur in the results obtained by the first two methods. During the discussion at the February Meeting it was stated by Mr. D. H. Sadler, Superintendent of the Nautical Almanac Office, that each of these first two methods worked in units of 0″·1 in $\Delta\sigma$, and it was possible for the results to vary by one or two units, due to rounding off at different stages of the work. Dr. Davidson stated that he was not prepared to admit an error greater than 0″·04 by his method, and an error of 0″·1 would be utterly unjustifiable, especially if certain checks suggested by Mr. Robbins were utilized. In the February *Journal*, Dr. Davidson has a supplementary paper on the whole subject, in which he shows how considerably less work is entailed in the process of computation by his method, if functions of certain spherical co-ordinates are used instead of their direction cosines.

The Soviet Polar Enterprise

Some Preliminary Results

SOME preliminary results of the observations made on the drifting Soviet polar station are contained in articles supplied by the Soviet Union Year Book Press Service. Prof. V. Shuleikin, writing on currents and winds of the Arctic, says that the rate of drift of the ice is about three per cent of the velocity of the wind and that the drift deviated from the wind direction by so much as 45°. Further, he maintains that the pack-ice moves only by the action of the wind and that apart from the winds there were no surface currents observable in the Arctic Ocean. Thus there must obviously be a general prevalence of winds across the polar basin, for the observers are insistent that no sign of a circulatory movement of the floes within the basin was apparent. The East Greenland current is attributed to the persistence of north-west winds from the plateau of Greenland giving a southward movement, presumably in conjunction with the northward push of the ice due to the earth's rotation. It is said to be entirely a wind current.

Prof. N. Zubov points out that the conception of the Arctic as a region of continuous high pressure must be modified since cyclones penetrate to the region of the North Pole and bring relatively warm weather. If, however, the drift of the ice, which was principally to the south, is due solely to wind action it would appear that the wind must prevail from one direction and this may prove to be from the region of cold in north-eastern Siberia. There the radiation from a land surface results in lower winter temperatures than occur over the Arctic Ocean, where higher temperatures are maintained by the unfrozen water below the ice. The low pressure of the Greenland sea in conjunction with this high pressure over north-eastern Siberia would no doubt account for a pressure gradient leading to these transpolar winds. Previous observations on the winter drift of pack-ice north of Asia show some correlation with the air current from the Siberian high pressure area. In summer, northerly winds on the Asiatic coast, due to a change in pressure condition, fray out the edges of the pack towards the south. Comparable northerly winds seemed to have driven the Soviet floe southward on the other side of the Pole in summer.

Prof. L. Zenkevich, writing on the biological results, has little to say so far, except to record that fauna has been collected at depths of more than 1,000 metres. This is more than four hundred metres below the ridge between Greenland and Spitsbergen. Thus it would appear that the deep Arctic fauna is completely cut off from the faunas of the Atlantic and Pacific basins, and may well contain faunas of great interest. Lastly, Prof. O. Schmidt foresees further exploration of the inner Arctic basin by this novel form of transport on drifting ice, the only suitable means that has so far been adopted. The new magnetic observations will be a great help to future aviators, both in placing and removing such parties of floating observers. Aerial transport between Europe and the Far East will also be facilitated.

R. N. R. B.

Veterinary Science in India

IN his presidential address before the Section of Veterinary Research of the Indian Science Congress Association at its recent jubilee meeting in Calcutta, Sir Arthur Olver discussed "The Development of Veterinary Work in India". Sir Arthur gave a detailed history of the early pioneers of veterinary science in India and the great efforts they made to lay down the foundation upon which the present structure had been built. So long ago as 1788, Joseph Earl published in Calcutta an English translation of a Sanskrit work on the diseases of horses entitled "Saluter and Farrier", and in 1799 a number of qualified veterinary surgeons, graduates of the London Veterinary College, were drafted to India for the organization of cattle and camel breeding and the establishment of studs for the breeding of cavalry horses. The most prominent among these was William Moorcroft, who was appointed in 1808 by the East India Company as superintendent of their Bengal stud at Pusa, in North Bihai; and it is recorded that by improved management he reduced losses by 90 per cent, and amongst other things introduced the cultivation of oats into India. Unfortunately, whilst on an expedition to Central Asia on behalf of his scheme to improve the breed of remounts for India he was murdered, but his writings were of exceeding value, not only on veterinary subjects but also in connexion with agriculture; and he is credited with having placed the Kashmer shawl industry on a sound footing, and to have described a breed of mountain sheep with wonderful wool and to have given an account of a new species of the genus *Equus* which was neither horse, ass, nor mule, and which he thought might have been the 'Onagar' of Pliny.

In 1821, in consequence of the terrible losses from disease amongst the animals, the East India Company insisted upon veterinary surgeons forming part of the staff of the various depots, and arranged a system by which Indians could be trained as assistant apothecaries to the troops of the Bengal Army. In 1823 a scheme was promulgated for an organized veterinary service, but the Veterinary Department of India remained without an official head or a single administrative officer for forty years; spasmodic efforts to fight the many tropical diseases from which the animals suffered being undertaken only in districts where there happened to be stationed veterinary officers of the British and Indian cavalry regiments. It was one of these, Dr. Griffith Evans, of the Army Veterinary Department, who, in 1881, for the first time, demonstrated a large flagellated organism, now known as *Trypanosoma evansi*—in the blood of horses and camels affected with surra, and this discovery was the pioneer work in the knowledge of protozoan diseases, and has since been of immense benefit to the human race as well as to livestock.

The years between 1860 and 1892 saw considerable advance in the organization of veterinary services in various provinces, and the formation not only of an army veterinary school but also several teaching schools and veterinary colleges. With these must ever be associated as pioneers the names of Hallen, Steel, Pease and Fred Smith; and in most provinces superior veterinary services were formed, officered by members of the Royal College of Veterinary Surgeons with subordinate services officered by graduates of the Indian Veterinary Colleges. The year 1891 marked one of the most important steps ever taken for the development of veterinary work in India, in the appointment of an Imperial bacteriologist; the sequel to which has been the establishment of the well-equipped and well-staffed Veterinary Research Laboratory at Muktesar. It was here that Dr. Lingard, who was the first Imperial bacteriologist, discovered the special affinity of arsenic for the parasite of surra; a discovery which has led to results of greatest importance to the human race. The more recent work of Dr. J. T. Edwards in the production of a goat virus of fixed and reduced virulence for the ox laid the foundation to what has proved a highly successful and economical method of controlling outbreaks of rinderpest amongst plains cattle, without the use of anti-rinderpest serum; the results being to confer a lasting immunity at a fractional cost of the serum methods which had been in vogue previously.

Sir Arthur Olver directed attention to the enormous field for scientific veterinary work which exists in India and deplores the paucity of trained scientific workers, and the heavy loss which could be avoided if more and more scientifically trained staff could be brought into action for combined veterinary and animal husbandry activities. He suggests that in addition to the five veterinary colleges which at present exist, at three of which the course is only three years, whilst at the other two the course is four, there should be added a Central India University Veterinary College. This would work in conjunction with the Veterinary Research Institutes of Izatnagar and Muktesar to train specially selected students who would be required to undergo a minimum of five and perhaps even six years of scientific veterinary research with special facilities for training in animal husbandry and a university matriculation to enable them to train up to modern standards and to carry out the higher diagnostic and research work which is so essentially necessary to control the epidemics of animals—especially in a tropical country like India, where the wealth and also the health of the people so largely depends on the health of its farm animals. As Sir Arthur said: "the field for such work is unlimited, and up to the present almost untouched."

The meeting of the Veterinary Section at the Indian Science Congress was well attended, and the papers on veterinary scientific subjects were of a very high order. One notable result ensued in that a proposal to add to future science congresses a Section of Comparative Medicine—in which medical men, veterinarians, physiologists, and those interested in animal husbandry could take equal part, was enthusiastically received and adopted.

The New Super-Novæ

A NUMBER of interesting notes on the discovery and the investigation of the two 'super-novæ', found within the course of a month, by F. Zwicky at the Mount Palomar Observatory, California, have been recently published in the *Astronomische Nachrichten*.

On an earlier occasion Zwicky (*Proc. Nat. Acad.*, 22, 459; 1936) had emphasized the great importance of extensive observation of these unique objects. Super-novæ radiate during several weeks as much energy as a whole galaxy of stars, and thus these data may furnish most valuable information on fundamental problems, such as the generation of energy in stars, the evolution of stars and stellar systems, the origin and the characteristics of cosmic rays travelling in space.

The latest discoveries, as well as earlier ones, for example, that in the nebula *NGC* 4157 in February 1937, are the result of a careful and regular search organized by Hubble, Baade and Zwicky, in the course of which the most important clusters of nebulæ were photographed as often as possible and tens of thousands of nebular images carefully searched for new stars (see *Publ. Astro. Soc., Pacific*, 49, 290; 1937).

Zwicky's recent super-novæ are of special interest because of their enormous absolute brightness, namely, −16, which makes them the most luminous stars known.

The first of these new stars, "Nova 144.1937 Canum Venaticorum", was found with the 18-in. Schmidt telescope in the faint nebulæ *I.C.* 4182 on August 31, when it had already reached the magnitude 8·5. It then faded rather rapidly; M. Beyer-Hamburg (*Astro. Nach.* No. 6307) recorded it on September 2 as 8·85 m., and by September 6 it had decreased to 9·8 m. In this period several spectra have been obtained by K. Walter and W. Strohmeier, of the Astrophysical Observatory at Potsdam (*Astro. Nach.*, No. 6308). The plates show on a rather strong continuous background some very wide emission bands, the whole spectrum having an appearance similar to that of a Wolf Rayet star of early *O*-type, characterized by bands at λ 4680 and λ 5411, He II, λ 5007, [O III], and the Balmer lines. Discussing spectra obtained at the Lick Observatory, D. M. Popper (*Publ. Astro. Soc. Pacific*, 49, 282; 1937) expresses the half-widths of the most distinct bands in km./sec. and finds a velocity of expansion of the star of about 4500 km./sec.

The other super-nova was discovered on September 10 in the east end of the nebula *NGC* 1003. Plates taken at the Hamburg-Bergedorf Observatory on September 6 and September 8 by A. Wachmann showed the star increasing from 13·6 m. to 13·3 m. (*Astro. Nach.*, No. 6310). On September 19, W. Strohmeier succeeded in obtaining an objective prism spectrum with the Potsdam 30-cm. reflector. This plate reveals strong emissions of He II at λ 5411 and of the nebular lines of [O III] at λ 5000, the width being about 200 A. The continuous spectrum resembles that of a *B*-type star. Neutral helium at λ 4471, 4388, 4144, 4026 appears in absorption. The Balmer lines are present as faint emissions, perhaps with violet absorption companions.

The photographic light curve of this super-nova, "145.1937 Persei", has recently been discussed by A. Beer and C. C. L. Gregory before the Royal Astronomical Society. This paper was based on a number of plates secured with the 24-in. Wilson reflector of the University of London Observatory at Mill Hill. The results show that the brightness of this nova was also fading rapidly. From 13·3 m. on September 20 it decreased to 13·8 m. on September 26, to 14·6 m. on October 3–4, and to 15·4 m. on October 9–10. Soon afterwards the star had become too faint for these observations. A high positive colour index is indicated, the visual brightness on October 12 being greater by 1·7 m. than the photographic value. No reports from the large American observatories are yet available, and nothing is known up to now about the doubtlessly very interesting spectroscopic results obtained there.

Development of Co-axial Cables for Television

ONE of the results of the modern developments in television technique has been the production on a commercial scale of cables capable of transmitting, with reasonable efficiency, alternating electric currents at frequencies up to one or two megacycles per second. These cables, which are of the concentric or co-axial type, are employed in the first place for conveying from the studio or outdoor scene to the television transmitter, the modulation frequency currents of the scene being televised. Such a cable is, for example, employed by the B.B.C. to connect the Alexandra Palace station to Broadcasting House and other important places in central London. But the scope of the application is now being extended to the use of the cables for the interconnexion of television transmitting stations separated by distances of the order of 100 miles. When the distance covered is of this order, the use of the cable is by no means limited to television, since the frequency band available provides a large number of ordinary telephone channels along the cable, thereby considerably augmenting the normal land-line trunk-connexion facilities. By a suitable arrangement of the relative frequencies, these telephone channels can be operated simultaneously with the transmission of the television signals, and the value of the cable is thus considerably enhanced. At the present time, a high-frequency co-axial cable is being installed by the Post Office between London and Birmingham, and the results of its operation will be awaited with interest.

Although Great Britain has been the pioneer country in operating a public television broadcasting service, the development and installation of these cables have been proceeding elsewhere, notably in Germany and the United States. The *Wireless World* of December 30 contains a note on the work of the German Post Office on a scheme for the linking-up of Berlin with other important towns. The cables in contemplation or actually undergoing installation will provide interconnexion between the television stations; the Post Office will further provide television-telephone facilities and in addition, arrangements have been made for sending as many as two hundred telephone conversations along the new cables in the frequency band not required by the television currents. For the purpose of transmitting television pictures on a basis of 441-line definition and interlaced frames at 25 per second, it will be necessary to instal amplifiers or repeaters at intervals of 10–12 miles along the cable. These repeater stations will be entirely unattended and will be supplied with power-frequency alternating current passed along the cable. Three types of cable made by different firms are being employed, and it is anticipated that the installations will be completed during the current year.

An interesting demonstration of the possibilities of these co-axial cables was provided last November by the transmission of a sound-picture film between New York and Philadelphia, a distance of ninety miles. This matter was briefly referred to in NATURE of December 4 (p. 962), and further details of the experiment have now been supplied by the Bell Telephone Laboratories. The cable in this case consists of two co-axial conductor units, each of which is formed of a flexible copper tube and a single concentric wire insulated at intervals with ebonite disks. Along the route are situated unattended installations of special amplifying equipment which receive their power supply over the two inner conductors. Each of the co-axial conductors with its associated one-way amplifiers is capable of transmitting simultaneously the currents from 240 telephone transmitters. Thus, using the two units of the cable for transmission in opposite directions, the system provides for 240 simultaneous conversations. In the present arrangement, the transmitters are formed into twenty groups of twelve, each transmitter being limited to a frequency band of four kilocycles per second. For the transmission of vision or picture signals, practically the entire frequency band of the cable—about one million cycles per second—is utilized.

In the demonstration to which reference was made above, a cinematograph film moving uniformly past a gate where it was scanned by a rotating disk system at a rate corresponding to 240 lines and 24 frames per second was used to provide a picture. The light passing through the film entered an electron multiplier, and the resulting current contained component frequencies between zero and about 800 kc./sec. For transmission along the cable, the frequency of this signal current was raised by modulation about 100 kc./sec. in order to avoid the portion of the range where transmission would be unsatisfactory and amplification difficult. In passing along the cable, the lowest frequencies fall behind the highest by a time amounting to some twenty microseconds. Delay equalizers were therefore developed to secure equal transmission times for all frequencies to within a quarter micro-second. At the receiving end a cathode ray tube was employed to produce a picture about eight inches square, and the demonstration provided satisfactory and clear reproduction of the scenes portrayed on the film at the sending end.

At the conclusion of the demonstration Dr. F. B. Jewett, president of the Bell Telephone Laboratories, stated that the experimental development was proceeding with the view of extending the operating frequency range of the cables and associated apparatus to at least two megacycles per second. This would provide a system capable of accommodating the maximum number of telephone channels which it is economical to handle on such a cable, or the widest band of frequencies which the best television scanning and reproducing apparatus may require.

Fuel Research in Great Britain

THE annual report of the Fuel Research Board[1] is always an interesting document because it covers so wide a range of topics that the reader can gain a fair conspectus of the problems engaging the attention of fuel technologists at the moment. The Coal Survey of Great Britain is probably, taking the long view, its most important task, and steady progress is recorded. With time, the scope of its activities increases as increased refinement in fuel processes makes greater demands on the supplies of raw fuel. The demand for cleaned, closely sized fuel grows at the expense of that for large lumps, and this creates many problems. The problem of breaking coal, removing dust and fine coal, clarifying wash water grow in importance. In Yorkshire, efforts are being made to reduce the number of standard sizes, which are bewildering in their number and names. The dust-proofing of coal by spraying it with suitable oil or other liquid to prevent the raising of dust when disturbed is another problem receiving study.

The investigation of the production of oil from coal continues. The staff at Greenwich has studied the process of carbonization at low temperatures from the outset and evolved a design of vertical retort for the purpose. It is now reported that a setting of these retorts has been in operation at the South Yorkshire Chemical Works Ltd., near Rotherham, during the period under review and has given entire satisfaction.

A more comprehensive account of the Fuel Research Board's work on domestic fuels is found in Technical Paper No. 46, describing the results of Mr. J. S. Hales' observations on the use of coke in open fires[2]. Although it covers some ground previously traversed by others, only good can follow repeated assertion of experimentally ascertained facts so imperfectly known or understood. Although fire has been used by man through the ages, until recently no quantitative answers could be given to some of the simplest questions. This is exemplified in Mr. Hales' report, for he deemed it necessary to show by experiment that the rate of combustion of an open fire is not changed by opening or closing a canopy, if fitted.

Great ignorance prevails as to the relative merits of coals and cokes so that the view—encouraged by some coal merchants—is common that coke is a debased fuel fit only for the indigent. In this connexion, the general conclusion of this report is important, namely, that " 'combustible' coke may be superior to normal household coal from the point of view of freedom from smoke, easy ignition and rate of initial combustion, but that the control of the rate of radiation of heat can be more easily achieved with coal". It ought to be pointed out that a measure of control is possible, but the consumer needs educating in the technique of using carbonized fuels.

The basis of test used is the measurement of radiation in one direction emitted by a fixed *volume* of fuel in a single charge. This method gives useful information capable of interpretation by a discerning reader. Fuel, however, is bought by *weight*, and the undiscerning reader may get a wrong idea of the comparative cost of the unit of radiated heat, from the statement that the maximum radiation from a normal household coal may exceed by 30 per cent that from a coke. This apparently relates to equal volumes of fuel and the fact is obscured that the rate of consumption of the coal probably exceeds that of coke by 50 per cent.

The third report of the Oil from Coal Committee issued by the Scottish Development Council merits attention not merely for its contents, but also as an example of local initiative[3]. Areas hit by depression may have been richly endowed with natural resources. Those who have exploited these resources have often been content to take out great wealth without 'ploughing in' sufficient to develop subsidiary industries. Thus a decline in the main industry leaves the area economically stranded. The efforts of the Scottish Development Council set a good example of the local self-help by scientific study of the possibility of grafting new industry upon old stock. The report deals with experiments on the low temperature carbonization of Scottish coal, but the conclusions are not too hopeful as to the economic aspects.

The Duke of Montrose criticizes the manner in which the Committee has approached the problem of marketing, and there is force in his criticism. No one familiar with the matter will expect the use of raw coal to be easily displaced and the consumer must be educated to understand the conclusions of the Technical Paper No. 46 (v.s.), namely, that cokes have advantages as well as disadvantages. The technique of using them must be taught and the organization of sales and distribution will require effort, otherwise the best laid scheme may fail. Thus in one town municipal houses were fitted with grates suitable for burning coke, but no organization was provided for the regular distribution of suitable fuel in small quantities; the tenants consequently burn coal delivered at the door. H. J. H.

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[1] Department of Scientific and Industrial Research Report of the Fuel Research Board for the year ended March 31, 1937; with Report of the Director of Fuel Research. Pp. ix+213+5 plates. (London: H.M. Stationery Office, 1937.) 3*s*. 6*d*. net.

[2] Department of Scientific and Industrial Research: Fuel Research Technical Paper No. 46: "The Use of Coke in Open Domestic Grates". By J. S. Hales. Pp. vi+50 (London: H.M. Stationery Office, 1937.) 1*s*. net.

[3] Scottish Development Council. Economic Series No. 14: Scottish Industry—Third Report of the "Oil from Coal" Committee. (Revised.) Pp. 46. (Glasgow: Scottish Development Council, 1937.) 6*d*. net.

Science News a Century Ago

Progress of Statistical Studies

THE anniversary meeting of the Statistical Society was held on March 15, 1838, the Earl Fitzwilliam being elected president. In the report of the Council read at the meeting it was said: "The direct and incidental use which, at present, is made of statistical documents in scientific and philosophical writings on the most important moral and political questions, and the now frequent insertion of statistical notices in the publications of the day, may be adduced as indicating the prevalence of a sense of the indispensable necessity of continually adverting to the tabulated numerical results of systematic inquiries. It is, indeed, truly said, that the spirit of the present age has an evident tendency to confront the figures of speech with the figures of arithmetic, since it is impossible not to observe a growing distrust of mere hypothetical theory and *à priori* assumption. But a more decisive proof of the just estimate which is formed of the value, and of the deep interest which is felt for the result of statistical researches is presented in the continual formation of new societies." The report then went on to refer to statistical organizations in Liverpool, Ulster, New York, Turin, Calcutta, Manchester, Bristol and York.

Nathaniel Bowditch (1773-1838)

ON March 16, 1838, Nathaniel Bowditch, the American mathematician, died at Boston at the age of sixty-four years. He was born in Salem, Mass., on May 26, 1773, of poor parents. At the age of twelve years he was placed in a ship chandler's shop, but by his own exertions became a good mathematician and learnt Latin in order to read Newton's "Principia" in the original. Leaving the shop when twenty-one years of age, he went to sea as a clerk and rose to be a master. In 1800 he published his "Practical Navigator", and quitting the sea in 1803 became president of an insurance company in Salem. Twenty years later he was made actuary to the Hospital Life Insurance Company, Boston, then the largest institution of its kind in the United States. He was offered chairs of mathematics at Harvard, in the University of Virginia and in the Military Academy at West Point, but declined them. For several years he was president of the American Academy of Arts and Sciences and contributed many papers to its transactions. The great work of his life was the translation of, and his commentary on, Laplace's "Mécanique Céleste" in four volumes of over a thousand pages each. He commenced this work in 1815 and was correcting the proofs of the last pages of the fourth volume when he died. The work met with a flattering reception both in America and Europe. He was elected a member of many societies, including the Royal Society, and the Royal Society of Edinburgh, and for twelve years was a fellow of Harvard College.

Parrot's Observations at North Cape

IN the *Athenæum* of March 17, 1838, it is stated that Prof. Parrot, well known for his travels to the Caspian Sea and Caucasus and more recently for his ascent of Mount Ararat, made a journey in the course of last summer to North Cape, for the purpose of making astronomical and magnetical observations, and of noting the oscillations of the pendulum at the most northern point of the European continent. Leaving Dorpat on July 10 he reached Tornea on July 23, proceeded 380 miles up the Rivers Tornea and Muonio and reached the source of the latter close to the borders of Sweden, Norway and Russia. Leaving his boat, his instruments were carried by eight Finlanders to the inlet Lyngen Fiord, where he embarked in a small boat for a journey of 200 miles to North Cape, which he doubled on August 25. His observations were made under favourable circumstances. He returned to Dorpat in December with, it is presumed, a rich harvest of philosophical materials.

Anthracite Coal for Iron Smelting

THE *Mechanics' Magazine* of March 17, 1838, quoting from the *Cambrian*, said: "On Friday the 23rd ult., a public dinner was given at Swansea to Mr. Crane, the inventor and patentee of the application of anthracite coal to the smelting of iron ores. Mr. Crane was invited by public requisition from upwards of one hundred mineral proprietors and others, interested in the successful results of his valuable discovery. . . . The practical application of Mr. Crane's discovery has now been fully tested for upwards of twelve months at the Yniscedwin Iron Works. . . . His success will, we trust, stimulate others to the application of this valuable fuel to other branches of trade. Already we hear that the experiments are now in progress, and we have every reason to believe that ere long the economical application of this coal for the generation of steam in marine engines will be proved beyond a doubt."

Societies and Academies

London

Royal Society (*Proc.*, A, 164, 307–446; February 4).

HAROLD JEFFREYS: Significance tests for continuous departures from suggested distributions of chance.

O. W. RICHARDSON: New bands ending on the $1s\sigma 2p\sigma\, ^1\Sigma_u$ state of H_2.

ROSA M. MORRIS: Two-dimensional hydrodynamical theory of moving aerofoils (2).

T. H. GOODWIN and R. HARDY: Crystal structure of pentaerythritol tetracetate.

C. A. COULSON: Electronic structure of some polyenes and aromatic molecules. (4) The nature of the links of certain free radicals.

G. W. WHELAND. Electronic structure of some polyenes and aromatic molecules. (5) A comparison of molecular orbital and valence bond methods.

W. G. PENNEY and G. J. KYNCH: Electronic structure of some polyenes and aromatic molecules. (6) Phenylethylene, stilbene, tolane and the phenylmethyl radical.

H. M. CUNDY: Rotational energy-levels of a diatomic molecule in a tetrahedral field.

J. MONTEATH ROBERTSON and I. WOODWARD: X-ray analysis of the dibenzyl series. (5) Tolane and the triple bond.

Proc., A, 164, 447–603; February 18.

A. N. BLACK and R. V. SOUTHWELL: Relaxation methods applied to engineering problems. (2) Basic theory, with applications to surveying and to electrical networks, and an extension to gyrostatic systems.

E. V. Appleton and **J. H. Piddington**: Reflection coefficients of ionospheric regions.

G. I. Taylor: Spectrum of turbulence.

C. J. B. Clews and **F. Schoszberger**: Structure of stretched rubber.

F. J. Wilkins: (1) Statistical mechanics of the adsorption of gases at solid surfaces. (2) Adsorption of argon, nitrogen and oxygen on smooth platinum foil at low temperatures and pressures.

A. Elliott and **W. H. B. Cameron**: Emission band spectrum of chlorine (Cl_2^+). (2).

L. Howarth: On the solution of the laminar boundary layer equations.

Dorothy Crowfoot: The crystal structure of insulin. (1) The investigation of air-dried insulin crystals.

Geneva

Society of Physics and Natural History, December 2.

Richard Extermann and **Jean Weigle**: Bragg reflection on a medium disturbed by ultra-sounds. The theory of the reflection of light on a face perpendicular to the direction in which a medium is periodic is established. The case is analogous to that of Bragg reflection of X-rays on a crystal.

Léon Schames: Interstellar matter as the eventual cause of the displacement of the spectrum of nebulæ towards the red. Starting from the properties of interstellar matter a characteristic distance can be calculated. It follows that the empirical displacement in this distance is equal to the wave-length of Compton. This suggests that the light produces on the small particles composing interstellar matter, besides the classical Mie effect, a quantum effect which would then be the cause of the displacement.

December 16.

Georges Tiercy: (1) Direct calculation of the velocity of the wind as a function of the height. The purpose of this note is to indicate some hypotheses of work which can be admitted for certain coefficients and to write the differential equations which follow. An approximate solution is then established which expresses the wind velocity as a function of the altitude. The constants of integration will take values suitable for each atmospheric layer. (2) Variation of the pressure gradient with altitude. Starting with the well-known equality which connects the pressure with the absolute temperature at a height, and adopting for the variation of T the law $T = T_0.e^{-\frac{\varepsilon}{m T_0}}$, it is shown that the variation of the pressure gradient can be represented by the simple law $G = G_0.e^{\mu x}$, where μ remains small.

Emile Briner, C. El-Djabri and **Henri Paillard**: The ozonation of some hydrocarbons (hexane, heptane and various octanes). As in the cases studied before, the presence of ozone leads, in the oxidation, to large proportions of oxygen being involved. These proportions, however, are much smaller for one of the *iso*-octanes (2-2-4 trimethylpentane), well known for its high anti-detonant power.

Paul Wenger, Chevel Cimerman and **Alice Corbaz**: The micro-estimation of cobalt by means of anthranilic acid. I. (1) The Pregl technique. (2) The Emich technique. The authors have established a gravimetric micromethod for the estimation of cobalt by two microchemical techniques, those of Pregl and Emich. II. The influence of foreign salts. The authors have studied the influence of sodium acetate, sodium chloride and ammonium chloride on the microdetermination of cobalt with anthranilic acid.

Chevel Cimerman and **Paul Wenger**: Microseparations of zinc with ortho-oxyquinoline. The authors have established a working method for microseparations with ortho-oxyquinoline in the presence of calcium, strontium, barium, aluminium, chromium and lead.

Rome

National Academy of the Lincei (*Atti*, 26, 3–53; 1937).

N. Spampinato: Functions of one variable in one of the four commutative complex algebras of the third order.

A. Colacevich: Orbital elements of ν Octantis.

S. Vardabasso: Contribution to the knowledge of the recent volcanism in Sardinia.

C. Finzi and **M. Colonna**: Chemical constitution and sweet taste.

C. Lauro: Calcite from the hill of the Madonna del Carmine in Dorgali (Sardinia).

V. Capraro and **M. Fortunato**: Contribution to the study of the antineuritic factor (B_1) on the testicle.

M. Fedele: Contractability and neurogenic and miogenic excitation in the Ascidiacea.

A. Spirito: Studies in embryology. Different behaviour towards anærobiosis and normal absorption of oxygen in the various forms of Amphibia.

E. Platania: The origin of the peritrophic membrane of the intestine of *Reticulitermes lucifugus* Rossi.

A. Baglioni: Antineuritic vitamin B_1 content of Italian grains.

V. Capraro: Thyroidisation and experimental beriberi in the pigeon.

Tokyo

Imperial Academy (*Proc.*, 13, No. 10, December 1937).

Tatsuo Kawata: A theorem concerning the Fourier series of a quadratically summable function.

Shin-ichi and **Tatsuo Kawata**: Notes on Fourier series. (1) Riemann sum. (2) Convergence factor.

Masao Sugawara: Transformation of a theta-function by Siegel's modular substitutions.

Hidetaka Terasaka: Theory of topological combinations.

Hitoshi Hombu: (1) Projective parameter of generalized 'paths'. (2) Projective theory of 'paths' $x^{(3)i} + A^{i}_{k}x^{(2)k} + B^{i} = 0$.

Hisakatsu Yabe: Palæogene stratigraphy of Russian Saghalin (2).

Hisakatsu Yabe and **Tashio Sugiyama**: (1) Preliminary report on the fossiliferous Gotlandian and Devonian deposits newly discovered in the Kitakami Mountain land. (2) Some reef-building corals of a raised coral reef of Mindanao, Philippine Islands. Fourteen species belonging to eleven genera of corals are described, together with four specifically indeterminable forms. (3) Two new species of reef-building corals from Yoron-zima and Amami-Ô-sima. One species belongs to the genus *Favites* and the other to *Psammocora*.

Toranosuke Sugiura: A list of chromosome numbers in angiospermous plants (4). The meiotic numbers of 37 species belonging to 12 families have been determined.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Monday, March 14

Royal Geographical Society, at 5.—Discussion on the Air Almanac to be opened by Dr. H. Spencer Jones.

Tuesday, March 15

University of Cambridge (Cavendish Laboratory), at 3.—Prof. W. Pauli: "Contributions to the Theory of Field Quantization" (succeeding lectures on March 16 and 18).

University College, London, at 5.—Prof. A. P. H. A. de Kleijn: "Some Remarks on Vestibular Physiology".*

Wednesday, March 16

Royal Meteorological Society, at 7.30.—F. Entwistle: "Atlantic Flight and its Bearing on Meteorology" (Symons Memorial Lecture).

Society for the Study of Alchemy and Early Chemistry, at 8.—Prof. R. Campbell Thompson: "Assyrian Chemistry of the Seventh Century B.C."

Thursday, March 17

Chemical Society and Physical Society (joint meeting at Burlington House, Piccadilly, W.1), at 8.—Discussion on "Electron Diffraction and Surface Structure", to be opened by Prof. G. J. Finch.

Friday, March 18

Royal Institution, at 9.—Sir William Bragg, P.R.S.: "Ice".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Technical Officer (male) in the Meteorological Office—The Secretary (S.2.A.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (March 12).

Junior Assistant Bacteriologist in the Department of Pathology, Postgraduate Medical School, Ducane Road, London, W.12—The Dean (March 14).

Lecturer in Psychology in the Brighton Municipal Training College for Women—The Education Officer, 54 Old Steine, Brighton (March 18).

Assistant (grade II—engineering or physics) at the Air Ministry Headquarters—The Secretary, Air Ministry (S.2.D.), Room 8.205, Kingsway, London, W.C.2 (March 18).

Teacher of Chemistry in the Northern Polytechnic, Holloway, N.7—The Clerk (March 23).

Assistant (lady) to the Director of Research, Wool Industries Research Association, Torridon, Leeds—The Secretary (March 24).

Assistant Chemist in the London Shellac Research Bureau—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (March 25).

Assistant Administrative Officer in the Research Department, Woolwich, S.E 18—The Chief Superintendent (March 25)

Lecturer in Electrical and General Engineering in the Faraday House Engineering College, Southampton Row, W.C.1—The Principal (March 26).

Three University Demonstrators in Anatomy in the University of Cambridge—Dr. F. J. W. Roughton, Department of Physiology, Cambridge (March 31).

Investigator (welding) in the British Non-Ferrous Metals Research Association, Regnart Buildings, Euston Street, London, N.W.1—The Secretary (March 31).

Secretary of the London School of Economics, Houghton Street, Aldwych, W.C.2—The Director (March 31).

Research Assistant (computational work) in the Mathematics Department, Imperial College of Science and Technology, South Kensington, S.W.7—The Secretary (April 21).

Lecturer in Physiology in the Queen's University, Belfast—The Secretary.

Professor of Engineering in the Queen's University, Belfast—The Secretary.

Assistant Civil Engineers in H.M. Office of Works, Storey's Gate, S.W.1—The Chief Architect, Room 65 A/3.

Assistant (grade II—engineering) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (March 18—quote Ref. No. 361B).

Reports and other Publications

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1937–1938. Vol. 58, Part 1, No 1: Induction Proofs of the Relations between certain Asymptotic Expansions and Corresponding Generalised Hypergeometric Series. By Prof. T. M. MacRobert. Pp. 13. 1*s*. Vol. 58, Part 1, Nos. 2, 3 and 4: Quantitative Evolution. iv. Deductions from the BAT Curve; v. The Free and Apparent Dp-Ages of Compositæ; vi. Further Deductions from the BAT Curve. By Prof. James Small. Pp 14–54. 3*s*. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [72

University of Leeds. Thirty-third Report, 1936–37. Pp. 179. Publications and Abstracts of Theses by Members of the University during Session 1936–37. Pp. 27. (Leeds: The University.) [82

University College, Nottingham. An Outline of the Scope of University Education provided; a Statement as to available Scholarships, Exhibitions and Studentships; Notes on the Careers open to Students Pp. 36+8 plates. (Nottingham: University College.) [92

Manchester Museum: University of Manchester. Museum Publication 113. Report for the Year 1936–37. Pp. 32. 6*d*. Museum Publication 114 (Notes from the Manchester Museum, No. 39): Four Greek Vases in the Manchester Museum. By Prof. T. B. L. Webster. Pp. 9–20+5 plates. 6*d*. (Manchester: Manchester Museum.) [122

The Girlhood of Mrs. Ramsay MacDonald. By Isabella M. Holmes. Pp. 16. (London: *Middlesex County Times* Printing and Publishing Co., Ltd, Ealing) 6*d*. [122

Other Countries

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 7: Tropical Fruits and Vegetables; an Account of their Storage and Transport. By C. W. Wardlaw Pp. xii+224. (Trinidad: Imperial College of Tropical Agriculture) 4*s*. [72

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 10: Indian Grazing Conditions and the Mineral Contents of some Indian Fodders. By Dr. P. E Lander. Pp. 71. (Delhi: Manager of Publications.) 3 14 rupees; 6*s*. 9*d*. [72

U.S. Department of Agriculture. Technical Bulletin No. 584 Chemical and Physical Studies of certain Hawaiian Soil Profiles By George J. Hough and Horace G. Byers. Pp. 27. (Washington, D.C.: Government Printing Office.) 10 cents. [72

Journal of the Indian Institute of Science Vol. 20A, Parts 3, 4, 5 and 6: Equilibrium in Electrodeless Discharge. Part i. The Disappearance of Hydrogen in Electrodeless Discharge; Part ii. Electrodeless Discharge through Water Vapour and Silane; Part iii. Electrodeless Discharge through Oxygen; Part iv. Electrodeless Discharge through Carbon Dioxide. By N. B. Bhatt and S. K. K. Jatkar. Pp. 25–48. 1.12 rupees. Vol. 20A, Part 7. Proteins of Indian Vegetables—Drumstick (*Moringa pterygosperma* or *Guilandina* or *Hyperanthera*). By Y. V. S. Rau and V. Ranganathan. Pp. 49–54. 10 annas. Vol. 20A, Part 8: Reactions of Chromates at High Temperatures. Part iii. The Decomposition of Calcium Chromate. By V. T. Athavale and S. K. K. Jatkar. Pp 55–66. 1.4 rupees. Vol 20A, Part 9: On Chemical Methods of determining Phosphorus Availability in Soils By V. Sadasivan and A. Sreenivasan. Pp. 67–81. 1.2 rupees. Vol. 20A, Part 10: The Rôle of Pepsin in the *in vitro* Digestion of Proteins. By V. Ranganathan and B. N. Sastri. Pp. 83–86. 8 annas. Vol. 20A, Part 11: The System Sulphuric Acid—Ethers. Part i. System Sulphuric Acid—Methyl Ether. By S K. Kulkarni Jatkar and N. G. Gajendragad. Pp. 87–93. 12 annas. (Bangalore: Indian Institute of Science.) [72

Union of South Africa: Department of Commerce and Industries Fisheries and Marine Biological Survey Division. Report No. 14 for the Year ended December 1936. By the Director of Fisheries. Pp. 83+4 plates. (Pretoria: Government Printer.) [82

Annual Report of the Public Health Commissioner with the Government of India for 1935. Vol. 1, with Appendices. Pp. viii+276 (Delhi: Manager of Publications) 2 rupees; 3*s*. 6*d*. [102

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An Educated Democracy

AMONG the social services which have undergone remarkable developments in Great Britain during the present century is that of education, and particularly of secondary education since the passing of the Education Act of 1902. The actual and potential changes in the structure of society brought about by these expansions of educational opportunity are far-reaching, yet it may be doubted whether their significance is generally appreciated. This is the view of Mr. G. A. N. Lowndes, who in a recent work with an arresting title[*] says: "Nothing is more exasperating to those to whom social reform is religion in action than the readiness with which the English neglect, forget or minimize their achievements." Mr. Lowndes recalls and appraises those achievements in the field of public education, elementary, secondary and technical, in the past forty years, thanks to which Great Britain, it is claimed, is becoming "an educated democracy". Some of the most telling in the series of contrasts through which the magnitude of these achievements is presented illustrate the progress of secondary education—progress which has been rightly characterized as 'revolutionary' by statesmen and historians.

The secondary school population has quadrupled and now includes 350,000 former pupils of public elementary schools. In 1934 the proportion of elementary school pupils, aged 10–11, passing into secondary schools was 119 per thousand, whilst in 1895 the corresponding proportion (elementary school leavers passing on to endowed grammar schools) was probably not more than 3–6 per thousand. Forty years ago the number of pupils holding county and county borough scholarships at schools of secondary type was 2,414, as compared with the 224,981 total, and 23,188 partial, exemptions from payment of fees in grant-aided secondary schools in 1934.

These figures indicate an appreciable advance towards that elusive goal—equal educational opportunity for equal abilities. A similar advance is discernible when one turns to statistics of the output from the grant-aided secondary schools to the universities. Of the 4,192 students who passed from those schools to universities in 1934 (London 1,040, Wales 613, Cambridge 463, Oxford 382, other universities 1,694), 1,983 of the men and 831 of the women had begun their education in elementary schools; 2,209 had paid no fees. Comparable statistics of forty years ago are not given, but Mr. Lowndes recalls a reply given by a witness examined by the Cross Enquiry Commission in 1888 to a question as to the prospects of a public elementary school pupil ever reaching a university: "It would be next to expecting a boy out of the London Board Schools to take wings . . .", and adds "He was right."

The output from the grant-aided secondary schools to the universities has been a subject of comment in the Board of Education's reports since 1924, when in the course of a comprehensive review of secondary education attention was directed to the rapid increase of this output between 1909 and 1921 from 1,056 to 2,888, chiefly ex-public elementary school pupils. The following year the Board remarked: "It is commonly assumed that a secondary school provides an avenue to the university, at any rate for able pupils. Fifteen years ago this assumption was not generally warranted." In 1909–10 about 400 out of 950 schools on the grant list sent one or more pupils to the university. By 1924 there were very few that did not at least occasionally send one. In 1932 the output to the universities had increased to 4,560 and since then the numbers have declined, the total in 1935–36 being 3,578.

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[*] P. 236 of "The Silent Social Revolution: an Account of the Expansion of Public Education in England and Wales, 1895–1935". By G. A. N. Lowndes. Pp. xii+274+8 plates. (London: Oxford University Press, 1937.) 6s. net.

The position in regard to assisted students in the universities was reviewed by the University Grants Committee in the last quinquennial report (for 1929–30 to 1934–35). The Committee emphasizes the extent to which the approach to the universities is made possible by scholarships, maintenance allowances, or eleemosynary grants. At least £1,350,000 is spent in this way annually by Government departments, local education authorities, universities, Oxford and Cambridge colleges and the trustees of public endowments in Great Britain. The Committee adds that fifty per cent of the students in the provincial universities began their education in public elementary schools. In further illustration of the same point may be cited, from the Board of Education's report for 1935–36, the fact that out of 719 open scholarships at Oxford and Cambridge 374 were won by pupils at the grant-aided secondary schools, of whom nearly three fourths had paid no fees and two thirds had been previously educated in public elementary schools.

The contribution of the grant-aided secondary schools to the universities is really greater than that represented by the Board's statistics already mentioned, because these exclude the considerable number of students who enter universities after an interval instead of proceeding immediately from school. The number so excluded was estimated by the Board in 1925 to have been about ten per cent; according to Mr. Lowndes, twenty per cent is nearer the mark. Assuming the intake of the universities from this source to be between four and five thousand, how does this compare with the intake from other sources? The total of admissions into the universities of England and Wales is about twelve thousand, of whom about ten per cent are from outside the British Isles. Whence come the remainder, from six to seven thousand, who do not come from the grant-earning secondary schools? With very few exceptions, from the other secondary schools. The grant-aided schools account, according to an estimate in the University Grants Committee's report, for five sixths of the whole secondary school population. The estimate is perhaps a high one, but it seems plain that more than a moiety of the influx of students is from a comparatively small catchment area.

This state of affairs is, of course, associated with that dual system of which Lord Baldwin declared in 1929 "the interests of social unity demand the removal of this source of class prejudice", but which seems immune to the equalitarian influences of the "silent social revolution". Its most obnoxious feature is that, as the authors of "In Defence of Democracy" (Methuen, 1935) put it, it operates to make the consciousness of social difference all pervasive in the working of men's minds in all social and political questions. The success of Rendcombe College goes to show, however, according to Mr. J. H. Nicholson ("Education for Modern Needs": Ivor Nicholson and Watson, 1936) that this feature can be eliminated from the "public schools". Certainly any tendency to divide the community into mutually unintelligible groups is specially to be deplored at a time when a maximum of social unity is needed for meeting the challenge involved in the rise of the powerful and energetic totalitarian régimes.

To that challenge Mr. Lowndes's book makes no reference; nor have the achievements he tells of contributed conspicuously towards generating that active vigorous citizenship in harmony with democratic principles which is indispensable for their maintenance. The sectional loyalties fostered in so many of our schools are not enough, and wider views will have to be taken if education is to provide a firm basis for constructive democracy.

During the past four years, much valuable work in this direction has been done by the Association for Education in Citizenship, of which Lord Baldwin has recently accepted the presidency. It seeks "the best methods of educating citizens who are likely to maintain and strengthen our democratic system". Much promising exploratory work has been done in various schools (see the Association's "Experiments in Practical Training for Citizenship"), but it has to be recognized that any training for citizenship before the age of fourteen or fifteen years, when the great majority of citizens of the future leave school, can be but very elementary. The British genius for self-government was evolved in the hard and efficient school of learning by doing in days when every village householder had to do his bit of community service, and training in citizenship for the million must await the acceptance by the nation once again of the burden of national service for all.

Frazer on Totemism

Totemica:
a Supplement to "Totemism and Exogamy". By Sir James George Frazer. Pp. xii+518. (London: Macmillan and Co., Ltd., 1937.) 25s. net.

HALF a century ago, in 1887, there appeared in Edinburgh a small booklet entitled "Totemism". It was destined to exercise an influence on the science of man second only to that of another masterpiece by the same author—I mean of course Frazer's "Golden Bough". Both works produced an immediate impression at home among scholars and abroad among workers in the field. Both have since reappeared in a much fuller form; the first as "Totemism and Exogamy" (in four volumes, 1910); the second as a series of twelve volumes jointly named "The Golden Bough" (1911–15).

Each of the two great works has now received a valuable epilogue: "Aftermath", a supplement to "The Golden Bough", published last year; and now "Totemica", giving the finishing touch to Frazer's work on totemism. To those of us who owe the main inspiration of our life-work to Frazer these recent events are both welcome and significant. The additional volumes bear witness not only to the vigour and creative power of the author but also to the value and vitality of the British school of anthropology.

Frazer, more than anyone else, has given the science of man wide currency among cultured people all over the world. It is largely due to the literary charm of his style and the profoundness of his insight that anthropological books are now extensively read, appreciated, and enjoyed. He also, above all others, has brought anthropology into line with classical scholarship. Nor is it an accident that the first systematic and planned scientific expedition was undertaken from Cambridge, Frazer's spiritual home and personal abode. The work of Spencer and Gillen in Central Australia, the researches of Roscoe among the Baganda, the African classics of Smith and Dale, of Rattray, and of Junod, throughout bear witness to Frazer's genius and vision.

The direct imprint of Frazer's ideas on anthropological theory is not less remarkable. Take the range of its subject-matter: magic and kinship, social organization and the clan system, political power and problems of early science, of ritual and religion: in all these Frazer has given at least the initiative and in most cases the fullest and most adequate treatment of each subject. When the great Frenchman, Durkheim, was shaping his theory of primitive religion, he had in "The Golden Bough" an encyclopædia of fact upon which to draw, and a compendium of theoretical points of view to inspire him. When Freud made his attempt to apply psycho-analysis to the 'cave man' and his murderous and incestuous offspring, he turned to Frazer's "Totemism and Exogamy" and to "The Golden Bough". Most modern schools of anthropology, whether 'functionalism' or 'structuralism', the search for 'patterns of culture' or hunt for 'tribal geniuses', largely depend for their inspiration on Frazer.

The present book is a review of evidence on totemism which has accumulated since 1910. It is arranged geographically, pride of place being naturally given to Australia: ". . . for it is to Australia, with its varied and very primitive forms of Totemism, that we must ultimately look, if we are ever to find a clue to the problem of the origin and meaning of the institution" (from the preface). From that continent some new and important facts have been brought to light in field-work organized from Sydney by Prof. A. R. Radcliffe-Brown and his successor Dr. A. P. Elkin. Some of the discoveries, such as those by R. Piddington and P. M. Kaberry, W. E. H. Stanner and U. McConnel shed a new light on our theoretical conception of totemism.

Readers of Frazer, that is, all anthropologists, will note with interest that the new evidence establishes the widespread occurrence of two facts: the ignorance of physical paternity and the magical ceremonies for increasing totemic species. It is on these two ethnographic facts that Frazer founded his hypotheses of the origins of totemism.

Equally rich and interesting is the evidence from Oceania. It has been known since the times of Codrington that developed forms as well as the rudiments of totemism are to be found in Melanesia. Its occurrence among the Polynesians, foreshadowed by Rivers, has since been established through the recent researches of Drs. R. W. Firth and H. I. Hogbin. The data from Africa and India which Frazer is able to register in the present book, important as they are, do not add anything revolutionary to our knowledge. America, the continent in which totemism was discovered, has yielded only twelve pages.

Frazer himself keeps aloof in this book from controversy; nor does he work out his earlier theories any further. It is tempting, therefore, to inquire how far these have been strengthened or modified by recent discoveries and developments in anthropological doctrine. In his first theory, dating back to the original book of 1887, Frazer finds the origins of totemism in the widespread belief in the external soul, a belief in which primitive man associates his welfare and destiny with some symbolic object. Organized on a communal scale, that is, associating a whole clan with an animal or plant species, this belief becomes in substance totemism.

Frazer himself has discarded this view as a theory of the origins of totemism. We cannot, however, dismiss it as a contribution towards the understanding of the primitive tendency to symbolize, nor yet of the constitution of primitive society. An external symbol seems to be indispensable in the integration of primitive, and for that matter even of civilized, groups. Durkheim, developing Frazer's theories more fully, has rightly insisted on the functional value of the Australian *churinga* and of our modern flag, of the medieval scutcheon, and the crown and sceptre of contemporary monarchs. The appreciation of social symbolism, of the concept of the external soul in its wider setting, reveals to us some of the workings of the primitive, that is, essentially human mind, and of group integration at all levels of development. For the progress of civilization in a way consists in the imprint of things spiritual being given to matter, while shaped matter fashions spiritual processes in turn. The very essence of symbolism in thought, in speech and writing, in liturgy and in art is, after all, nothing else but the concept of 'external soul' developed and refined beyond recognition and yet without any breach of continuity. Thus Frazer's first hypothesis can be regarded as the starting-point of some of the most important developments in the study of culture.

The second theory, formulated by Frazer after the sensational discoveries of Spencer and Gillen in Australia, links up totemism directly with magic. The Arunta and allied tribes perform magical ceremonies of totemic increase in which every clan acts as a co-operative unit in a vast enterprise of multiplying edible and otherwise useful animals and plants. The means to this practical end appear to us completely fictitious. This, however, does not detract from their social and even educational value. They bring home to the participants the importance of co-operation, the necessity of obeying rules and following tribal tradition—an aspect of ceremonial life brought out by Prof. Radcliffe-Brown in the second part of his "Andaman Islanders".

The role of magic as an all-important organizing and integrating force can be seen even more clearly at a level higher than that of the Australian and Andaman islander. In the Trobriand Islands the garden magician, in virtue of his mystical power over Nature, becomes the leader and organizer of the enterprise: he acts as the agricultural expert and supervisor of work (*cf.* "Coral Gardens" by the reviewer). So also the man who magically controls wind and weather, the dangers of the open seas, and the vicissitudes of the commercial moods of his trading partners, acts as captain of the canoe and master of an overseas expedition ("Argonauts of the Western Pacific"). As regards Polynesia, the connexion between magic and practical activities has been well documented by Dr. R. W. Firth in his "Primitive Economics of the New Zealand Maori" (1929).

In his third and final theory of totemic origins Frazer reveals the significance of the primitive ignorance of physiological paternity. Here once more the Central Australians provide the cue. They believe that conception is due to the entry into a woman's womb of a totemic spirit-child. These are believed to reside in sacred spots, primarily deposits of bull-roarers (*churinga*), where mythical ancestors, half-human, half-totemic, had left their souls and their magical implements. This belief, argues Frazer, is sufficient to explain the reason why primitive man regarded himself as mystically bound up with an animal, plant, or inanimate object. It accounts also for the formation of clan bonds, and it explains why, through his totemic kinship with natural phenomena, primitive man claimed magical control over natural processes and objects.

At the time when Frazer was setting forth his theory, he was really generalizing boldly—some might even say, too boldly—from evidence confined to one insignificant tribelet in the deserts of Central Australia. Yet here once more Frazer's genius had anticipated the course of future discoveries. Animistic beliefs about conception have since been discovered in one tribe of Australia after another until their distribution map almost covers the continent. They have been signalled by Rivers from Melanesia, by the present reviewer from eastern New Guinea, and by Dr. Hogbin from Polynesia.

It is interesting to note that simultaneously with Frazer's "Totemica" there appears a monograph dealing with totemic paternity in aboriginal Australia. It is really a monument to Frazer's insight and vision, and to the value of his theories of totemism (M. F. Ashley-Montagu, "Coming into Being among the Australian Aborigines" 1937). Dr. Ashley-Montagu concludes that, with very few and insignificant exceptions, "the orthodox doctrine of each tribe" in Australia is "that children are the result of the immigration into a woman of a spirit child which is of an origin going back into the far distant mythological past. . . . Thus it is that by means of this belief in the immigration of spirit children into women the proper totemic and moiety membership of the child is secured". (*Op. cit.* p. 199.)

Taking any one of the three hypotheses in isolation, it might be contended that none of them alone is sufficient to account for the birth and nature of totemism. Taken in conjunction, they give a full and adequate explanation of the phenomenon. They all centre round the conception, almost the definition, of totemism which runs through Frazer's theoretical treatment and gives the perspective to his magnificent edifice of fact: totemism expresses ritually and mythologically man's selective interest in a number of animal or plant species; it discloses the primitive's profound conviction that he is in body and mind akin to the relevant factors of his environment. These he is able to control magically in virtue of the kinship; and towards them he has to observe a religious attitude of reverence and consideration.

In any theory of totemism, we have first and foremost to account for the linking of man with environmental forces and principles. In his third theory, Frazer makes the important suggestion that the primitive ignorance of reproductive physiology combined with beliefs of spirit-child incarnation is the natural basis of totemic kinship between man and Nature. This bond was to primitive man not merely an intellectual affirmation and a sentimental attitude; it became above all a means of action. Since his interest in his surroundings was pragmatic, that is, nutritive and utilitarian, and his earliest means of control magical, the main function of totemic belief consisted in the ritual of magical increase directed upon useful or practically important factors of the environment. Thus we are led inevitably to Frazer's second hypothesis, in placing the first within the context of primitive thought, feeling, and action.

Such terms and concepts, however, as 'principles of fertility', 'useful environmental factors' go beyond primitive man's intellectual horizon. He has to use concrete and tangible symbols, both ritually and psychologically. The principle of ritual symbolism, that is, the belief in the external soul, on which Frazer lays emphasis in his first theory, is the indispensable corollary to our understanding of the magical function of totemism and of its conceptual origins. The Australian *churinga*, for example, is the prototype of the external soul. In native belief it is also the main reservoir of spirit-children. In the increase ceremonies it becomes the main instrument of magical efficacy. This small object embodies as it were and epitomizes Frazer's hypotheses of totemic origin; and, let us remember, to the Central Australian the *churinga* is the most sacred and important object in the whole universe. It represents to him tradition, magical force, and the social unity of the clan, condensed but all-powerful. It stands for a long line of ancestors; it gives man the means of securing wealth and welfare; it is the source of human fertility. In 'singing' to his *churinga*, in his mythologies and ritual actions, the Central Australian pragmatically bears witness to the intuition and insight of the great historian of totemism.

Frazer's theories explain not only the origins of totemism but also its functions. From the survival point of view, it is vital that man's interest in the practically indispensable species should never abate, that his belief in his capacity to control them should give him strength and endurance in his pursuits and stimulate his observation and knowledge of the habits and nature of animals and plants. Totemism, in the light of Frazer's theory, appears thus as a blessing bestowed by religion on primitive man's efforts in dealing with his useful surroundings, upon his 'struggle for existence'. At the same time it develops his reverence for animals and plants on which he depends, to which he feels in a way grateful, and yet the destruction of which is a necessity to him.

Frazer's interpretation of totemism gives us still the best insight into the earliest phases of religion, of man's pious attitude of dependence, of his early seeking for permanent tangible values instinct with spiritual and moral substance. Within the framework of Frazer's interpretation we see how in totemism the beginnings of ethical attitudes are developed through the magical co-operation of clan members, and of the clans for the welfare of the whole community. Frazer has also shown that totemism, in its insistence on material symbolism, contains perhaps the earliest rudiments of sacred metaphor, that is, of abstraction, with all its possibilities of development into ritual, on one hand, and science on the other.

Frazer's contribution has been as essential to the progress in empirical field-work as to our theoretical understanding of primitive man. More than that, in his great works, "The Golden Bough", "Totemism and Exogamy", "The Fear of the Dead", "The Belief in Immortality" and "Folklore in the Old Testament", Frazer has given us in outline a lasting philosophy of culture capable of indefinite development.

The extraordinary sympathy and insight with which the leader of the British school has treated primitive ways of thought and action, his fundamental humanism, his scientific acumen and artistic intuition have allowed him to reveal most of the problems with which modern anthropology is concerned. Frazer's vision has also led him to foresee the main currents of empirical discovery and to lay down the foundations of the comparative science of human cultures.

B. MALINOWSKI.

Hydrocarbons

The Reactions of Pure Hydrocarbons
By Gustav Egloff. (American Chemical Society Monograph Series, No. 73.) Pp. xvii + 897. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) 84*s.* net.

FEW men are more widely known or popular at gatherings of petroleum technologists than Gus Egloff, largely on account of his immense knowledge of his subject and his willingness to impart it to others. His research record is also second to none, so that a book from his pen is assured of a ready reception based on the expectation that it will prove to be of outstanding utility and interest.

The teaching of organic chemistry began for most of us with the paraffin hydrocarbons, though as we progressed we took but little interest in their chemistry. It is the conversion of the oil industry into a chemical industry that has brought about their extensive reinvestigation.

Faraday's famous paper in 1825 on "New compounds of carbon and hydrogen obtained during the decomposition of oil by heat" introduced benzene to the world, and already in those days "The Portable Gas Co." prepared gas by decomposing a mixture of fish and vegetable oils. In the latter part of the last century, oil gas was successfully used in lighting railway carriages, being made by the Pintsh process from petroleum or shale oil by heating—what is to-day termed cracking. An early description of this process by H. E. Armstrong (*J. Soc. Chem. Ind.*, Sept. 29, 1884) summarizes what must have been some of the first experiments on the pyrolysis of hydrocarbons.

Of late years, the hydrocarbons have assumed a new aspect, since it has been realized that almost unbelievable quantities are naturally available all over the world, appearing as gases, liquids and solids. The outstanding progress made by the oil industry in marketing liquid products is well known; as a by-product of refining, it produces large volumes of hydrocarbons supplementing the billions of cubic feet of natural gas handled daily. Natural gas in favoured countries has replaced manufactured illuminating gas. A new industry which is growing up is based on using the hydrocarbons, particularly those which are unsaturated, as the raw materials of an ever-increasing variety of chemical syntheses, and by cracking the saturated hydrocarbons an unlimited amount of unsaturated raw material is available.

Egloff divides the hydrocarbons into seven groups, distinguished as paraffins, olefines, acetylenes, aromatics, cyclo-paraffins, cyclo-olefines and terpenes. Although each group is individual in properties, it can be produced from, or converted into, most of the other groups under varying and to a high degree controllable conditions generally involving pyrolysis. Such processes have become of technical importance.

The seven main chapters of the book deal with the reactions of these groups, which are subdivided again under the individual hydrocarbons of the homologous series. Egloff uses the words "pure hydrocarbons" in his title, the justification being that the technique has progressed so far that in most instances complete separation is possible though the hydrocarbons are obtained in complex mixtures.

Theoretically, any organic compound may be prepared from its parent hydrocarbon, so that for the future a cheap source of this parent will give a great impetus to the development of synthetic organic chemicals: this is indeed likely to happen.

Inasmuch as paraffins are more susceptible to thermal than to chemical treatment, chief interest is attached to their decomposition both in the laboratory and in the factory when they are being transformed into more reactive unsaturated hydrocarbons. Hence the importance of an accurate knowledge of their decomposition reactions. The olefines are studied largely from the point of view of their susceptibility to polymerization, rearrangement to isomeric hydrocarbons and decompositions.

Acetylene has characteristic properties due to its unsaturation and high negative heat of formation, which enables it to polymerize into simple or complex molecules, such changes being facilitated by catalysts. Acetylene will be the source of many new substances, such, for example, as duprene (neoprene) the new synthetic rubber material. As yet, the higher acetylene homologues have been but little studied.

The reactions of benzene and its homologues bring the average chemist on familiar ground; here Egloff deals in detail with the theory and mechanism of their pyrolytic reactions.

The naphthenes or cyclo-paraffins have been much less studied though very large quantities are available. The 100 pages of this chapter are full of information not easily available elsewhere: some day these compounds will be put to specialized uses.

The final chapter concerns the terpene hydrocarbons present in the essential oils of plants whereas the other hydrocarbons described are of mineral origin: there are terpenes in certain mineral oils. The major industry connected with terpenes is that of turpentine and resin. Great interest attaches to isoprene, the unit hydrocarbon of rubber. Egloff has been at pains to collect the information relating to the thermal decomposition and polymerization of this group.

The magnitude of the work is evidenced by the fact that the subject and author index occupy 44 pages in double column. Its utility is unquestionable, it is veritably a master work, and future workers all over the world will be obligated to its author ; indeed it will undoubtedly accelerate the development of the subject experimentally.

E. F. ARMSTRONG.

Agents affecting Plant Growth and Movement

Der Einfluss einer Pflanze auf die Andere, Allelopathie

By Prof. Hans Molisch. Pp. viii + 106. (Jena: Gustav Fischer.) 4.50 gold marks.

IN this book, Prof. Molisch published shortly before his death an interesting account of a number of experiments he carried out to examine the effect exerted by one living plant upon another. His investigations do not deal with the so-called autogenetic radiations of Gurwitsch, of which he is a little sceptical, but have their starting-point in the known fact that, if early and late maturing apples are stored in close proximity, the latter arrive at maturity earlier than if they are stored separately. The same effect has also been observed in the case of pears. As it is known that ethylene is produced in the process of respiration of ripening fruits, it is probable that ethylene vapours are responsible for this phenomenon. Indeed Elmer, Huelin, Gane and other workers of the Food Investigation Board have not only proved the ripening effect of these ethylene-containing vapours of apples and other fruits, but have also shown that they inhibit the sprouting of potatoes and the growth of pea seedlings (see Gane, NATURE, 134, 1008; 1934). Experiments by Crocker in the United States have shown that epinasty of leaves can be induced by ethylene, and E. M. Harvey has determined the effect of ethylene on plant metabolism.

Molisch's experiments were concerned with the growth of seedlings exposed to the natural emanations from maturing apples, pears, oranges, lemons and bananas. Using the seeds of peas and vetches he found that, by placing a few apples in the closed vessel containing the germinating seeds, the growth of the seedlings was considerably retarded. Instead of attaining a height of 12–16 cm. in five days in a water culture, the peas seedlings had only grown 3–4 cm. in height. Grown in sand, the difference was even more striking. A further experiment showed that if the seedlings were exposed to the effect of maturing apples for only 1–5 hours their growth was actually stimulated, their height being 10 cm. when exposed for 1 hour and 9·5 cm. when exposed for 5 hours as compared with 7 cm. in pure air. The gas in dilute concentration evidently acts as a stimulant, agreeing in this respect with certain other organic poisons like morphine and amygdalin. The effect of other maturing fruits was of a similar retarding nature and in addition, as in the case of apples, they produced curious curvatures of the stem.

Epinastic curvatures of the leaves of growing plants, for example, *Solanum* and *Bœhmeria*, were also observed, and in other cases (privet and *Mimosa*) the proximity of apples produced leaf-fall.

The book contains further interesting records of the effect of ripening apples on the growth of roots, on the formation of callus, the development of lenticels, on the growth of pollen tubes and of fungi.

As it is known that roots excrete certain organic acids and also carbon dioxide, Molisch carried out some experiments with the roots of horse radish, carrot and beet and found that they had a slight stimulating effect on the growth of seedlings, but if the roots were cut longitudinally into four pieces they retarded growth. A considerable stimulus to growth was exerted by the root system of *Melaleuca squamea* and *Acacia verticillata.*

The effect of the proximity of vegetative shoots on the growth of vetch seedlings was to retard their elongation to a greater or less extent, while flowering shoots and particularly the flowers themselves inhibited growth in length very markedly. The inflorescences of the lilac had a deleterious effect on the growth of tomato seedlings.

At the end of the book, Molisch discusses the possible importance to the plant of the production of ethylene. Since he had shown that it retards the development of the mycelium and sporangia of *Phycomyces,* he concludes that it may prevent or at any rate delay the rotting of the fruits. On the other hand he is inclined to accept the view of Crocker that it may act as a fruit-ripening hormone. He points out that its action has much in common with such a growth-promoting substance as hetero-auxin. It causes similar epinastic curvatures, it delays the opening of buds and promotes the development of callus in poplar and the production of roots in cuttings of willow.

These undoubted resemblances between ethylene and some of the plant hormones are certainly very suggestive, and it is to be hoped that Molisch's book may lead to further researches in their elucidation.

Naturgeschichte der nordatlantischen Wale und Robben

Von Prof. Dr. Ernst Hentschel. (Handbuch der Seefischerei Nordeuropas, herausgegeben von H. Lübbert und E. Ehrenbaum, Band 3, Heft 1.) Pp. v + 54 + 10 plates. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele), 1937.) 15 gold marks.

THIS is a comparatively small new part of Lübbert and Ehrenbaum's indispensable handbook of the North European fisheries. It is by Dr. Ernst Hentschel, known to us by a useful book on the marine mammals, published twenty-five years ago.

Here we have, in some fifty pages, a brief but sufficient account, well and copiously illustrated, of all the whales, dolphins, seals and walrus which inhabit the North Atlantic region, and have in some cases a wider, even a world-wide, distribution. All the great whales come into the story except the Californian Grey; and even that is said by some to have reached European coasts in former days.

Here and there the book seems to miss something. The herds of Ca'ing whales are mentioned at the Faeroes, but not at the Orkneys, though to them these islands owe their very name; Murie's paper on the same small whale is mentioned, but not his fine monograph on the walrus; the large walrus skull in Fig. 43 looks suspiciously like the Pacific variety; the peculiar teeth of the porpoise, so easily distinguishing it from all the other dolphins, are not mentioned; and the figure of the "gestreifter Delphin", whose "Rücken ist mit einer Anzahl unregelmässiger heller Streifen gezeichnet", merely shows, unless we are greatly mistaken, the scars of a recent encounter with a cuttlefish. D. W. T.

Univers 1937:

quelques aspects de l'astronomie contemporaine. Par Prof. Paul Couderc. Pp. xii + 182 + 12 plates. (Paris: Les Éditions rationalistes, 1937.) 20 francs.

THIS work serves a double purpose. Almost entirely devoid of mathematical formulæ, it is accessible to general readers who are interested in astronomy, though practically ignorant of its most recent developments. Nevertheless, the author has never dealt with any subject in a superficial manner, and it is amazing how he has condensed into such a small space the results of modern research, while still maintaining accuracy and precision in his descriptions. In the work we find all the most up-to-date information on nebulæ, stellar spectra, galactic rotation, proper motions, the expanding universe, the age of the universe, novæ, cosmic clouds, etc. Prof. Couderc has kept very closely in touch with every phase of the subjects, which he handles with consummate skill and with wonderful clarity in his descriptions.

The book is illustrated by ten plates, some of which are due to the first telescope installed at Forcalquier, the future astrophysical station in France. Altogether we have found it a most readable work. M. D.

Astronomy for the Layman

by Frank Reh. Pp. xviii + 308 + 16 plates. (New York and London: D. Appleton-Century Co., Inc., 1936.) 12*s*. 6*d*. net.

THIS work is intended for the average reader who has little knowledge of astronomy, and is written in simple and non-technical language. Some may wonder why the author commenced with the sidereal universe and ended up with the solar system; but this is a minor point which will be lost sight of in the clear and interesting presentation of salient matters in astronomy. In the foreword by Dr. Clyde Fisher reference is made to the wealth of poetical quotations which appear in the different chapters, and many will be grateful for this anthology, ranging from the days of Hebrew cosmogony up to modern times.

A considerable portion—nearly one hundred pages—is devoted to descriptions of the constellations, with numerous diagrams. There are also many illustrations and photographs in the text. The book should stimulate readers to pursue more fully the subjects dealt with in the cursory fashion which is inevitable in the wide survey taken by the author. In the very brief discussion of various matters it is impossible to avoid expressions which may be misleading. Thus, on p. 235, readers might gain the impression that the moon is approaching the earth at present, owing to tidal friction. It is true that our satellite will some day approach us after it has receded a long way from its present orbit, but it is not approaching us now. In Chapter xvi there is little or nothing to show the distinction between the planetismal theory of Chamberlin and Moulton and the tidal theory of Jeans and Jeffreys. These are minor blemishes which do not detract from the value of a very interesting work. M. D.

Electron Tubes in Industry

By Keith Henney. Second edition. Pp. viii + 539. (New York and London: McGraw-Hill Publishing Co., Ltd., 1937.) 30*s*.

THE author is not so much concerned with fundamental scientific ideas as the practical application of electronic devices, and he does this very thoroughly, with ample references to original literature. The general characteristics of vacuum, gaseous, and photo-sensitive tubes are explained and suitable applications indicated, some of which are surprising. The text forms an ideal reference book and should be widely known. L. E. C. H.

The Methodology of Educational Research

By Prof. Carter V. Good, Prof. A. S. Barr and Douglas E. Scales. (Appleton Series in Supervision and Teaching). Pp. xxi + 882. (New York and London: D. Appleton-Century Co., Inc., 1936.) 16*s*. net.

A SURVEY of the chief methods used in educational research, together with a list of those problems which the authors consider suitable for university research workers.

America Revisited

By Dr. G. W. C. Kaye, O.B.E.

EVEN in depressed times, America is a stimulating country to visit, and I found the present national outlook a good deal more subdued than on the occasions of my previous visits; one, ten years ago at the height of a boom period, the other, during the Great War. Even so, the public and industrial activities of the United States seem to have lost little of their customary courage. San Francisco, lacking a site for its projected International Exhibition in 1939, has not hesitated to create one in the shape of an artificial island, some 400 acres in extent, in the middle of the bay. Not content with this, the city has just spent twenty-three million pounds in four years on two large new bridges, one of them, across the Golden Gate, having a record span of 4,200 feet. New York City is building at monumental expense a new elevated high-speed roadway along the water-front of Manhattan Island to try to relieve the traffic congestion, while Los Angeles is constructing road tunnels with the same object.

Americans, one gathers, pride themselves on owning more cars than any other nation. Traffic problems in the big cities are proportionately acute: it appears that on a normal weekday a quarter of a million cars enter New York and leave it, and that in the early afternoon some 35,000 cars are parked in busy streets. Incidentally, no lights are required on cars parked in American streets at night. There are relatively few buses and most of the passenger traffic in New York is carried by the 'subway' (underground). This is cheap (2½*d.* everywhere), noisy, foul but fast, and the rush-hour scenes are incredible. The elevated railways in both New York and Chicago are an unmitigated eye-sore and a noisesome blight upon the unfortunate streets which hold them.

Thousands of miles of magnificent highways, beautifully graded and cambered, have been built all over the States, largely by 'volunteer' battalions as a palliative for unemployment. Dual tracks and flying junctions lead to high cruising speeds—60 m.p.h. or more seemed to be commonplace. The published annual death-roll from motor accidents in the States is considerably higher than with us—it was nearly 40,000 in 1937, that is, nearly twice as large as ours in proportion to the population.

The roads in residential areas gain in attractiveness from the American custom of no fences in front of houses. It follows that there is little or no privacy in the gardens or "yards", but none is apparently desired. The Americans have a great aptitude for coining words; 'mortition' I knew of old, but 'beautician' must have come in with the countless beauty parlours.

Continuous demolition and rebuilding and disorganized streets seem to delight the New Yorker, who regards them as a sign of progress and doesn't mind being a little late to-day for the sake of being a little early to-morrow. New Yorkers claim, too, with no apparent contrition, that they possess the noisiest street corner in the world. Public apathy recently helped to terminate the existence of the Noise Abatement Commission. In a room on the sixteenth story, I found the noise of the elevated railway nearby was intolerably loud. On the twenty-seventh story it was beneficial to shut the windows, when telephoning, in order to cut out the rumble of the street traffic.

Most American cities seem to possess skyscrapers, partly in emulation, one supposes, of New York, where the newer skyscrapers are really beautiful by day, and almost fairylike by night when floodlit or when picked out by the lights of the windows of the occupied rooms. I noted, incidentally, that the express elevators usually allowed one second per floor (though sometimes less) whether going up or down. The tall isolated buildings of the new Rockefeller Centre and Radio City, which occupy some 12 acres, arrest attention by their dignified grouping.

Air-conditioning, which one finds in public rooms throughout the States, is a valuable addition to the amenities of railroad travel, particularly in the warmer south. The cooled and filtered air enters from the roofs of the coaches, the chilling being effected either by ice or by refrigerators, and the filtering by asbestos mats or the like. Some of the transcontinental railways run high-speed 'limited' trains on certain days in the week, largely to meet the growing competition of air travel, which is well organized and popular, being well suited to the great distances. In Canada the air carriage of freight, which already greatly exceeds that of any other country, being one third of the total for the world, is acclaimed as an outstanding boon for the widely scattered settlements.

Public interest in scientific matters appears to be high: popular scientific and technical journals of many and varied types cater in abundance on the bookstalls for the multitudes of young men who want to make good in the world. Public lectures gather large audiences, and no public dinner or luncheon is apparently complete without a post-prandial lecturer, who will find himself attentively and closely followed. Uplift movements of all kinds receive the enthusiastic support of the women, whose domestic arrangements seem to afford them more leisure than with us. There is a strong and growing movement, so I was told, for a five-day week for all classes of workers, though I should hazard that, class for class, the men work longer hours per day than in Great Britain. Their leisure is never too scanty, however, to prevent their showering on the English traveller kindly and proverbial hospitality: it is impossible to acknowledge their friendliness to England too appreciatively.

New York abounds with interest for the visitor with scientific leanings—Columbia University, the Bell Telephone Laboratories, the National Broadcasting Co., the 'Long-Distance' building for telephone and radio-telephone circuits. Everywhere one experienced boundless keenness, enthusiasm, knowledgeability, and friendliness.

The two capital cities of Canada and the States well repay a visit. Ottawa, which is being subjected to a measure of replanning, occupies a site of great natural beauty. Among the recent buildings are the palatial National Research Laboratories which, finely situated on the bank of the Ottawa River, are playing an ever-increasing part in Canada's industrial affairs. Washington must surely be one of the most beautiful cities in the world, with its stately buildings and wide avenues bordering on the Potomac River and Park. White marble and Greek architecture are adhered to for public and Governmental buildings in the environs of the Capitol, among the more recent additions being the magnificent Supreme Court and the Folger Shakespeare Library with its replica of the old Globe Theatre. The dignified building of the National Academy of Sciences stages permanently a fine series of working exhibits of fundamental experiments, which the public eagerly frequents. Some four miles away is the National Bureau of Standards, sister institution to the National Physical Laboratory, and with many problems in common.

Western America provides a powerful magnet for the visitor, in the shape of the Canadian Rockies, the Yosemite Valley, the Big Trees, the National Parks, the Grand Canyon, and the gracious beauty of San Francisco where the delightful climate, sea fogs and western geniality make an Englishman feel thoroughly at home. At Berkeley, a few miles away, the University of California exemplifies the scale of grandeur on which so many of the American and Canadian universities have been established. Among much that is intriguing are the full-scale daily newspapers which the students control, finance, publish and edit at some of the universities. Berkeley rejoices in a fine campus and many magnificent buildings, including a Greek theatre holding 10,000 and a sports stadium for 90,000. It is here that E. O. Lawrence by his genius and persistency has developed the cyclotron into the most potent practical contribution of recent times to the study of neutrons and artificial radioactivity. I refer to this again later. Thirty miles south at Palo Alto, is the Leland Stanford University, the buildings of which are most attractive with walls of buff-coloured sandstone and red-tiled roofs in the old Spanish mission style. Among much else of interest is a 2 million-volt transformer outfit, the insulating supports of which were braced with temporary steel strutting. This, I learnt on inquiry, was a precautionary measure in readiness for the next great earthquake, which was about due!

Los Angeles, that city of astounding growth and spacious conceptions, confronted with the problems of overcoming desert conditions, has solved them with gigantic irrigation schemes. Water is distributed lavishly: lawns are only kept alive by almost continuous sprinkling. Fruit is amazingly cheap. Here are the fine new buildings of the University of California, the University of Southern California, and the renowned and immense film studios of Hollywood, a city which merges completely into Los Angeles. Near by is the 'Hollywood Bowl'—a natural hillside auditorium capable of holding forty thousand people and possessing marvellous natural acoustics, which are reinforced by a large 'shell' reflector enabling those in the remotest seats 550 feet away to hear easily. The Bowl is famous for its "Symphonies under the Stars". The stable and agreeable climate enables outdoor social functions to be held with certainty.

Ten miles away near the hills is Pasadena, with its famous California Institute of Technology. Among much of interest is the Kellogg radiation laboratory where Dr. C. C. Lauritsen's pioneer work on super-voltage X-ray therapy is being carried out. In another building one can see the process of grinding the 200-inch reflector which, when completed in about two years' time, is intended for Mount Palomar, a hundred miles away, as the night glare of Los Angeles has grown to interfere with some of the work at Mount Wilson. Incidentally, there is now a magnificent road up to the 5,700-ft. summit of Mount Wilson, the journey by car from Pasadena taking about an hour, a very different state of things from that which prevailed a few years ago. The Observatory lays itself out to attract visitors, some twenty thousand attending the lectures and demonstrations during the year. A similar public response meets the efforts of the Observatory in Griffith Park, overlooking Los Angeles, visitors flocking to see the planetarium and astronomical working models.

While much of Chicago is drab and drear, the new and reclaimed portion on the shore of Lake Michigan is remarkably attractive. In September last at Chicago, the Fifth International Congress of Radiology, with some 2,800 members from forty nations, held its meetings and housed its members in a single hotel equipped with suitable convention halls and some two thousand bedrooms. Under the efficient presidency of Dr. A. C. Christie of Washington, several hundred papers were down for reading : they were dealt with by nine different sections, which met concurrently, apart from a few general sessions. The enthusiasm of members was catered for by programmes of meetings and educational courses which, together with intervals for sustenance, went on daily from 8 a.m. until midnight or after. Any unemployed moments could be devoted to a large scientific and industrial exhibition of apparatus. Many examples of shock-proof high-voltage X-ray apparatus were on view, together with associated devices designed primarily for the study of neutrons and nuclear physics.

The radiophysics section was mainly devoted to the measurement and generation of very short wave radiation, that is, X-rays generated by voltages of the order of a million volts, and radium gamma rays. Some of the papers were of extreme interest. As regards the production of very high voltages, America, always a pioneer in such matters, is now paying widespread attention to the use of super-voltages, not only for nuclear physics research, but also for X-ray therapy for cancer treatment. As against radium therapy, the arguments advanced are that it is not yet proved or ruled out that the shorter gamma rays have any clinical advantage over X-rays, while the latter, though bearing higher maintenance charges, offer the advantages of a lower initial cost and the possibility of implanting greater depth doses in the body. There appeared, however, to be a considerable body of opinion which doubted whether there is as yet any sound clinical evidence which could establish a real superiority of million-volt X-ray therapy over, say, 200 or 400 kv. therapy.

Quite apart from the achievements of the high-voltage electrical engineer for commercial utilities, there have recently been developed for physical and clinical purposes a number of radically different methods for generating very high voltages : (*a*) the super-tension transformer, (*b*) the radio-oscillator generator, (*c*) the electrostatic generator of the belt type, (*d*) the cyclotron.

Million-volt transformers of which some part or other of the high-voltage circuit is in the open air, are of necessity so large as to require a special building to house them ; there are numerous examples operating X-ray tubes, neutron tubes, etc., mainly in the States, but also elsewhere. The principle of mounting both transformer and X-ray tube in a common oil tank has long been familiar, but it has now been extended to voltages of 400 kv. and upwards. In a recent development of high-voltage X-ray apparatus by Dr. Coolidge, only the earthed target-end of the tube emerges from the tank. The advantageous features of this type of outfit are the freedom from electrical dangers, the relatively small amount of lead protection required, the accessibility of the target, and, perhaps, most of all, the small space needed, the dimensions of the outfit being of the order of only a few feet. Recent experiments on the replacement of transformer oil by compressed gaseous dielectrics are likely, it is anticipated, to lead to high-tension generators of even more modest dimensions.

Examples of radio-oscillator resonance X-ray generators, designed by Dr. D. H. Sloan, are to be found in New York and San Francisco. A short-wave radio oscillator sends its power into a high-voltage resonance coil mounted within a metal vacuum tank which serves as the X-ray tube and which is continuously evacuated. The hot cathode is situated in the side of the tank directly facing the X-ray target, which is mounted on the bottom of the coil where there is a voltage maximum, so that the high voltage is generated entirely within the X-ray tube precisely where it is to be used.

Electrostatic machines were largely used in the early days of X-rays, and the electrostatic high-voltage generator of the endless-belt type, which we owe to Van de Graaff, is virtually a large Holtz machine, consisting essentially of a rounded conducting terminal supported on an insulating column and charged by a swiftly moving (4,000–5,000 feet a minute) flat insulating belt (of rubberized fabric) conveying electricity 'sprayed' on the belt by corona points charged with 20,000 volts, and depositing it within the terminal. The outfit is robust and simple, and very high and steady voltages (several million) may be obtained. The current output is proportional to the speed and number of the belts and the dielectric strength of the surrounding medium, usually air. There are now a number of these installations in the States ; I saw an early type at the Carnegie Institution (Dept. of Terrestrial Magnetism) at Washington. This produces a million volts with regularity : the only uncertainty is occasioned by the high humidity which often occurs in Washington. This difficulty will be avoided in the new 5 million-volt apparatus which is being constructed, and which will operate at several atmospheres pressure within a large pear-shaped steel reservoir (some 60 or 70 feet high), mounted vertically on its small end. This outfit is designed for work on nuclear physics. Another outfit at the Huntington Memorial Hospital, Boston, operates a continuously pumped cascade X-ray tube at a million volts and up to three milliamperes; while yet another outfit, at the Massachusetts Institute of Technology, develops a steady voltage of five million and a current of two milliamperes in work on atomic disintegration.

The cyclotron was designed for use in the domain of atomic physics and, while it is inapplicable at present to X-ray purposes, it does, as already mentioned, render available for the biological worker and radiologist two powerful new tools, in the shape of artificial radioactive elements and neutrons. Some twenty-five outfits are at present under construction the world over, six or seven in the States and two in England (Cambridge and Liverpool).

The latest model of the cyclotron, which incidentally weighs 100 tons, utilizes the principle of multiple or 'cascade' acceleration of ions by a combination of a magnetic and a swiftly alternating electric field, and can so impart to a beam of protons or deuterons equivalent voltages up to 7½ million. If the beam is allowed to impinge on beryllium, a stream of neutrons results which may be some thousands of times more powerful than any other method can provide. For example, a beam of neutrons corresponding to 7½ million volts and 20 microamperes is stated to be equivalent to the gamma radiation from 100,000 grams of radium in equilibrium. The controls for the operator are remotely situated from the cyclotron, further protection being afforded by tanks of water three feet thick encircling the apparatus.

By the use of one or other of the three types of particle which the cyclotron provides in such abundance, virtually all the known elements have been made to yield radioactive isotopes through the method of nuclear bombardment. Among them is radio bismuth, which is identical with radium-E in every respect. In one day as much radio sodium (with a half-life of 15 hours) can be made as corresponds to 100 mgm. of radium. Some of the artificial radioactive elements are finding a revolutionary field of service as 'tracers' or 'tagged atoms' in biological and clinical research. For example, radio sodium, when drunk in a solution of common salt, manifests itself in the fingers of the hand in less than two minutes by the emission of gamma rays; the residue, magnesium, is quite innocuous within a few days.

Both in Berkeley and elsewhere the study of neutron therapy (on animals) is being taken up. Neutrons ionize in a manner very different from that of gamma or X-rays, and are unique in being more absorbable in body tissue than in bone. If the present claims of selective reaction to tumour tissue are substantiated, it would seem that neutrons may presently have high therapeutic significance.

Prof. Lawrence has under construction a special building for housing a much larger cyclotron, which has been designed expressly to generate radioactive elements for prosecuting bio-physical and medical research. The new outfit, which will weigh 220 tons, is expected to afford voltages equivalent to 10 million, and to give five or ten times the yield of the present cyclotron.

It is the practice of the International Radiological Units and Protection Committees to meet on the occasions of the International Congress. The chief business before the Units Committee, which met under the chairmanship of Dr. Failla of New York, was to determine whether or not the time had come when the röntgen—the ionization unit of X-ray quantity—should also be used for very high-voltage rays and radium gamma rays. The British delegates (Dr. N. S. Finzi, Prof. F. L. Hopwood and Dr. G. W. C. Kaye) presented a memorandum from the British X-ray Units Committee, which advocated the step and with it an appropriate modification of the present definition of the röntgen. In the end, the important step was taken and a generalized definition was agreed provisionally until the next Congress, when it was anticipated that a still more general definition embracing all classes of radiation may be forthcoming. The röntgen is now defined as follows: "The röntgen (symbol r) shall be the quantity of X- or gamma-radiation such that the associated corpuscular emission per 0·001293* gramme of air produces, in air, ions carrying 1 electrostatic unit of quantity of electricity of either sign."

The International Protection Committee, which met under the chairmanship of Dr. Kaye, made a number of changes in the existing recommendations, particularly in relation to the new problems of protecting operators working with super-voltage X-rays or radium 'bombs' containing large quantities of radium. Many of the data utilized were based on recently published results of the National Physical Laboratory.

It was announced during the Congress that the next meeting would be held in Berlin in 1940 under the presidency of Dr. Holthusen of Hamburg. It will be governed by a new set of rules and regulations adopted at Chicago, largely through the energy and initiative of Dr. Christie.

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* 0·001293 gramme is the mass of 1 c.c. of dry atmospheric air at 0° C., and 76 cm. of mercury pressure.

Quaternary Glaciations in Central China

DR. J. S. LEE, the well-known Chinese geologist, has sent to the Editor of NATURE the proofs of a monograph entitled "Quaternary Glaciations in the Lushan Area, Central China" with a series of photographs, intended in the first place for publication in vol. 2, ser. B, of *Academia Sinica*. Its transfer to England by air transport, with the request that it be placed in the safe custody of a responsible geological institution, conjures up a lively sense of the present and future state of affairs in China; which aspect, however, has no part in this article except in its bearing on the future publication of the monograph. Another aspect, and one having some significance, is that one would scarcely expect Dr. Lee to take such care to ensure the preservation of this material and to have it brought to the critical notice of expert glacialists, if he were not confident of the prime importance of his latest investigations in the Lushan mountain massif.

A few words of explanation are perhaps necessary to a proper understanding of the latter remarks. The very existence of evidences of glaciation in Central China has in the past been questioned by many geologists with experience of glaciated districts. When Dr. Lee in 1934 published his first account of the 'Boulder Clays', striated rocks, transported blocks, etc., in the Lower Yangtze Valley, and invoked true glaciation (as against solifluxion and allied phenomena) to explain the facts, his evidence was challenged by G. L. Barbour after a cursory joint traverse of the ground.

Barbour, while admitting the extraordinary character of many of the deposits, sought to identify them with long periods of abnormal subærial weathering and erosion, possibly commencing so far back as early Pliocene or even Miocene times. The clay matrix of the 'Boulder Clay' was likened to non-glacial loam; the presence of boulders he explained as due to sinking into the leached soil of laterized surface rocks followed by gradual descent to lower ground under gravity; while a theoretical series of structural events was postulated to account for the presence of transported blocks in elevated positions relative to their apparent source. Further, an absence of (1) glacial sculpture, (2) glacio-fluviatile deposits, and (3) *roches moutonnées* was claimed by Barbour, though it was admitted that shortage of time prevented his seeing many crucial features.

At that time (1934), Barbour was clearly inclined to the belief that the glacial explanation of the Lushan phenomena was not acceptable. Yet he paid high compliment to Lee for "his penetrating recognition of the possible significance of this extraordinary geological occurrence", admitting further that the last word on the matter had not yet been said and that his (Lee's) interpretation had not been disproved.

That Dr. Lee was not deterred by these criticisms from a geologist of wide experience is shown by his energetic pursuit of confirmatory evidence, and the monograph under consideration directs attention to this glacial evidence under the headings (*a*) geomorphological indications; (*b*) moraines and their associated deposits; (*c*) striated rocks. A short account of the bed-rocks of the Lushan is given to enforce the arguments dealing with transported blocks; and more ambitious inferences than previously attempted are introduced to demonstrate a three-fold glaciation of the Yangtze valley.

A well-contoured map of the Lushan, bounded on the north by the Yangtze River and on the east by the Poyang Lake, accompanies the monograph. It shows the geographical extent of the glaciations and includes the observed indications of fluvio-glacial deposits, terminal and lateral moraines, drainage channels, glacial striæ, and striated boulders. The scale of the map is 1 : 50,000.

A critical review of the monograph is thought to be undesirable here. For it is clear that, failing an intimate knowledge of the area, an unquestioning acceptance of the validity of the glacial terminology must precede any attempt to estimate the full value of the evidence. This assumption is supported by the fact that G. L. Barbour, well experienced in low-latitude glacial phenomena, was unable to put forward final and convincing conclusions regarding the Lushan deposits and allied features. Attention will therefore be confined to a summary of the chief points of interest raised by Dr. Lee. Glacial geologists, by permission of the Editor of NATURE in arrangement with the Director of the Geological Survey and Museum, will be afforded the opportunity of consulting the monograph and map at the Survey Library, where the documents are being housed pending further instructions from Dr. Lee.

In his analysis of the glacial evidence, Dr. Lee stresses the fact that landforms have suffered extensive erosion and consequent modification since the last glacial period. The geomorphological indications are therefore not in themselves conclusive; but they were sufficient to inspire Lee and induce him to search for other signs of glacial

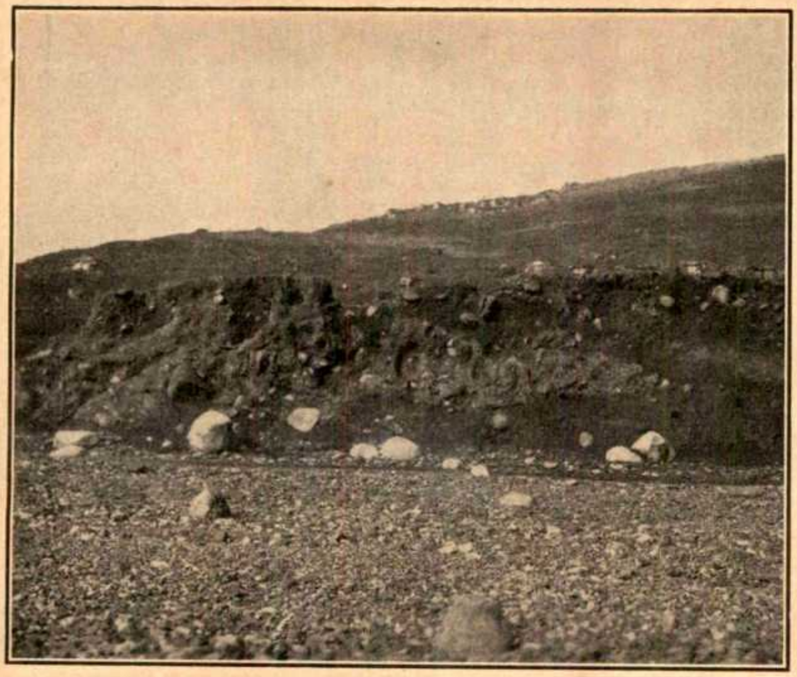

Fig. 1.

A LENTICULAR MASS OF HARDENED AND LATERIZED BOULDER CLAY OF THE POYANG PERIOD INVOLVED IN THE LOOSER BOULDER CLAY OF THE TAKU PERIOD, NEAR THE KUTANG VILLAGE.

but along the side of it." The ravine begins abruptly in front of a mass of Boulder Clay "which proved to be the remnant of an end moraine", and here is a slight similarity to certain drift-diverted streams and gorges in Lancashire. Another case of drainage which suggests the former existence of a valley glacier is described from the Chilichung Valley.

In connexion with several dry gaps which have been cut into the north-western ridge of sandstone in the Lushan, the statement that "the only feasible explanation of the origin of these gaps seems to be that they were produced by spills from the glacier" is supported by acceptable evidence. Examples are also given, though with varying assurance, of firn basins, corries, and kindred features; more confidence is expressed in the phenenoma. The frequent occurrence of rock basins on the top and flank of the northern part of the Lushan is noted, but not accepted indiscriminately as evidence of glacial sculpture. A strong case, however, is made for a true cirque on the central heights at a spot where a circular depression is carved out of resistant rock of uniform composition, free from structural weakness. It has a fairly steep back-wall and hangs to a main valley in front; further examples on the south-eastern flank are also described.

A circumstantial account is given of the most striking example of a U-shaped valley seen in the area, namely, the Wangchiapo Valley. One feature is worthy of Lee's own words: "The question therefore arises as to whether the U-shape of the valley is not entirely due to the synclinal structure with the non-resistant Kuniuling rocks being more or less completely removed by stream erosion. That this is not entirely true is indicated by the behaviour of the existing streams and by the deposition of terminal moraines which still survive. . . . Here it suffices to note the occurrence of a deep ravine through which the stream pours down the valley. This feature has been incised by the stream and has attained a depth of no less than 70 m. below the floor of the valley at Wangchiapo. . . . Beds of the Wulafoeng Grit are thereby excavated in the form of a trench; and curiously enough, the trench does not run along the axis of the syncline or the lowest part of the valley bottom

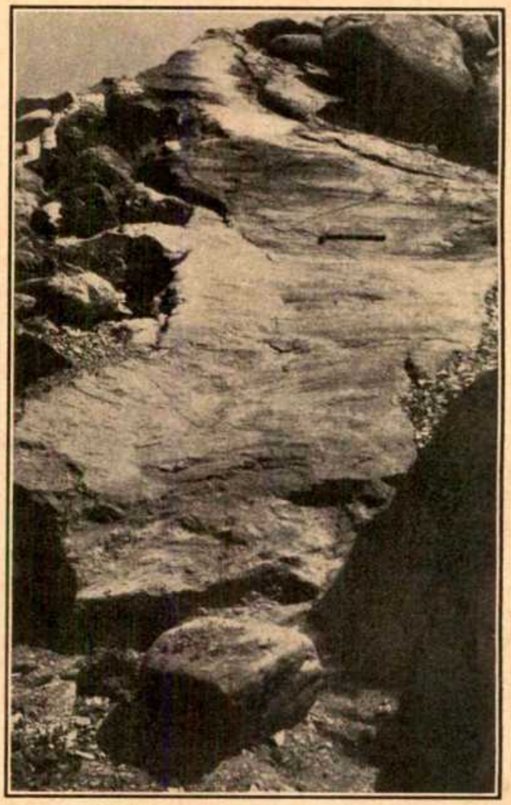

Fig. 2.

GLACIAL PAVEMENT NEAR PAISHITSUI, STRIÆ POINTING SOUTH-EAST; BEDDING PLANE DIPPING NORTH-WEST AT ABOUT 20°.

case of two "zungenbecken" or "central basins" relics of piedmont glaciers on the north side of the mountain.

Coming now to the important matter of depositional evidence, that is, moraines, boulder-clay, etc., we are presented with an interesting story leading to the postulation of three glaciations, associated with three distinct types of boulder-clay. The two lowland types are illustrated in Fig. 1, which shows the incorporation of blocks of the earlier well consolidated dark red variety by the later brick-red less consolidated one. The latter is more widespread and has undergone less laterization. It is important to note, in view of Barbour's earlier objection that the boulders in the boulder-clay were invariably hard quartzites and grit, that Lee now emphasizes their lithological variety. Lateral and terminal moraines, a block moraine, and an outwash apron are instanced, though a fuller development of these is said to be lacking as a result of excessive, inter- and post-glacial destruction. Solifluxion has been found inadequate to explain the transfer of large blocks over the long distances required; the famous Poyang Lake section of glacial drift containing such boulders is 9 km. from their source in the Lushan, and the intervening pre-glacial gradient is negligible, yet is, according to Lee, demonstrably greater than in Boulder Clay times.

Finally, the scratched boulders and striated rock surfaces (Fig. 2) are claimed by Lee to be perhaps the most convincing evidence for glacial operation, and it need only be remarked that Barbour's scepticism on this matter must have created in Lee a strong urge to test this type of evidence very thoroughly. W. L.

Obituary Notices

Dr. G. E. Hale, For.Mem.R.S.

BY the death of George Ellery Hale on February 22, at Pasadena, California, solar physics loses its greatest leader. Born in Chicago on June 29, 1868, he had already in 1890, before completing his studies at the Massachusetts Institute of Technology, begun working at the Harvard College Observatory on his idea of a spectroheliograph. Resisting the temptation to accept Prof. Holden's offer of opportunities to develop his new instrument in connexon with the 36-in. refractor at the Lick Observatory, he established with his father's help a private observatory at Kenwood, in a suburb of Chicago. There, working in the fourth order of a 4-in. Rowland grating attached to a 12·2-in. equatorial, he studied the spectrum of the solar prominences and photographed them in monochromatic light, using first of all the bright K line of calcium. As he found by photographic spectroscopic observations that the bright K_2 line could be detected here and there on the disk of the sun, he extended his work to monochromatic studies of the whole solar disk, finding the presence of great areas of glowing calcium clouds in general around sunspots. By 1892, his pioneer work had won for him recognition by the University of Chicago, of which he became an associate professor.

Through the munificence of C. T. Yerkes, by no means the last wealthy man in whom Hale was to inspire confidence in his ability to make excellent use of large benefactions, he was given charge of the new Yerkes Observatory at Williams Bay, Wisconsin, with the largest refractor in the world (40-in.) and with the Rumford spectroheliograph, which gave him an image of the sun 6·5 inches in diameter. At the Yerkes Observatory with Barnard, Burnham and Frost to help him he worked steadily for nearly ten years on stellar spectra and solar problems. The next great instrumental development became possible for him in 1904, through the generous assistance of the Carnegie Institution, when he was made director of the Mount Wilson Observatory. Here he successfully developed the tower telescope (60 ft. and later 150 ft.) with underground spectrographs (30 ft. and 75 ft.) for solar work; for high dispersion stellar spectra and work on distant nebulæ the 60-in. and 100-in. reflectors were available, the latter being due to the munificence of J. D. Hooker. He gathered a great team of colleagues together, and the publication of the annual report of the Observatory became one of the major events of the astronomical year. Hale's own contributions were mainly on the solar side and included such outstanding discoveries as that of the intense magnetic fields in single sunspots, the existence of bipolarity in groups of spots of opposite polarity, the change of polarity of such bipolar spots after each sunspot minimum and the relatively weak general magnetic field of the sun (a full account of Hale's solar work is given in an article by Prof. H. F. Newall in the series of Scientific Worthies in NATURE of July 1, 1933, p. 1).

In 1923, under the strain of his many activities, Dr. Hale's health gave way and he retired from the active directorship of the Observatory to become honorary director. But his work was not done. On the observational side, he developed the spectrohelioscope, now a valuable instrument in the study of solar eruptions of short duration and of their reaction on the terrestrial ionosphere; on the administrative side he was mainly responsible for securing in 1928 the grant from the Education Branch of the Rockefeller Foundation, which made it possible to undertake the heavy task of constructing a reflecting telescope with a mirror 200 in. in diameter. Hale took a large share in the preliminary studies and work necessary for the successful completion of this project.

As an investigator, Hale did as much as one man could be expected to do. But his scientific activities covered a much wider range. As foreign secretary of the National Academy of Sciences he was active in establishing the National Research Council of the United States, of which he remained honorary chairman until his death. His international work in astronomy began in 1895 with the foundation of the *Astrophysical Journal*, following upon the publication three years earlier of *Astronomy and Astro-Physics*.

Then in 1904 at St. Louis came the foundation of the International Solar Union on Hale's initiative. President at its first meeting, he, with Schuster and Arrhenius, was elected on to its first executive committee, remaining a member of it throughout the life of the Union. In 1919 came the formation of the International Research Council with Hale as an active member of the original executive committee; later he became president for the years 1934–37 of the International Council of Scientific Unions. In the International Astronomical Union formed under the auspices of the Council, Hale was elected president of the Commission of Solar Physics (1919–25).

Honours and awards came to Hale freely from scientific bodies and universities all over the world. To mention only those from Great Britain, they included honorary degrees from Oxford, Cambridge and Manchester, medals from the Royal Institution and the Royal Astronomical Society, of which latter body he was an associate. Foreign membership was given him by the Royal Societies of Edinburgh and Dublin, by the Cambridge Philosophical Society and by the Royal Society, which in 1932 awarded him the Copley Medal, primarily for his work on magnetic fields in the sun.

F. J. M. STRATTON.

ANYONE meeting George Ellery Hale must, I think, have felt at once that he was somewhat out of the ordinary run of scientific men. We knew he was a great figure in science, but felt that he could have been equally great at almost anything else. For Nature had not only endowed him with those qualities that make for success in science—a powerful and acute intellect, a reflective mind, imagination, patience and perseverance—but also in ample measure with qualities which make for success in other walks of life—a capacity for forming rapid and accurate judgments of men, of situations, and of plans of action; a habit of looking to the future, and thinking always in terms of improvements and extensions; a driving-power which was given no rest until it had brought his plans and schemes to fruition; eagerness, enthusiasm, and above all a sympathetic personality of great charm. This great and varied array of talents gained for him the complete confidence of everyone he met, from the highest to the lowest.

I never ceased marvelling at his great knowledge of almost every department of observatory work. He was not only for many years director of the great observatory which was so largely his own creation, but also had made himself an expert in most of its varied branches; and I know from my own experience how genuinely he could interest himself in other people's scientific work and ideas, and how warmly and sincerely he could give encouragement.

It was a great tragedy that indifferent health so restricted his activities in the latter years of his life—his ever-eager mind and ardent spirit had made too exacting demands on a none too strong body; it is an even more poignant tragedy that he has not lived to see the completion of the great new telescope which will owe so much to his forethought and planning.

J. H. JEANS.

THE death of Dr. G. E. Hale, coming at the end of a slow decline of strength such as he has suffered since July 1936, can scarcely be regarded as other than a merciful release from protracted suffering. The sincere sympathy of his very numerous friends goes forth to his wife and family and relatives, and the memory of a very remarkable personality will be widely cherished.

His geniality and his interest in a wide extent of natural knowledge and of art and literature and history made him a very welcome companion.

Hale was in truth a leader not only in his own chosen investigations in solar physics but also in the initiation and furthering of organization of scientific co-operation. By a rare combination of personal qualifications of which he seemed to be entirely unconscious, he achieved early in life recognition of his power to evoke enthusiastic support in developing available resources for the advancement of natural knowledge. In 1890 he had resisted an offer of the director of the Observatory on Mount Hamilton in California, an offer that he should have the use of the Lick refractor during stated hours in the week for the development of his spectroheliograph. Fortunately, through the wise advice of his father, he decided to utilize full time with a 12-in. refractor specially constructed at the expense of his father. After a couple of years of successful observations in the Kenwood Observatory he was called upon to take charge of the new observatory in Wisconsin, where a finished product of the workmanship of Alvan Clark in the form of a 40-inch achromatic objective, which Hale's enthusiasm had induced Mr. C. T. Yerkes to purchase, was to be mounted in the Yerkes Observatory of the University of Chicago.

In 1904, Hale received noble encouragement from the trustees of the Carnegie Institution to found a Solar Observatory in California, and there he began that very notable succession of advances based on experimental trial on relatively small scale and leading to successively increased power of instrumental equipment on novel lines. Aided by funds contributed by the Carnegie Institution, by Miss Snow, by Mr. J. D. Hooker, by the Rockefeller Foundation and probably also by other sources, there arose on Mount Wilson the observatory provided with extensive workshops and physical laboratories and devoted to the intensive study of all branches of astronomy and many branches of physics.

There, under the stimulating influence of Hale in the encouragement of team work, not only were opportunities of a very unusual kind afforded to the members of the devoted permanent staff, but also welcome was extended to students of recognized authority from all parts of the world, to join in co-operative work.

Even in the resulting activity, Hale himself found time and energy to produce very notable scientific contributions, such as his splendid discovery (based on Zeeman's discovery of the influence of a magnetic field on spectral lines of a gas rendered luminous in such a field) that sunspots were the seats of violent magnetic phenomena and that the sun showed signs of having a general magnetic field, with poles not far removed from the poles of the axis of the sun's rotation. One of his latest achievements was the invention of his beautiful spectrohelioscope for visually studying local changes of short duration in the features of the sun's surface—a study that seems likely to throw light not only on the cosmical origin of terrestrial magnetic storms and of the aurora borealis, but also on certain peculiar phenomena encountered in the reception of wireless signals, which seem to indicate the arrival of external influences (probably of solar origin) in the outer atmosphere of the earth.

Truly Hale was a leader of outstanding ability, and his influence and memory will long be cherished. His many friends will join in a deep regret that it was not given to him to live to see the completion of that huge enterprise of the 200-in. reflector, in the initiation of which he took so deep an interest.

H. F. NEWALL.

THE most prominent characteristics of Dr. Hale were his whole-hearted devotion to astronomy and his friendship with his colleagues and fellow workers. His invention of the spectroheliograph and spectrohelioscope and his discovery of the magnetic field in sunspots are tributes to his mechanical genius and insight. The two magnificent observatories and the 200-in. telescope are outstanding achievements. But he had also a very catholic interest in the work of his colleagues all over the world, and was always ready to give them help. The Solar Union had Hale for father and, as wittily said by a German astronomer, Schuster for mother. He attached great value to good fellowship among astronomers, amateur and professional alike, for the advancement of the science.

I shall always remember the times I have met Hale and the complete absence of any superiority or what is vulgarly but expressively called 'side'. The last occasion when I saw him was some seven or eight years ago, when he invited Sir Herbert Jackson, Prof. A. Fowler and me to lunch, and we heard of his project for the 200-in. reflector. Another time he was passing through Edinburgh after a visit to Andrew Carnegie at Skibo Castle, and was hugely delighted at having beaten Andrew at golf and caught a bigger fish. He was a great man, and I, with many more, am proud to have been among his friends.

F. W. DYSON.

Mr. C. Green

THE death of Charles Green, chief inspector of fisheries in the Fisheries Branch of the Department of Agriculture of Eire, on February 9, after a short illness, came as an unexpected shock to his friends.

He was born in 1876, the only son of the Rev. William Spotswood Green, a well-known alpine climber and organizer of deep-sea trawling expeditions, and was educated at St. Edward's School, Oxford. After taking a degree, with a gold medal in natural science, in Trinity College, Dublin, he was, in 1900, appointed a naturalist on the staff of the newly constituted Fisheries Branch, afterwards becoming inspector and, later, chief inspector.

Though his official duties tended to direct his attention more to the legislative and administrative side of fishery affairs, of which his knowledge was extensive and profound, Green kept in close touch with recent biological research, and it was due largely to his insistence that the dictum, laid down by his predecessors, that fishery administration must have an adequate biological basis, continued to receive due official recognition. His loss will be realized most fully by his immediate friends and colleagues, for most of his work was done under the cloak of official anonymity.

Until other claims on his time became more pressing, Green often attended the meetings of the International Council for the Exploration of the Sea, first as an expert on the staff of the British delegation and later as a delegate from the Irish Free State.

He was for many years an active member of the Council of the Dublin Zoological Gardens, and was elected a vice-president shortly before his death.

G. P. F.

WE regret to announce the death of Prof. Wladyslaw Grabski at Warsaw on March 1, after a long and painful illness. He had been rector and lecturer at the Polish Agricultural College and was an authority on the economics of agriculture. After the Great War and the liberation of Poland, Prof. Grabski became a prominent statesman, first as Minister of Agriculture and later as Finance Minister. During his period in office, he founded the State Agrarian Bank and also the Bank of Poland. In 1925, Prof. Grabski retired from political life and returned, as principal, to his old college.

WE regret to announce the following deaths:

Mr. Charles Benson, formerly deputy director of the Agricultural Department, Madras, known for his work on Indian cotton and tobacco, on March 5, aged eighty-two years.

Prof. Alfred Fischel, formerly professor of experimental embryology in the University of Vienna and editor of the *Zeitschrift für Wissenschaftliche Biologie*, aged sixty-nine years.

Prof. Friedrich von Krüger, for many years director of the Department of Physiological Chemistry in the Rostock Institute of Physiology, aged seventy-six years.

News and Views

Prof. I. M. Heilbron, F.R.S.

PROF. I. M. HEILBRON, whose appointment to the chair of organic chemistry in the University of London (Imperial College) has just been announced, is a man of many activities, that of a research director and teacher of organic chemistry being exceptionally prominent. Prior to the Great War, he held a lieutenancy in the A.S.C., 52nd Division, and proceeded to G.H.Q., Salonika in 1917. He was promoted lieutenant-colonel and assistant director of supplies, G.H.O., Salonika in 1918, and was given the D.S.O. and mentioned three times in despatches. It is, however, as a research chemist rather than as a soldier that he will be best recognized. His field, for many years past, has been in the sterol group and in matters generally relating to calciferol and the group which contains the important vitamin D; he has instituted a series of experiments on the synthesis of vitamin A and has progressed definitely towards a successful conclusion of this problem. He has also covered a wide field in other directions, particularly in connexion with the Algæ and carotenoid pigments. Since 1933, he has been able to give full scope to his genius and has made many important discoveries by the help of the large research school which he has gathered together. He was lecturer in the Royal Technical College, Glasgow, from 1919 until 1920; Heath Harrison professor of organic chemistry in the University of Liverpool in 1922–33, and thereafter professor of organic chemistry in the University of Manchester, succeeding Prof. A. Lapworth in the Sir Samuel Hoare chair in 1935.

Dr. J. S. Turner

DR. J. S. TURNER, senior demonstrator in botany in the University of Cambridge, has been appointed to the chair of botany in the University of Melbourne, in succession to the late Prof. A. J. Ewart. From the Sheffield Central Secondary School, Dr. Turner went up to Cambridge in 1927 as a scholar of Selwyn College, and after obtaining first classes in both parts of the Natural Sciences Tripos commenced research on plant respiration under Dr. F. F. Blackman in 1930. He was afterwards elected, successively, to the Frank Smart and Allen studentships in the University, and was awarded the Gedge prize for an essay on respiration in plants. He was appointed University demonstrator in 1934, and since 1936 has been in charge of the large practical classes for Part 1 of the Tripos in the Cambridge Botany School. His main research interest has been in plant physiology, especially in the relationship between respiration and fermentation in yeast and in the tissues of the higher plants. At present, he is engaged on a study of photosynthesis and respiration in aquatic plants. He is also much interested in ecology, and in association with Dr. H. Godwin has contributed substantially to the elucidation of the plant communities of Wicken Fen and the Norfolk Broads. In 1936 he organized a party of research workers to investigate the natural oakwoods of the Killarney district, and in other ways also he has been most successful in stimulating students to work in the field. At Melbourne, Dr. Turner will have a much wider sphere of work; with his enthusiasm as a teacher, and a happy combination of interest in laboratory and field experimentation, he assumes this important professorship with every augury of success.

Dr. Willis Jackson

DR. WILLIS JACKSON has been appointed to succeed Prof. Robert Beattie, who retires in September from the Edward Stocks Massey chair of electrotechnics in the University of Manchester, which he has occupied since 1912. Prof. Beattie has been associated with the University since 1896. Dr. Jackson was educated at Burnley Grammar School and the University of Manchester, where he graduated with first-class honours in 1925, and was the recipient of various prizes and scholarships. He has held the posts of lecturer in electrical engineering at Bradford Technical College and the Manchester College of Technology, and of lecturer in engineering science in the University of Oxford. Since 1936, he has been research engineer to the Metropolitan-Vickers Electrical Co., Ltd., and lecturer and tutor at the Board of Education Summer School for Engineering Teachers in Technical Colleges. His research work has been mainly devoted to high-frequency measurements and to the properties of insulating materials, and has appeared in numerous papers published in the *Proceedings of the Royal Society*, the *Journal of the Institution of Electrical Engineers*, the *Philosophical Magazine* and other journals.

Prof. Alexander Low

THE Court of the University of Aberdeen has accepted the resignation of Prof. Alexander Low, regius professor of anatomy in the University, to take effect on September 30. Prof. Low has occupied the chair since 1925, when he succeeded Prof. Robert Reid, whose assistant he had been for many years. Born in 1868, he was educated at the Aberdeen Grammar School and in the University of Aberdeen, afterwards studying at Freiburg, Vienna and Zurich. His association with Aberdeen as student and teacher covers a period of more than fifty-two years. In his professional studies, Prof. Low has specialized in anthropology and embryology, and has contributed a considerable number of papers to the journals of learned societies in anatomy, anthropology and embryology. He was one of the original members of the Aberdeen University Anthropological Society, to which British archæology is indebted for its contributions by excavation to early studies of the osteology of the 'beaker-folk'. For many years Prof. Low has been an active member of the anthropological section of the British Association.

Oxford's Programme of Development

A year ago the University of Oxford appealed to its friends for endowment on a scale appropriate to the part it is called upon to play in the world of learning to-day. The response was £426,000. This sum, with the new foundation of Nuffield College for the study of the social sciences, will provide for many of the needs which were mentioned in the appeal. It is strongly felt, however, that further development should take place, and for this a new appeal, which will remain open until July 31, has recently been made. The sum now asked for is £250,000. The most urgent need at the moment is the creation of a general research fund, both for the humanities and for the natural sciences. In the past ten years the number of research students at Oxford has doubled, and throughout the University there is a keen spirit of research. To endow a promising piece of research, whatever it may be, whenever an original line has been struck out, a research fund of £100,000 is regarded as essential. For the development of research in archæology it will be necessary to complete the extension of the Ashmolean Museum, and for this £15,000 will be required. It is felt also that as soon as possible the Departments of Physiology and Botany should have new laboratories. Towards the costs of these £60,000 and £40,000 are required. Lastly, another £35,000 is needed to complete and maintain the new physical chemistry laboratory that is to be erected. These sums make up the £250,000 which is being asked for.

Transatlantic Steam Navigation

In connexion with the centenary of the inauguration of regular steam passages between Great Britain and the United States by the four steamers *Sirius*, *Great Western*, *Royal William* and *Liverpool*, which all crossed and recrossed the Atlantic in 1838, a special exhibition has been arranged at the Science Museum to illustrate "One Hundred Years of Transatlantic Steam Navigation". The central feature of the exhibition is the magnificent model of the *Queen Mary*, the model being 22 ft. long. The gallery also contains models of the *Normandie*, the *Conte di Savoia* and other notable vessels of recent years. Of greater historic interest, however, are the newly made models of the *Sirius* and *Great Western*. The former ship was of only 703 tons gross and was never intended for work in the Atlantic, but she was the first steamer ever to cross the ocean from east to west using her engines as the main motive power. Her voyage began on April 4, when she left Cork, and ended on April 23, when she tied up in New York harbour. The *Great Western*, designed by the famous engineer Isambard Kingdom Brunel, was of 1,340 tons and it was she which demonstrated in unmistakable manner the possibilities of steam on the ocean. The original drawings of the ship are shown beside the model, and also various interesting documents. Other ships shown are the *Great Britain* and the *Great Eastern*, the *Britannia*, first of Cunard vessels, the *Scotia*, the last of the paddle vessels on the Atlantic, the *Servia*, the first steel liner, and the *Philadelphia*, the first large twin-screw ship on the Atlantic. The exhibition was opened on March 16, and will remain open until the middle of September. An illustrated handbook has been prepared by Mr. H. P. Spratt, the Museum officer who has arranged the exhibition.

Hadrian's Wall

Some major problems of the Roman Wall of Hadrian would appear to have been brought to a solution by recent excavations of the Durham University Excavation Committee, of which an account was given on March 11 before the Society for the Promotion of Roman Studies by Mr. I. A. Richmond of King's College, Newcastle-on-Tyne, co-director of the investigation with Mr. F. G. Simpson, of the Cumberland Excavation Committee. It is found that the lack of uniformity between the remains in different sectors of the Wall, which has been the main difficulty of the archæologist, is not due to haphazard work, but arises from deliberate changes in plan as the Wall was in course of erection, as well as to the differences in material available for building. From Newcastle to the Irthing the builders began with a wall of stone 10 ft. thick (afterwards reduced to 7½ ft. to expedite the work), erecting barracks for patrols in large courtyard gateways piercing the Wall at every mile, and hence called 'milecastles'. Over the north gate of each and at every 540 yards was a turret. This section of the Wall was then extended eastward to Wallsend; and a narrow stone wall built to the westward between milecastles 49 and 53; but in the main westward extension from the Irthing to Bowness-on-Solway, limestone for grout was lacking, and a turf wall took the place of the stone wall. It was supplied with stone turrets of distinctive type and milecastles of wood. This turf wall was replaced by a stone wall later in the century.

Tactical considerations now took the place of time and material, which had previously determined changes in plan. When the Wall was completed, eight forts were embodied in the line, holding either 500 cavalry or a nominal 1,000 infantry. Thus was formed a front line force capable of taking the offensive in overwhelming strength. It had been found that the Wall, designed originally as a patrol line, could be better used for concentrated garrisons, and thenceforward the emphasis was on forts rather than milecastles. Next in order comes the Vallum, the earthwork of which the ditch is the main feature, south of the Wall, the purpose of which has been the subject of much controversy. Mr. Richmond is of the opinion that it demarcates the military zone of the Wall and its dependent structures and also served as a barrier against southern marauders. Further excavation may show whether this view is to be regarded as final.

Toxicology of Narcotic Drugs

IN his presidential address before the Society of Public Analysts delivered on March 4, Dr. G. Roche Lynch discussed "The Toxicology of the Narcotic Drugs", embodying observations regarding the barbiturates, thio-barbiturates, straight-chain ureides and morphine, based on his own record of cases. He pointed out that the barbiturates, of which seventeen are now on the market, can be divided into two main groups, one of which produces light narcosis of long duration and the other deep narcosis of shorter duration. The individual barbiturates differ greatly in the rate at which they are destroyed in the body; some are destroyed so rapidly that it is rarely possible to recover more than minute quantities of them from urine or tissues. The extent of their use is illustrated by the fact that 18 million tablets of one of them, and that not the most common, are produced annually. The habit of taking them at night regularly is widespread, especially among women; but in keeping them within reach as a means of inducing sleep there is a danger that, after one or two tablets have been taken, a state of 'automatism' might supervene, in which a person, more or less unconsciously, might take a further number, with serious results. For purposes of treatment, the analyst should be able, by examination of urine, to ascertain within a quarter of an hour whether or not a barbiturate had been taken; but for purposes of evidence in court a complete identification with melting point determination is desirable.

Broadcasting Television

IN a discussion in the House of Commons on March 11 of the supplementary estimate for £360,000 for the B.B.C., Major Tryon made some very satisfactory remarks. He pointed out that in this year's report there were two entirely new features. First there was the expansion of television which accounted for an additional £295,000, and also about £15,000 proposed for broadcasting news in foreign languages. The latter sum was not included in the original estimate as it was not a part of the policy of the Government. He said that Great Britain was the first country in the world to have a public television service. It had been found by the Television Advisory Committee that further experiments must be made before new recommendations could be accepted for extension. That was a scientific inquiry, and he was sure that the House would like to pay tribute to the men of science who had made this wonderful discovery, and to the B.B.C. and its engineers for bringing it into working order. He also expressed the gratitude of the Government to the Television Advisory Committee, under the chairmanship of Lord Selsdon, who had been given great help in scientific matters by Sir Frank Smith. The additional sum required for television was provided simply. In the future 8 per cent of the licence revenue should go to the B.B.C. to help with the additional work. Television had only lately been started and the cost had been very heavy. If the service was to be efficient there must be a greater accommodation of studios, etc. The technical standards of television had been stabilized for three years, and that gave security to producers of sets and encouraged them to make more sets and more cheaply. This grant would foster the growth and development of an infant industry in which we were at present leading the world.

The British Broadcasting Corporation

THE eleventh annual report of the British Broadcasting Corporation, which covers the year ended December 31, 1937, refers to the completion of the first year of operation of the London Television Station, and the year's experience is regarded as having justified the confidence in the future of television which led to its establishment. Financial uncertainty which had complicated further plans was relieved towards the end of the year by the Treasury's acceptance of the view that the costs involved should be met by a grant from the balance of net licence revenue retained by the Treasury. The adoption of the Marconi-E.M.I. transmitting standards as a single system in February made it possible to widen the scope of television programmes during the year, notably in outside broadcasts. Reference is also made in the report to the work of the Talks Advisory Committee, to attempts to promote closer contact with listeners and various experiments in technique. The Engineering Section of the report refers to developments in Empire service and to the obstacle which lack of sufficient wave-lengths continues to present to the planning of extensions to the home service. Further progress in experimental studio design has been made, and improved methods were adopted in the acoustical treatment of studios under construction. The results of research on the performance of short-wave directional aerials were successfully applied in the design of the Empire station. The total income for the year amounted to £3,356,074, of which 85·67 per cent was derived from licences and 14·32 per cent from publications. Of this income, more than 51 per cent was expended on programmes and nearly 18 per cent of the remainder on engineering. £200,000 were transferred to capital account, an amount insufficient to cover the year's expenditure on fixed assets. The report stresses the impossibility of building up any reserve funds in liquid form, although this is most essential while income is still increasing.

Promotion of International Co-operation

THE annual Bulletin of League of Nations Teaching, just issued by the secretariat (No. 4, December 1937), deals with the teaching of the facts and principles of international co-operation, this subtitle indicating that its scope has been extended to cover a wider field than the activities of the League of Nations itself. The activities of the Advisory Committee on League of Nations Teaching continue to be reflected in the volume, which as in previous years gives publicity to those League activities likely to be of particular interest to educationists. The admirable series of articles in the present volume, particularly those on the role of intellectual co-operation in contemporary life and on the use of modern means of spreading information in the cause of peace, give it, however, strong claims on the attention of all who are studying or seeking to promote international co-operation and understanding. Moreover, the articles on the League of Nations at work, which covers the problem of raw materials and the League of Nations; the reform of the League; the League of Nations and International Hygiene; and Changing Aspects of Child Welfare, and on the International Labour Organisation, dealing particularly with the raising of the minimum age of admission to employment, represent concise and balanced surveys of the present situation of these problems which should be of real service to the speaker or general student. The reprints of broadcasts such as that on nutrition and the Singapore Health Bureau, of Sir Malcolm Delevigne on opium and drugs, and of Prof. Gilbert Murray on intellectual co-operation, provide other material of the same type.

Copper and Brass Welding in Germany

IN 1936, the Deutches Kupfer Institut of Berlin published a valuable pamphlet describing carefully the best methods of welding copper and brass. The Copper Development Association of London has now translated this into English. It is pointed out that there are certain differences between German and British welding practice, mainly associated with the general employment in Great Britain of deoxidized copper. But knowing the high standard of excellence which has been achieved in Germany, there is much of it which will be of value to British readers. The hand-made copper and bronze domestic vessels shown in the Berlin State Museum and dating back thousands of years prove that soldering and riveting were in common practice from very early times. In course of time, the necessity arose for a new and improved jointing technique which would produce smooth and strong joints and yet avoid the expense of riveting. This demand is universally met to-day by the adoption of welding. The development of copper welding has been much slower than that of steel, but the difficulties in the way have now been largely overcome, and welded copper appliances of the highest quality are now produced. Deoxidized coppers, which are extensively used in Great Britain, are not discussed in this pamphlet. The thermal conductivity of copper is about six times that of steel. Molten copper readily dissolves other metals and forms the basis of several important alloys. With zinc it produces brass and with tin bronze. The thermal conductivity of brass is two or three times that of steel, and only about one third that of copper. This feature is a decided advantage in welding. For this reason, brass requires a smaller flame for welding than copper. Although gas welding is the one most commonly used, new electrical methods are in process of development which will probably enable arc welding to be profitably employed.

The Clock of the Future

AT the British Horological Institute in London, on January 12, an interesting discussion was held on the respective merits of spring-wound and electric clocks. Mr. D. W. Barrett, of Smith's English Clocks, Ltd., began by pointing out that his firm has large investments in spring-driven clocks and its business was founded on them. He claimed to be impartial and he would not have taken up the electric type had he not been assured of its future. A spring-wound clock cannot be relied upon to give accurate time. It needs regular winding and its parts are delicate. The electric clock needs no attention and is robust. It is true that it stops when the current fails, but on the average this only happens once a year. There are areas where no break has been recorded for three years. In the United States, 66 per cent of the sales were of electric clocks. In Great Britain about 33 per cent of the money spent on clocks last year was for electric clocks of the synchronous type. When it is remembered that the spring-wound clock has been in existence for three hundred years whilst the electric clock has only been on the market for some seven years it will be seen that the latter is the more popular. There are about 45 million clocks in use in Great Britain, the bulk of them being spring-driven. There can be little doubt but that the electric clock will be the clock of the future. It is practically immune from the effects of heat and damp.

The Soviet Institute of Physical Problems

PART 3 of the *Physics Bulletin* of the Soviet Academy of Sciences for 1937 contains Dr. P. Kapitza's address to the Academy last March, which he devoted to an account of the new Institute founded by decree of December 1934. The building, which has taken a year longer to complete than was anticipated, is, although only 80 metres from Moscow tram lines, surrounded by gardens in which other institutes of the Academy are to be built. It nearly surrounds a quadrangle 40 m. × 25 m., with outer walls 63 m. × 50 m., the long side nearly north and south. The south-eastern corner is not built on, and gives access to the quadrangle. The main laboratories are on the ground floor, and provision for very sensitive apparatus is made in the basement. A first floor over the eastern block is occupied by the administrative department. By introducing a simplified system of book-keeping, Dr. Kapitza has reduced the five accountants originally thought necessary to one. The apparatus taken from Cambridge has been installed and is described. It includes the Metropolitan-Vickers alternator and the coil through which it is short-circuited to produce for 1/100 sec. an intense magnetic field, the hydrogen liquefier producing 7 litres per hour and the helium liquefier which first cools the gas to 65° absolute by means of liquid nitrogen, then to 10° abs. by adiabatic expansion and finally liquefies it by the Joule-Kelvin cooling. A new machine on this plan is now being constructed to work with a double cycle and deliver 6–8 litres per hour.

History of American Agricultural Research

A "History of Agricultural Experimentation in the United States, 1607–1925", by A. C. True, has just been issued as Miscellaneous Publication No. 251 by the United States Department of Agriculture, Washington, D.C. This is the third official monograph in a series intended to give a comprehensive summary of the history of agricultural education, extension and research in the United States, the two previously issued having dealt with agricultural instruction in schools and colleges, and the history of agricultural extension work respectively. The present volume naturally begins with the work of private individuals including some biographical information, and shows how they and organizations such as the geological surveys and the Patent Office, themselves little concerned with research, laid the foundations of public agencies for agricultural investigation. It will be noted with interest that the first governmental movement to help agriculture was made when George Washington was president, while Federal State aid for the agricultural experiment stations, founded by pioneers all over the country, was secured by Hatch in 1887 by the passage of an Act bearing his name. The rapid development of research from this period up to 1913, the effects of the Great War and the agricultural depression of 1921–25 are then described in detail. A bibliography of more than three hundred references is appended. These are limited to sources of information used in the text and to bibliographical sketches of some of the leading figures in the earlier periods of agricultural development in the United States.

Marine Fauna of the Isle of Man

THE publication of a new local fauna list is always an event of some interest, and it is of importance when it concerns such historic ground as that of the sea around the Isle of Man ("Marine Fauna of the Isle of Man". Compiled by Dr. Hilary B. Moore. Editor: Dr. R. J. Daniel, assisted by J. R. Bruce and Dr. M. W. Parke. University Press of Liverpool, 1937. 2*s*.). This up-to-date list of the marine animals found in that region is therefore to be warmly welcomed. Future visitors to the Biological Station at Port Erin will be grateful to Dr. Moore, a former member of its staff, for his work of compilation. He has been wise in following the same general plan as that of the well-known "Plymouth Marine Fauna", giving after each recorded name a reference to a good description, adding notes on the ecology, and breeding dates when known. There are three charts and a general introduction describing the most accessible and typical grounds. Dr. Moore and the editors have done their work well, while the printers have succeeded in producing well-balanced and attractive pages. As a work of reference, this list will be much used; to those studying the marine ecology of our islands it will be invaluable. We should like to suggest that in future editions a note be included as to the origin of the ancient drawing of a viking ship which so attractively adorns the cover.

The Film in Education

IN "The Film in Relation to the School Curriculum" (pp. 70; price 1*s*.) the Central Information Bureau for Educational Films, Ltd., has provided a useful reprint of a series of articles which appeared in *Film Progress* from July 1936 until July 1937. It deals with the teaching of geography, natural history, natural science and physical training. The advice given is in close accord with the Board of Education's "Suggestions for the Consideration of Teachers", "Suggestions on Health Education" and "Science in Senior Schools", long excerpts from which are reproduced. A report to the Manchester Education Committee on experimental film-teaching is quoted in support of the assertion that children are stimulated by this means to further effort in geography and nature-study. It is claimed that their interest and mental activity are so aroused as to lead them to seek out knowledge for themselves, their powers of observation and memory are increased and, in the case of geography lessons, the film tends to eliminate anti-foreign bias. Although some teachers prefer still pictures, it seems obvious that these cannot compete with such films as "The Life-Cycle of a Plant", "The Blowfly", "The Amœba" and physical training films.

Battersea Polytechnic

IN its recently published report for 1936–37 the Battersea Polytechnic directs attention to the increased volume and high standard of its research work. In the past, this has been pursued mainly in chemistry, physics and mathematics, but new facilities have made possible extended programmes in the Mechanical and Civil Engineering Department. In the Electrical Engineering Department, the demand for accommodation for research work could not be fully met. For researches in chemistry two Ph.D. and one M.Sc. were awarded by the University of London. Fifty-four other degrees of the University of London and thirty-four National Certificates in Engineering were obtained in addition to many other examination successes. An enumeration of positions obtained by Polytechnic students during the past thirteen years includes 1,218 domestic science inspectors, teachers, organizers and practitioners, 413 engineers, 413 health visitors, sanitary inspectors, nurses, etc., 233 chemists and 97 art practitioners. The general recognition of the enormous national importance of sound teaching in domestic science may be expected to lead to increased activity in this department of the Polytechnic.

The Plant Hormone Committee

As the outcome of a meeting held at the Royal Botanic Gardens, Kew, on November 6 (see NATURE, **141**, 88; 1938), a Committee, to be known as "The

Plant Hormone Committee" has been formed with the following membership: Mr. F. P. Knight (Knap Hill Nursery Co.), Dr. C. R. Metcalfe (Kew, convener and secretary), Mr. F. O. Mosley (Lowe and Shawyer, Ltd.), Prof. R. H. Stoughton (University of Reading), Mr. W. G. Templeman (Imperial Chemical Industries, Ltd.), and Dr. M. A. H. Tincker (Royal Horticultural Society). The terms of reference are "to consider the practical applications of 'phytohormones' in relation to plant cultivation". The committee is at present engaged in compiling a list of species of which cuttings cannot easily be struck even by experienced propagators, in the hope that by intensive experimentation, methods for propagating them successfully may be discovered. Further information about the committee may be obtained from the Secretary.

Announcements

PROF. A. KROGH, professor of animal physiology in the University of Copenhagen, and Prof. L. Lapicque, professor of general physiology in the Sorbonne, have been elected honorary members of the Physiological Society.

THE HON. SIR EVAN CHARTERIS, chairman of the Trustees of the National Portrait Gallery since 1928, chairman of the Tate Gallery Board since 1934, and Trustee of the National Gallery and Wallace Collection; Sir Francis Lewis Castle Floud, High Commissioner of the United Kingdom in Canada, Permanent Secretary, Ministry of Agriculture in 1920–27, chairman of the Board of Customs in 1927–30, and Permanent Secretary, Ministry of Labour in 1930–34; and Sir John Ledingham, director of the Lister Institute and member of the Medical Research Council, have been elected members of the Athenæum under the provisions of Rule II of the Club which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for their public services.

DR. BURGESS BARNETT, who was curator of reptiles at the London Zoological Gardens in 1932–37, and since then has been doing research on snake venom, has been appointed superintendent of the Zoological Gardens at Rangoon. Dr. Barnett will take up the new post in June.

PROF. H. ZEISS, of the University of Berlin Institute of Hygiene, has been elected president of the Berlin Microbiological Society in succession to Dr. J. Schumacher.

AT the annual general meeting of the Society of Public Analysts held on March 4, the following officers were elected: *President*, Prof. W. H. Roberts; *Vice-presidents*, B. S. Evans, J. R. Nicholls, W. H. Simmons, T. P. Hilditch (chairman, North of England Section), J. F. Tocher (chairman, Scottish Section); *Hon. treasurer*, E. B. Hughes; *Hon. secretary*, Lewis Eynon.

A VACATION Course on child psychology will be held on April 20–25 at Southlands Training College, Wimbledon Park Side, S.W. The course will be given in two concurrent sections: one for matrons of schools and one for medical officers and teachers. Further information can be obtained from the Secretary of the Child Guidance Council, Woburn House, Upper Woburn Place, London, W.C.1.

THE fifth European Congress of Mental Hygiene will be held at Munich on April 23–24, when the following subjects will be discussed: marriage prophylaxis and mental hygiene; prophylaxis of abuse of narcotics (alcohol, morphia, cocaine and hypnotics); and the importance of occupational therapy in physical and mental diseases.

THE League of Nations has sent a medical mission to the Far East to take measures to prevent or control the spread of epidemics. The mission is headed by Inspector-General Lasnet of the French Academy of Medicine; Dr. Hermann Mooser representing Germany and Dr. Robert Cecil Robertson representing Great Britain. The mission will first visit Hong-Kong and continue its work in south China.

ON the recommendation of their Science Scholarships Committee, the Commissioners of the Royal Commission for the Exhibition of 1851 have decided to increase from £250 to £275 a year the basic value of their overseas scholarships for scientific research, which are offered each year to students from Canada, Australia, New Zealand, South Africa, India and Ireland (Eire). The increase will take effect on April 1, 1938.

THE following awards of medals of the Institute of Patentees have recently been made: Grey-Wilson Memorial Gold Medal to Dr. S. C. Blacktin, for a dust and smoke meter (see NATURE, 140, 331, 582; 1937); Yorkshire Gold Medal to W. H. Siddle, for a wire-joining tool; Special Silver Medals to Mrs. F. Peace for a superhet washer, J. R. Churchill for a chair, W. McClelland for a balanced two-stroke engine, and to F. W. Mason for an automatic blind control.

THE following appointments and promotions have recently been made in the Colonial Service: B. W. H. Harding, inspector of mines, Kenya; W. G. R. Coates, engineer surveyor, Harbour Department, Hong-Kong; A. Gane, inspector of produce, Nigeria; P. H. Symons, assistant analyst, Medical Department, Hong-Kong; J. Pirie (agricultural superintendent, Gambia), agricultural officer, Nigeria; A. J. Wakefield (deputy director of agriculture), director of agriculture, Tanganyika; P. O. Wiehe (science master, Royal College), plant pathologist, Department of Agriculture, Mauritius; J. H. F. Sharkie (executive engineer, Public Works Department, Gold Coast), waterworks engineer, Public Works Department, Nigeria; J. Shelton (chemist), chief chemist, Institute for Medical Research, Malaya.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 518.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Radioactivity produced in Scandium by Fast Neutrons

ON irradiating scandium (^{45}Sc) with fast neutrons of energy $\leqslant 20 \times 10^6$ e.v., Pool, Cork and Thornton[1] observed two positron-emitting radioactive isotopes of scandium of half-lives 52 hours ('strong intensity') and 4 hours ('very strong intensity') respectively. With neutrons of $< 10 \times 10^6$ e.v., neither period could be observed. Previously Walke[2] had given the following assignment of radioactive isotopes of scandium: ^{44}Sc (52 hours), ^{43}Sc ($4 \cdot 0 \pm 0 \cdot 1$ hours), ^{42}Sc ($4 \cdot 1 \pm 0 \cdot 1$ hours). These he attributed to the reactions: $^{39}\text{K}(\alpha,n)^{42}\text{Sc}$, $^{41}\text{K}(\alpha,n)^{44}\text{Sc}$, $^{40}\text{Ca}(\alpha,p)^{43}\text{Sc}$, $^{42}\text{Ca}(d,n)^{43}\text{Sc}$ and $^{43}\text{Ca}(d,n)^{44}\text{Sc}$. Pool, Cork and Thornton suggested that the two periods which they observed were due to the formation of ^{44}Sc and ^{43}Sc resulting from the reactions

$$^{45}\text{Sc} + n = {}^{44}\text{Sc} + 2n - Q_1 \quad . \quad . \quad . \quad (1)$$

and

$$^{45}\text{Sc} + n = {}^{43}\text{Sc} + 3n - Q_2 \quad . \quad . \quad . \quad (2)$$

From the mass defect curve one can expect for the threshold energies the values $Q_1 = (10 \pm 2) \times 10^6$ e.v. and $Q_2 = (18 \pm 2) \times 10^6$ e.v. Energetically, therefore, both reactions might be possible, but the following discussion shows that it is difficult to understand why reaction (2) should take place more frequently than reaction (1).

Consider ^{45}Sc to be bombarded by homogeneous neutrons of energy E and denote by $P_1(E)$ and $P_2(E)$ the probabilities of reactions (1) and (2). P_2 will be zero for $E \leqslant Q_2$, and for $E > Q_2$ the 'evaporation' model indicates that it will increase rapidly with increasing E. It is not until $E - Q_2$ reaches values of the order of a few million electron volts that P_2 and P_1 will be of the same order. Furthermore, with a neutron source of the type used (a thick lithium target bombarded by deuterons of 6×10^6 e.v.), the neutrons of energy $E > Q_2$ will be very small in number compared with those of energy $E > Q_1$. Thus, the number of radioactive nuclei formed according to reaction (2) will be very small compared with the number formed according to (1).

We are therefore led to suspect that the two periods observed must be ascribed to ^{44}Sc and that this nucleus exists in two isomeric forms of half-lives 52 hours and $4 \cdot 1$ hours respectively. This would be consistent with the fact that both periods are obtained by bombarding potassium with α-particles, though previously[2] the $4 \cdot 1$-hr. period has been ascribed to ^{42}Sc. The 4-hr. period observed when calcium is bombarded with deuterons may be partly due to ^{44}Sc and partly to ^{43}Sc.

To test the hypothesis of isomerism we have bombarded scandium with neutrons of maximum energy 14×10^6 e.v. (obtained by bombarding lithium with 950 kv. deuterons) for which reaction (1) only, and not reaction (2), should be energetically possible. We have observed both the 52-hr. and 4-hr. periods with similar initial intensities (corrected for bombarding time). The particles emitted were found to be positrons. The isomerism of ^{44}Sc seems therefore established and the assignment of the radioactive isotopes of scandium should be as follows: ^{44}Sc (52-hr. and 4-hr.), ^{43}Sc (4-hr.). As to the radioactivity of ^{42}Sc, no evidence exists at present.

Gentner[3] has recently observed a 4-hr. period produced in scandium by γ-rays of 17×10^6 e.v. This he ascribes to ^{43}Sc formed in a $(\gamma, 2n)$ reaction. According to our results it appears that this activity should be attributed to ^{44}Sc formed in a (γ, n) reaction.

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R. D. HILL.

Cavendish Laboratory,
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March 8.

[1] Pool, Cork and Thornton, *Phys. Rev.*, 52, 41 (1937).

[2] Walke, *Phys. Rev.*, 51, 439 (1937); 52, 669 (1937).

[3] *Naturwiss*, 26, 109 (1938).

Deviations of Short Radio-Waves from the London-New York Great Circle Path

THE propagation of short radio-waves from England to New York has been found to involve many anomalous effects. Studies have been made of transmissions from Rugby, directed toward New York, and of broadcasts from Daventry using various transmitting arrays. Three multiple unit steerable antennæ (musas) located at the Holmdel, N.J. experimental receiving station of the Bell Telephone Laboratories have been used. One of these is the end-on musa described in a recent paper[1]. The other two are broadside musas steerable horizontally to permit explorations in azimuth. The British Broadcasting Corporation has kindly provided details of the transmitting antennæ in use during the various transmissions. These B.B.C. antennæ, together with the British Post Office transmitting antennæ in use on the London–New York radio telephone circuits, have provided simultaneous comparisons, which are, to a limited degree, representative of the effects of steerable transmitting directivity. Employment of the above facilities during the past eight months has disclosed the following characteristics:

(1) During 'all-daylight' path conditions, the usual multiplicity of waves distributed in or near the great circle plane, which constitutes normal propagation, has invariably been predominant. Neither ionosphere storms nor the catastrophic disturbances associated with short-period fade-outs seem to affect the mode of propagation.

(2) In contrast to (1), during periods of dark or partially illuminated path conditions, the great circle

plane no longer provides the sole transmission path. The extent to which other paths are involved varies greatly.

(*a*) Usually, transmission from mis-directed antennæ is accompanied by weak and scattered waves arriving off the great circle, in addition to normally propagated waves. Transmissions which emphasize radiation to the north especially exhibit such scatterings, arriving from north of the great circle with a considerable azimuthal spread. Acceptance of these scatterings by the receiving antenna results in rapid flutter fading.

(*b*) A considerable number of instances have been observed in which the ionosphere behaves as though it were warped, with resulting shifts of the wave path sometimes to the north and sometimes to the south with little regard to the transmitting directivity.

(*c*) Not uncommonly, the transmission medium displays more complex characteristics in which several azimuthal routes exist, the route selected by the waves depending upon the transmitting antenna. In these circumstances, transmitting antennæ directed, say 20 or 30 degrees off the great circle produce in the received waves, substantial deviations to the corresponding side of the great circle.

(*d*) On rare occasions, propagation during periods of dark, or partially dark, path conditions is entirely normal. That is, the waves travel in or near the great circle plane and are unaffected by the transmitting antenna directivity, except in amplitude.

When the transmitting antenna directivity is appropriate, the characteristic mentioned under (*c*) above often results in two paths sufficiently different in azimuth to be separable by one or the other of the broadside musas. The difference in the transmission time along such paths has sometimes been determinable by the method of audio delay equalization[1]. Such determinations are given in the following table :

Date 1937		E.S.T.	Station. Call	Station. Freq., mc.	Array Direction**	δ_1	δ_2	β_1	β_2	Delay Millisec.
May	28	7.54 p.m.	*GSB*	9·51	260°	11°	43°	2° S.	40° S.	1·50
Aug.	2	7.20 p.m.	*GSF*	15·14	260°			4° S.	34° S.	3·35
,,	2	9.10 p.m.	*GSB*	9·51	260°			8° S.	3° N.	1·00
,,	27	9.30 p.m.	*GSB*.	9·51	260°			5° S	19° S.	0·85
Nov.	19	4.10 p.m.	*GSD*†	11·75	260°/294°	9°	16°	7° N.	7° S.	1·35
,,	19	10.25 p.m.	*GDS**	6·905	288°			4° N.	18° S.	0·80
,,	23	4.35 p.m.	*GSD*†	11·75	260°/294°			4° N.	12° S.	1·40
,,	23	8.00 p.m.	*GSD*†	11·75	294°	2°	21°	1° N.	9° S.	0·47
,,	23	9.00 p.m.	*GSB*†	9·51	260°/306°			2° N.	14° S.	0·94
Dec.	18	8.20 p.m.	*GSC*	9·58	294°			0°	30° S.	2·70
,,	21	7.00 p.m.	*GSC*	9·58	294°	13°	22°	5° S.	8° N.	0·54

E.S.T. = Eastern Standard Time.

δ_1 and δ_2 = 'vertical' angles measured with end-on musa.

β_1 and β_2 = horizontal angles measured with broadside musa, in degrees north (N.) or south (S.) of the great circle.

Delay is in all cases inserted in the β_1 path. It, therefore, is the shorter path in point of time.

* Rugby.

† Two synchronized transmitters.

** The direction to New York is 288° (measured clockwise from north).

Excepting the northern scatterings mentioned in (*a*), substantial deviations to the north have been rare, but large deviations to the south, such as the 30°–40° values in the table, have been found frequently. Southern deviations appear to be associated with ionosphere storms. In storms of moderate severity, southern deviations appear with noticeable consistency, even on Rugby transmission directed sharply to New York. In such circumstances, Daventry transmissions to the West Indies have been received much better with a low-gain broadside musa steered 60° south of the great circle, than a transmission in the same wave-band directed nearly to New York and received with a rhombic antenna directed towards England. In normal conditions, the superiority is reversed, of course.

It is known that during periods of disturbance the intense magnetic and auroral effects, which are normally found in the auroral zone, extend to more southern latitudes. It has been suggested by my colleague, Mr. W. M. Goodall, that the southern deviations in transmission might be connected with the southward expansion of the auroral zone during disturbed periods. For example, at such times as the zone extends southward to the London–New York great circle, normal transmission might experience great attenuation. Any southern route which may then exist, because of this zone or for other reasons, may then be superior to the great circle route.

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Feb. 25.

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[1] Friis and Feldman, "A Multiple Unit Steerable Antenna", *Proc. Inst. Radio Eng.*, **25**, No. 7 (July 1937).

Effect of Longitudinal Magnetic Field on the Refractive Index and Conductivity of Ionized Air

THE experimental study of an ionized gas in presence of the magnetic field has recently acquired considerable importance in connexion with the ionosphere. Notable investigations have been made by several authors[1,2,3,4,5] on the effect of the transverse magnetic field on the refractive index and conductivity of the ionized gas. Very few investigations have, however, been made in the case of the longitudinal magnetic field. Mitra and Ghosh[6] have recently observed the magnetic double refraction of ionized air in the presence of longitudinal magnetic field.

During the experimental study of the effect of longitudinal magnetic field on refractive index and conductivity of the ionized air, it was observed by us that in most cases the refractive index and conductivity of the so-called 'extraordinary' wave did not show any commonly assumed tendency to attain infinite values when the magnetic field was gradually increased. The plots of refractive index and conductivity against magnetic field yield curves as shown by the dotted *B* lines in Figs. 1 and 2 respectively. Such curves, however, can only be interpreted by the more complete equations for the refractive index and conductivity, and not by the generally used approximate equations which are obtained by neglecting the collisional frequency (ν) of the electrons. In the present note we point out that in cases where the refractive index and conductivity are measured as the strength of the magnetic field is increased, at a fixed frequency of the initial wave, the collisional frequency ν, however small, should not be neglected.

The complete equations used by us for calculating the square of the refractive index and conductivity (σ in E.S.U.) of an ionized gas in the presence of

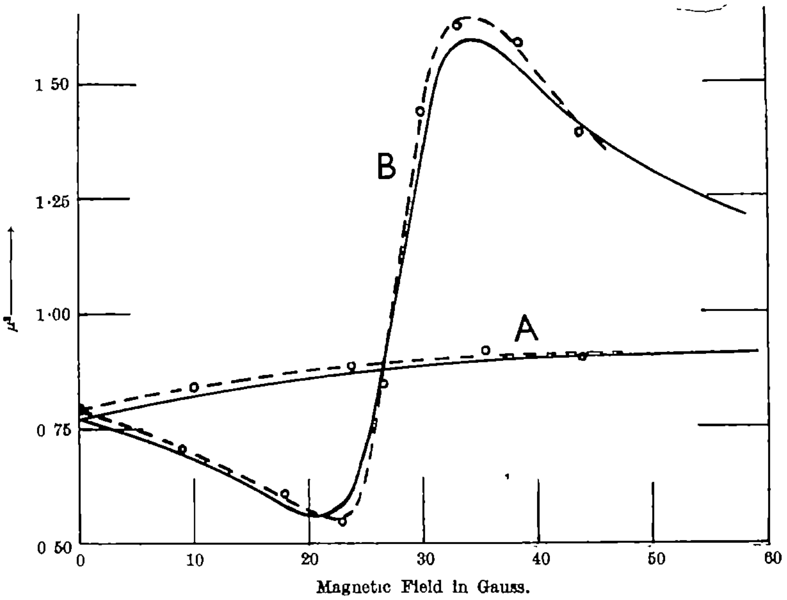

Fig. 1.

a longitudinal magnetic field may be shown to be,

$$\mu^2 = \tfrac{1}{2}\left[1 - \frac{(p \pm p_H)p_0^{\,2}}{p\{\nu^2 + (p \pm p_H)^2\}} + \sqrt{\frac{p^2\nu^2 + \{p_0^{\,2} - p(p \pm p_H)\}}{p^2\{\nu^2 + (p \pm p_H)^2\}}}\right] \quad . \; . \; . \quad (1)$$

$$\sigma = \frac{p_0^{\,2}\nu}{4\pi\,[\nu^2 + (p \pm p_H{}^2)]}\,; \quad . \; . \; . \; . \; . \quad (2)$$

where $p_H = \dfrac{He}{mc}$, H being the applied longitudinal magnetic field and the rest hold the usual meanings.

In the above equations the so-called 'ordinary' and 'extraordinary' waves are represented by the upper and lower signs of p_H respectively. It will be observed from the above equations that if ν be much smaller than p, in the case of ordinary wave it can be safely neglected for all values of p_H, since ν has to be compared with $p + p_H$. In the case of the extraordinary wave, however, ν cannot always be neglected even when it is considerably smaller than p, as ν has then to be compared with $p - p_H$, the value of which tends to become zero when p_H approaches p.

The arrangement of the apparatus was a modification of that adapted by Mitra and Ghosh[6]. As the intensity of the wave emerging from the discharge tube is considerably reduced due to absorption, a system consisting of a Hertzian dipole aerial was used in the output of an ultra-short wave oscillator for producing the impressed wave ($\lambda = 3{\cdot}71$ metres) and also at the input end of the Lecher wires. The conductivity was determined from the knowledge of leakance per unit length of the Lecher wires, which was measured by the method employed by one of us in connexion with the measurement of radiation resistance of transmission lines[7]. The refractive index was found by the usual method from the values of wave-lengths in air and in the ionized medium.

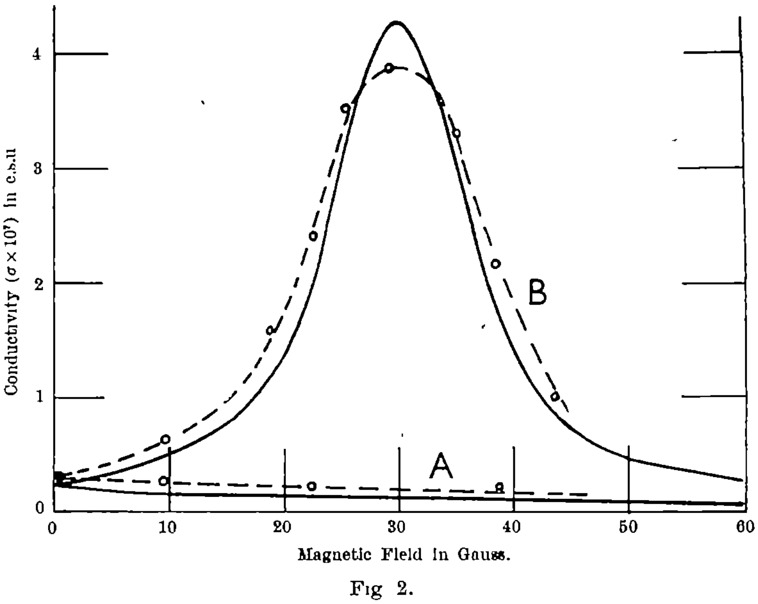

Fig 2.

Figs. 1 and 2, as already described, show the variations of the square of the refractive index and conductivity of ionized air when the magnetic field is gradually increased. The dotted curves are drawn from the experimentally observed values, and continuous ones from those calculated by equations (1) and (2). The curves for the ordinary and extraordinary waves are represented by A and B respectively. It will be observed from Fig. 2 that the maximum conductivity of the ionized air is obtained in the same region (near about $p = p_H$) where the irregularity appears in the values of refractive index, as shown in Fig. 1. From the above curves it will be seen that the inclusion of ν in equations (1) and (2) prevents the refractive index and conductivity from attaining infinite values.

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X-Ray Study of Isoprene, Butadiene and Chloroprene at Low Temperature

In view of the considerable technical importance of isoprene, butadiene and chloroprene, as the hydrocarbons which on polymerization give natural and synthetic rubber, some interest is attached to the study of their structure. At normal temperatures they are in the liquid or gaseous state, and as it is possible to make exact X-ray structure measurements only in the solid state, the substances have been examined at liquid nitrogen and liquid oxygen temperatures, in a Debye-Scherrer camera, of radius 57 mm., employing a simple technique developed in the Davy Faraday Research Laboratory. Exposures of 30–90 minutes at 100 ma. were given.

Butadiene gives an extremely good X-ray diagram with about 35 measurable lines. Although the photograph provides adequate data as to crystal spacings, it has not been possible to identify the diagram with that of any of the crystal classes of high symmetry. It is probable that this substance is a crystal of a class which makes an analysis by the Debye-Scherrer method extremely difficult, if not impossible. The spacings calculated from the 10 strongest lines, using the Bragg relation, are given in the following table. The intensities are visual estimates.

Line	Butadiene intensity	Cu *K*α radiation θ°	*d* in A.
1	8	9·49	4 67
2	6	10·49	4 23
3	7	10·86	4·08
4	10	12 52	3·55
5	10	12 84	3·47
6	8	13·52	3·30
7	8	13·94	3 19
8	6	19 82	2 27
9	5	20 30	2 22
10	6	21·42	2 08

With long exposures chloroprene never gave diagrams showing more than three lines corresponding to spacings of 3·28, 2·57 and 2·32 A., and two diffuse 'liquid' rings the maxima of which corresponded to spacings of 11·78 and 3·24 A.

Isoprene (Schuckert) never seems to crystallize at all sharply, but gives a glassy mass. This is in accordance with the facts quoted by Beilstein. It is not therefore surprising that only 'liquid' rings appear on the X-ray diagrams. (This substance was also studied using a 35 kw. tube with a rotating iron anticathode. Even a long exposure with an intense X-ray beam failed to bring out any lines.) A photometer trace of one of the films indicated intensity maxima corresponding to spacings of 8·6, 2·4 and 2·0 A.

It is not proposed to continue this work for the present. The purpose of this note is simply to put on record the preliminary results which have been obtained.

I am indebted to Dr. W. J. S. Naunton of Imperial Chemical Industries, Ltd., for supplying me with the chloroprene and butadiene, and to Sir William Bragg and the Managers of the Royal Institution for the facilities they have afforded me.

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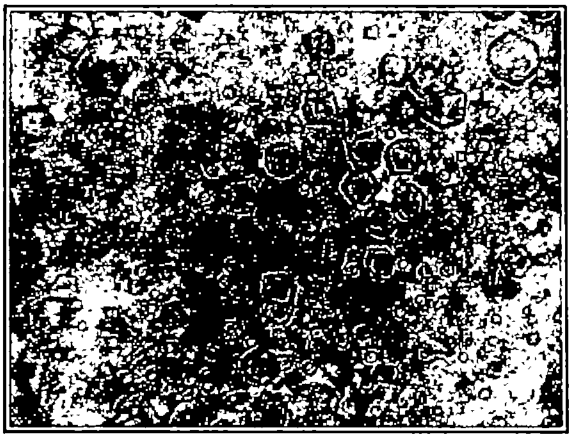
A Plant Virus Preparation in a Fully Crystalline State

Specific proteins, believed to be the viruses themselves, have been isolated from plants infected separately with each of seven viruses of the tobacco mosaic and potato virus 'X' groups[1–4]. Although these proteins have some properties in common with crystalline materials, and can be obtained in both solid and liquid anisotropic states, the solid preparations yet obtained lack the three dimensional regularity characteristic of true crystals. The particles of all these viruses are rod-shaped, and the connexion between this and the formation of fibres or pseudo-crystals has already been discussed[3,5].



Preparation of Bushy Stunt virus crystallized from ammonium sulphate solution. × 200.

From tomato plants infected with the virus causing bushy stunt[6], we have now isolated a specific protein which crystallizes in the form of rhombic dodecahedra. Solutions of this protein do not show anisotropy of flow, and the jelly formed by sedimenting the protein in a centrifugal field of 16,000 times gravity is not birefringent. As the crystals belong to the cubic system, they also are isotropic.

Infections (local lesions) of *Nicotiana glutinosa* can be obtained by rubbing the leaves with 1 c.c. of solutions containing 10^{-7} gm. of the protein, and 1 c.c. containing 10^{-6} gm. gives a visible precipitate with its antiserum. The activity of a preparation is unaffected by repeated recrystallizations or by sedimentation in a high-speed centrifuge.

After clarifying the infective sap by heating to 60° C. and centrifuging, the protein is isolated by repeated precipitations at room temperature with one quarter saturated ammonium sulphate solution. Impure preparations can also be fractionated by means of trypsin or a high-speed centrifuge. Crystallization is most readily effected by adding ammonium sulphate to a neutral solution at room temperature until the first sign of turbidity appears, immediately cooling to 0° C., and then slowly warming up to room temperature. The protein is much less soluble at room temperature than at 0° C., and as the clear fluid warms it becomes turbid and the protein crystallizes.

Analyses on dried preparations have given the following results: carbon 47, hydrogen 7·3, nitrogen 16, phosphorus 1·3 and carbohydrate 6 per cent.

This protein, like those we have isolated from plants infected with other viruses, appears to be a nucleoprotein, but it differs from them by having a rather higher nucleic acid content.

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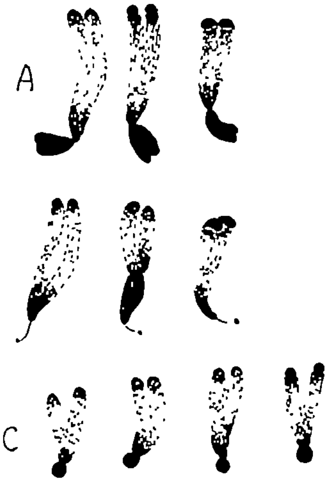
Heterochromatic (Inert) Regions in the Chromosomes of *Crepis capillaris*

GENETIC investigations on the inert regions in *Drosophila*[1,2] in connexion with the cytological studies on heterochromatin (inert chromatin) and the chromocentre[3-7] showed that the chromosomes have active (euchromatic) and inert (heterochromatic) segments; the proximal parts, near the centromeres, being the heterochromatic ones. These regions conjugate in the chromocentre in the salivary gland nuclei.

The data reported by Sturtevant[8] on the preferential segregation in triplo-IV female *Drosophila melanogaster* and those by Kikkawa[9], who studied haplo-IV *Drosophila ananasse*, indicating a probable conjugation between Y and IV chromosomes, suggested that non-homologous chromosomes most probably conjugate in the inert regions. More convincing evidence in this respect was supplied by Gershenson (in press) in studying the preferential segregation in triplo-IV flies having XY + fragmented X. Direct cytological evidence was supplied by Prokofieva[10], who showed that the second (inert) arm of IV chromosomes conjugate with the inert region of the left arm of the third chromosome.

A series of cytogenetic phenomena that occur in plants can be best interpreted if one assumes a conjugation between the inert regions of the non-homologous chromosomes. Heitz[11] and others showed that plant chromosomes (especially the sex chromosomes) have heterochromatic regions, but an exact analysis of the whole karyotypes, as in *Drosophila*[12], has not yet been carried out; therefore we have attempted to analyse the chromosomes of *Crepis capillaris*. This species has three distinct pairs of chromosomes: A, C, and D. Hæmatoxylin preparations with completely black chromosomes were slightly stained (fixation—Lewitzky-chromic acid-formalin). The proximal regions in each pair and the very distal ends remained darker, while the regions in between became lighter (see accompanying illustration). It should be noted here that the heterochromatic regions were not always exactly equal in length in all preparations. In some preparations the heterochromatin of the distal region (end) of C and D chromosomes were scarcely noticeable. We cannot decide yet whether in these particular cases it was completely lacking, or whether the chromosomes were highly stained. It is probable that the slight variations in length of the heterochromatic regions is due to the difference in density of euchromatin and heterochromatin. Perhaps such regions are partially active. In studying the karyotypes of *Secale* species[14] and *Nicotiana* species (Kostoff, unpublished), euchromatic and chromatic regions have been also found (compare chromosome 1 of *Secale Vavilovii*)[14].

The above data (also some others that cannot be mentioned here owing to limitation of space) in connexion with data reported by other investigators, a part of which is mentioned above, demand a revision of some cytogenetic conceptions and suggest new interpretations of known phenomena.



McClintock's data[15], for example, upon the non-homologous chromosome conjugations in *Zea* can be explained by assuming a conjugation between inert regions. 'Fold backs' of the univalents are results of attraction of inert regions. Her data as well as Avdulov's data[16] showed that in *Zea* even whole inert chromosomes occur. The terminal conjugation of the non-homologous chromosomes in haploids, as for example in *Triticum monococcum* ($n = 7$)[17,18], is obviously due to conjugation of distal heterochromatic regions of the non-homologous chromosomes. Numerous 'mutual' translocations in *Crepis* reported by many authors can be interpreted by the assumption of somatic interchange in conjugating inert regions. This concerns only the dynamics of the phenomenon. Stern[19] supplied convincing data for the occurrence of somatic crossing-over, and Peto[20] (in plant somatic tissue) and Levan[21] (in pollen) found direct cytological evidences.

Demerec and Hoover[22] found a viable deficiency. They wrote: "The deficiency 260–5 does not involve any of the visible extant loci. It takes a section of at least four bands at the tip end of the X chromosome. Flies homozygous for this deficiency are viable and fertile. They do not show any visible peculiarities." This deficiency is viable because it probably involves only the inert region. When one examines the drawings by Prokofieva[13] (Figs. 1, 4, 5 and 6) one sees that the very distal end of the X chromosome is inert.

In the light of these studies, it would be interesting to find out how much of the catenation in *Œnothera* is due to chromosome homology of the distal regions and how much to the conjugation between inert regions of the distal ends. *Œnothera* mutations, which are consequences of structural changes, might as well result from interchange in the inert regions of non-homologous chromosomes.

The probable rôle of the inert regions in interspecific hybridization and in evolution will be discussed elsewhere.

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Occurrence of the Freshwater Medusa, *Craspedacusta sowerbii*, in Eastern Canada

SOME four years ago, we[1] had the pleasure of recording in NATURE the occurrence of the freshwater medusa, *Limnocnida rhodesiæ*, from new localities that increased its southern range in Africa. In the present communication we wish to give some details regarding the finding of the freshwater hydromedusa, *Craspedacusta sowerbii*, in the Province of Quebec, Canada, these being the first records of its occurrence in Canada, so far as can be ascertained.

Freshwater medusæ were first observed by Sowerby in June, 1880, in the *Victoria regia* tank in the Royal Botanic Gardens, Kew, and were described and named *Craspedacustes sowerbii* by Lankester[2] in the same year. The spelling of the name has since been modified to *Craspedacusta*. The first record of the hydroid or polyp phase was made by Parsons in 1884 from tanks in the Royal Botanic Gardens. Since then *Craspedacusta* has been notified from a number of places in the British Isles, France, Germany, Holland, Austria, Czechoslovakia, Poland and Russia. In Asia, *Craspedacusta* have been recorded from open waters in China and Japan. In the United States there are a number of records covering a large area of the country and forming a somewhat compact block of States. These States are Michigan, Illinois, Indiana, Ohio, Pennsylvania, New York, Missouri, Kentucky, Virginia, Washington, D.C., Oklahoma, Louisiana, Alabama and Georgia. The medusa has also been found in the Gatun Lake, Panama Canal Zone and in Brazil.

Two records, both of unexpected findings of *Craspedacusta*, are here presented for Canada. The first time that the medusa was obtained was on a hot afternoon in late June, 1934, when we were collecting aquatic fauna from the margins of Horseshoe Lake, which lies at the foot of Lake Manitou, a few miles from St. Agathe des Monts, Quebec Province. Horseshoe Lake is approximately at lat. 46° N., long. 74·25° W. It is a natural lake, about 800 yards long, 350 yards wide, with a maximum depth of 50 feet. Three mature medusæ were found among reeds at a shallow spot and several very small ones were recovered from the plankton then collected. Prolonged search and stirring of the water and silt with poles failed to reveal more medusæ, nor were any hydroid stages found. The mature medusæ were all females and were 10–12 mm. in diameter. There were numerous Protozoa, Entomostraca and tadpoles present, so that abundance of food for the medusæ was available. Subsequent searches by friends and ourselves at Horseshoe Lake have been negative for *Craspedacusta*.

The second habitat for the medusa in Canada is from a locality between Cantik, Quebec Province, and Rouse's Point, New York State, United States, these places being the Customs and Immigration Stations of Canada and the United States respectively, on either side of the international frontier. A naturalist friend sent us a bottle containing seventeen medusæ, which he had found accidentally when searching for a lost ball in September 1938. Rouse's Point is in lat. 44·58° N., long. 73·25° W., according to several gazetteers. The exact site of collection cannot be given, but the collector was very definite that the medusæ were found well on the Canadian side of the boundary, in a hollow containing about two feet of water, with abundance of grass and rushes. The weather was hot at the time of collection and the water was warm. Four days later the area was visited again, but no medusæ were found. The medusæ collected earlier were preserved in formalin and were in good condition when we received them. On examination, all of them were found to be females. They varied from 7 mm. to 15 mm. in diameter, most of them being between 10 mm. and 11 mm. in diameter.

Mature *Craspedacusta* from both localities were typical specimens. The umbrella was not very thick, the mesoglœa being up to 1 mm. thick in those measured. The manubrium was quadrangular and there were four lip-like projections around the relatively small mouth. The four radial canals were well-marked, arising from the angles of the manubrium and passing to the rather voluminous peripheral ring canal. The nettle-ring was distinct and somewhat smooth. The contractile tentacles varied in number with the age of the medusa. Thus, a medusa of 11 mm. diameter had 218 tentacles, the per-radials being 6 mm. long, while another medusa of 12 mm. diameter had about 360 tentacles. Counting the smaller tentacles was difficult. In some of the larger medusæ the arrangement of the tentacles in seven series, as postulated by some European workers, was discernible, while in medium-sized but sexually mature medusæ only four rows could be differentiated. In the smallest medusæ from Horseshoe Lake four per-radial and four inter-radial tentacles were present. These small forms were 0·5–2·5 mm. in diameter. In the mature medusæ very numerous coiled nematocysts with much coiled filaments occurred on the tentacles. Statocysts were embedded in the velum, with their broad bases towards the nettle ring. They were refractile and had short stems. The number of statocysts in the larger medusæ varied, there being roughly about one statocyst to every two or three tentacles. The mature medusæ were all females, the gonads appearing as elongate pouches or flaps on the radial canals and containing well-formed ova.

These Canadian *Craspedacusta* have been compared with specimens of *Craspedacusta sowerbii*, which Dr. Dejdar[3] kindly sent us from Prague in exchange for *Limnocnida rhodesiæ*, and with *Craspedacusta sowerbii* (or *rileyi*) given us by colleagues in the United States. Morphologically the Canadian medusæ are like both the European and the American forms, and we are inclined to the view of Dejdar and of some American workers that *C. sowerbii* and *C. rileyi* are either the same organism or are but local varieties thereof. *Craspedacusta sowerbii*, then, would be the correct name and the species name *rileyi* would fall into synonymy. The Canadian freshwater medusa would appear to be *Craspedacusta sowerbii*.

From the literature available, it is found that more than thirty sites of occurrence of *Craspedacusta* have been recorded in the United States since the organism was first definitely described by Hargitt[4] in 1907 from Washington, D.C. Budding of minute medusæ from *Microhydra ryderi* had been previously reported by Potts in 1895. The medusa has been found in rivers, lakes, ponds (natural and artificial), quarry pits, reservoirs, filter beds and aquaria. In Canada the habitats of the medusæ were a natural lake and standing water in a grassy hollow, virtually the condition of a temporary pond.

The Canadian locality at Horseshoe Lake, lat. 46° N., at present appears to be the most northerly record of *Craspedacusta* for the American continent, and between Cantik and Rouse's Point, long. 73·25° E., the most easterly record. The most northerly record for the United States appears to be that of Woodhead[5] for Ann Arbor, Michigan, lat. 42·15° N. and the most southerly one Monroe, Louisiana, lat. 32·03° N., given by Viosca and Burkenroad[6].

Our experience of the behaviour of *Craspedacusta sowerbii* in Canada agrees with those of other workers on the organism. It is noted for its sudden and erratic appearance and disappearance in a locality and for the difficulty of finding the hydroid form. Also, often the medusæ from one locality are all of the same sex. Both the type of freshwater habitat and the time of appearance of the medusæ are variable and, in localities where they were found on one occasion, they have not been found again despite searches extending over several years.

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A Whale Shark Rammed by a Vessel off the Pacific Coast of Western Panama

ON May 30, 1932, a whale shark was caught on the bow of the United Fruit Company's steamer *Talamanca* in lat. 8° 14′ N. and long. 82° 46′ W., in the Pacific near Burica Point on the western boundary of Panama. This information was communicated to the U.S. Hydrographic Office by the second officer of the ship (whose name was not given), and was passed on to me by Admiral W. R. Gherardi, hydrographer. Accompanying the account was a splendid photograph showing a whale shark hung on the stem of the vessel.

In my search for exact data on this occurrence, I was handicapped in not knowing the name of the officer who had made the report. For the search I had only the name of the ship and the date. But after prolonged correspondence with the Hydrographic Office and with the United Fruit Co., I finally located the man who observed the occurrence, the second officer of the *Talamanca*, who had been transferred to another vessel and, on another run, had been far away. However, presently there came to my office in the Museum Mr. Paul R. Jones, to whose courtesy I am indebted for the essential facts of this interesting occurrence.

The steamer was proceeding from Panama to Puerto Armuelles on May 30, 1932. The sea was smooth, and fish and porpoises were feeding at the surface. Other porpoises were tumbling in front of the vessel, while a whale shark was lying at the surface to one side of the vessel. Suddenly, for some unknown reason, the great fish swam directly across the vessel's course and was caught on her bow. Since port was only twenty-five miles away, the vessel did not stop to get rid of the fish. In port the fish was dislodged and Mr. Jones noted that it was spotted like a leopard and that it was between 15 ft. and 18 ft. long. Impaled on the bow, the head and shoulder parts were on the left and the greater portion—about 15 ft. long—swung to the right. Thus caught, and being rather small for a *Rhineodon* (which has been measured up to 45 ft.), the shark did not impede the movement of the vessel as it would have done had it been struck nearer the middle.

In addition to being an interesting and unusual method of capturing a whale shark, Mr. Jones's data established a new faunal locality for *Rhineodon typus*. It has been recorded from Cape San Lucas in Lower California, from Guaymas in the Gulf, from Acapulco on the southern Mexican coast, in Panama Bay, at the Galapagos, and off Callao, Peru. I have elsewhere[1] given the geographical distribution and the history of every known specimen of *Rhineodon* up to December 31, 1934. The region of greatest abundance is in southern Philippine waters, and I assigned the Cape San Lucas region and the waters south of it as a second centre of concentration. This new record adds strength to that suggestion.

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Dipole Moment of Pyridine

PREVIOUS workers have obtained values for the dipole moment of pyridine in benzene varying from 2·11 to 2·26 units. We have measured this moment in six solvents at 20°, using carefully purified pyridine having the following physical constants: density $d_{20}^{4} = 0{\cdot}98272$; b.p. 115·2–115·3°/760 mm.; refractive index $n_{D}^{20} = 1{\cdot}50920$; $P_E = 24{\cdot}02$ c.c. The results for tho polarization and moment are as follows:

Solvent	Dielectric constant	P_{20° c.c.	Dipole moment μ
Hexane	1·899	127 7	2 21
Cyclohexane	2 018	126·5	2·20
Carbon tetrachloride	2 234	139·3	2·33
Benzene	2 279	132·6	2·26
Toluene	2 380	131 0	2 25
Carbon disulphide	2 638	117 8	2 10

The polarization in hexane, cyclohexane and carbon tetrachloride was almost independent of concentration and was greatest in the solvent of lowest dielectric constant. These results also show similarity with those for nitrobenzene in hexane ($\mu = 4{\cdot}03$) and carbon disulphide ($\mu = 3{\cdot}70$)[1], although the difference in moments in hexane and carbon disulphide is rather less for pyridine than would be expected from a consideration of the moments of nitrobenzene in the same solvents. This result would be explained if, as is probable, the pyridine molecule is more spherical than that of nitrobenzene. This would be expected from a consideration of the Kerr constants for pyridine and nitrobenzene, which are:

	Temp °C	$K \times 10^{15}$	$K_1 \times 10^{15}$	$K_2 \times 10^{15}$
Pyridine	146·3	25·7	4·1	21·6
Nitrobenzene	235·5	146·0	7·0	139·0

where K_1 is the anisotropic constant and K_2 the dipole constant at 760 mm. and 546 $\mu\mu$.

The polarization of pyridine in benzene and toluene was, however, found to decrease considerably with increasing concentration, this indicating a larger degree of dipole association in these two solvents than in hexane, cyclohexane and carbon disulphide. The higher value of the moment of pyridine in benzene and toluene may be due to association of pyridine molecules with the molecules of the solvent.

The high moment of pyridine in carbon tetrachloride is probably due to the formation of a complex in solution. This would be expected, since complex formation has been observed in the case of quinoline and carbon tetrachloride[2].

The work is being extended to quinoline and isoquinoline and the results will be published in detail in due course.

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Anaphylactic Sensitivity Produced by a Chemical Substance

THE phenomena of anaphylactic supersensitivity has been ascribed hitherto to a specific property of natural albumins, and the facts found so far were always explained by the supposition that albumin played an important part in anaphylactic reactions.

It is true that in some cases the *shock* could be reproduced by substances which are practically free from albumins, but these substances are of unknown constitution and are derived from different micro-organisms, such as pneumococci, *Achorion Quinckeanum*, etc. These natural substances are regarded as carbohydrates.

We have now reproduced the anaphylactic sensitization as well as anaphylactic shock by using a compound of known chemical constitution. It is absolutely free from albuminous substances and melts at 184–185°.

This substance, which corresponds to a full antigen, has the following constitution:

$$\mathrm{CH_3(CH_2)_7{-}CH{=}CH{-}(CH_2)_7{-}CO{-}N(CH_3){-}CH_2{-}CH_2{-}SO_3{-}Na}$$

Oleyl-(*n*)-methyl-taurin.

These facts will be discussed in the paper to appear in the *Helvetica chemica Acta*.

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Jan. 29.

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[1] *Presse Médicale*, Dec 1936.

The Advancement of Science and Society

MEMBERS of the American Association for the Advancement of Science have read with much interest the comments on their resolution on international co-operation of scientists which appeared in NATURE of January 22, p. 150. As gratifying as these comments are, in one respect they differ somewhat from the spirit of the resolution.

Since I wrote the resolution and am suggesting to the Executive Committee that it extend formal invitations for an international conference of representatives of scientific societies to be held in London this coming summer, I should like the privilege of explaining the spirit of the resolution, which I believe represents the present sentiment of a large majority of the members of the American Association. By frank expressions of opinions well in advance of the contemplated conference we shall be able to make progress towards mutual understandings of possible slightly different points of view and thus prepare the way for constructive action at the conference, if it should be held.

The resolution passed by the American Association on December 30 was published in the article in NATURE referred to above.

The preamble to the resolution consists of two distinct parts, the first of which acknowledges the profound effects of science upon society and thereby admits a heavy responsibility of men of science to their fellow men. The second part expresses the pure objectivity of science and states conditions only under which it can flourish permanently. Differing from the 1933 resolution of the American Association and from possible interpretations of the comments in NATURE, this preamble is in no degree political or national. There is in it absolutely no note of criticism of Governments or of social orders, for condemnatory words seldom lead to harmony and co-operation.

The resolution itself also consists of two parts, the first of which pertains only to the American Association. It expresses directly only what has long been a distinct policy of the Association. For example, the Section on Medical Sciences is now organizing the tenth of its symposia, participated in by leading American specialists, on subjects (in this case mental health) of wide public interest and importance. Another section has held important symposia on various aspects of conservation of natural resources, while still another has made plans for five symposia on the general title "Science and Society", of which one has been held.

The second part of the resolution relates entirely to international co-operation of men of science. The invitation to co-operation is not dependent on racial, political or theological qualifications; it is open to every organization in the world the purposes of which are to spread the benefits of science to all mankind.

This sadly disordered world needs some new objective upon which it can focus its attention, some new course of procedure which it will ardently follow. It is possible that men of science can set up such an objective and gradually work out practicable methods for attaining it. Certainly, of all the conclusions that men hold, those of scientists are most easily verifiable and the methods of scientists are most easily evaluated and standardized. The verifiable nature of much of the work of scientific workers and the relative freedom of their conclusions from emotions and prejudices insures for them from the beginning a considerable amount of common ground. Possibly this common ground can be gradually enlarged until it will form a substantial basis for the general progress of civilization. Is it too much to hope that international problems of health, for example, that have been precipitated by the applications of science should be attacked and solved by scientists ? Would not the altruistic spirit exhibited by science meet a compelling response in the general conscience of mankind ?

Without anticipating what recommendations the American Association may desire to make respecting the purposes of the proposed conference, and not wishing to do more here than to open the question for preliminary discussions, I suggest three things that might be considered and attempted: (1) The formulation of a set of fundamental scientific principles of an ethical nature on which unanimous agreement of the delegates can be reached. (2) The formulation of the maximum number of inviolable methods of international intercourse and co-operation among scientists on which the delegates can unanimously agree. (3) The planning of the necessary machinery for making effective and enlarging the agreements reached in (1) and (2).

F. R. MOULTON
(Permanent Secretary, American Association
for the Advancement of Science).

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Washington, D.C.
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Points from Foregoing Letters

WHEN scandium (^{45}Sc) is bombarded by fast neutrons, two periods, of 52 hours and 4 hours respectively, are observed. These periods have been previously attributed to the formation of ^{44}Sc and ^{43}Sc. It is shown by W. E. Burcham, M. Goldhaber and R. D. Hill that both periods are due to ^{44}Sc, which nucleus, therefore, exists in two isomeric forms.

C. B. Feldman's letter reports investigations of London–New York short wave radio circuits in which newly developed steerable antennæ are used as direction finders. It is stated that, after darkness has begun to fall on the great circle and during the dark period, wide deviations from the great circle sometimes occur in transmission. They are principally southern deviations and seem to be related to ionosphere storms.

Graphs showing the effect of a longitudinal magnetic field upon the refractive index and the conductivity of an ionized gas, are submitted by Dr. S. S. Banerjee and B. N. Singh. The experimental findings agree with the theoretical values calculated by means of new equations in which the collisional frequency is taken into consideration in order to prevent the refractive index and the conductivity from attaining infinite values.

Some results of an X-ray study of the structure of isoprene, butadiene and chloroprene (from which synthetic rubber is produced) are communicated by Dr. C. J. Birkett Clews. At the temperature of liquid air, butadiene gave a good X-ray diagram with about 35 measurable lines which, however, could not be identified with those of any crystal classes of high symmetry; chloroprene gave diagrams with three lines and two diffuse 'liquid' rings; while the results obtained with isoprene indicated a glassy structure.

A virus which crystallizes in the form of rhombic dodecahedra has been isolated by F. C. Bawden and N. W. Pirie from tomato plants infected with the virus which causes bushy stunt. The crystalline substance is apparently a nucleoprotein with high nucleic acid content. It produces infections (local lesions) in *Nicotiana glutinosa* in dilutions of one part in ten millions, and one part per million gives a visible precipitate with its antiserum.

Diagrams of the chromosome pairs in *Crepis capillaris* are given by Prof. D. Kostoff and N. Arutiunian to show the presence of active (euchromatic) and inert (heterochromatic) regions. The authors believe that many cytogenetic phenomena (such as the 'mutual' translocations in *Crepis*) can be best explained by assuming a conjugation between the inert regions of the non-homologous chromosomes. The inert regions may also play a part in interspecific hybridization.

A communication from the late Prof. H. B. Fantham and Mrs. Fantham (Dr. Annie Porter) records the occurrence of the females and young of the freshwater medusa, *Craspedacusta sowerbii*, in Canada at two localities in Quebec Province. The finding of *C. sowerbii* at Horseshoe Lake, Quebec, lat. 46° N., extends the known range of the medusa almost 4° to the north. A habitat approximating to a temporary pond between Cantik, Quebec and Rouse's Point, New York State, long. 73·25° E., is the most easterly record for North America.

The dipole moment of pyridine in six solvents has been measured by B. A. Middleton and Prof. J. R. Partington, and has been found to vary from 2·10 to 2·33. The results indicate that the pyridine molecule is more spherical than that of nitrobenzene and that in benzene and toluene association with solvent molecules may take place. In carbon tetrachloride a complex is probably formed.

Research Items

Microlithic Industries of India

A LIST of microlithic sites in India compiled by Col. D. H. Gordon in *Man* of February shows that so far as our knowledge extends at the moment, these industries extend from Sind on the west to Orissa on the east, and from Mirzapur in the north to Cuddapah (Madras) in the south. It is unlikely that these industries are all contemporary or even in some cases connected in any way. The Indus valley ribbon flake and large core industry is quite separate, and the thick coarse flakes of Bolari Hill, Kotri, etc. (Sind), are of a type not found elsewhere. The area of Mahadeo Hills and Jubbulpore presents an industry homogeneous in type and material. That covered by the Franks collection in the British Museum, Bundlekund and Baghelkund, almost certainly contains an extension of the same culture. The shelters at Singhanpur and Kabra Pahar in Raigarh State also appear to be associated with an industry very similar in type and material. The central Indian industry displays a wide range of types, including crescents, triangles, trapezes (very rare), crescentic blades, straight blades, disk-scrapers and end-scrapers, worked points, borers and cores. Unworked blades and chips are in abundance in localities that were factory sites. One true arrow-head can be claimed; other points have been found with signs of having been worked to form a tang. Association with rock-shelters containing paintings, none likely to antedate 500 B.C., and with pottery in the floors suggests that in these remote regions a microlithic culture may have persisted into the early centuries of our own era. The Pachmari Plateau (Central Provinces) has in addition to rock shelters three factory sites at Tamia. The industry at Singhanpur is of the same microlithic type, the flakes being scattered on a large area to the north of the village. The stone workers lived on the present village site, which probably has been occupied ever since. In northern Hyderabad, the site at Ellora is notable for its proximity to the famous caves. Microliths from Bombay are scanty, while the Punjab has produced none. The microlithic nature of the industry is attributed to the small size of the stone available and renders equation with Western industries unsafe.

Co-operation of Social Groups

THE co-operation of social groups is the subject of a recent article by Prof. F. C. Bartlett (*Occupational Psychology*, 12, No. 1). Few problems of contemporary social life attract more discussion than those connected with the co-operation of differently organized social groups. The impossibility of any effective social group living its life alone is a matter of daily experience, and yet while the need for co-operation is recognized as a necessity for modern groups, actually little is known of the conditions and circumstances on which such co-operation may depend. Prof. Bartlett suggests a study of smaller social groups than the nation, and makes an experimental beginning by collecting accounts of concrete situations, all within the experience of his subjects and all involving a situation between rival groups, forced by circumstances to consider co-operation and finding it necessary to begin. The subjects of the experiment were asked to assume the correctness of the descriptions and to give reasoned judgments as to whether co-operation would break up or develop. The tentative results showed that an ordinary person could give a considered opinion as to the probable chances of the co-operation failing or succeeding; that there was considerable agreement regarding the primary bases of social concord and discord; and that ideas about the leading conditions of social co-operation and discord may vary from one section to another even of the same general community. The writer hopes that investigators will study social harmony and discord, so that it may be possible to understand and control the conditions.

Spread of Grey Squirrel in Britain

CONTINUING his former work, A. D. Middleton, with the help of B. T. Parsons, has summarized the extension of range of the grey squirrel (*Sciurus carolinensis*) in 1937. In many areas on the margins of its former colonies this introduced squirrel continues to spread (*J. Animal Ecology*, 6, 286; 1937). In its central region in England it has pushed farther afield, mainly in the marginal zone from Lincolnshire to Monmouth. It now occurs on the Somerset side of the Avon near Bristol, has increased near Exeter, and there is a notable westward spread to Ashburton. In Yorkshire, as in Essex, there has been less movement, but the whole of North Yorkshire, with Darlington and South Durham, most of West Yorkshire as far as the Pennines, and parts of East Yorkshire are now occupied. In the Cheshire and North Wales district extension northwards has occurred to near Mold and also into the Wirral. In Scotland little change is reported apart from a slight spread to the east, in the 'kingdom' of Fife. Since the grey squirrel has shown itself to be destructive to woodlands, its further and steady extension of range is a matter of some concern.

Control of the Red Spider Mite

THE Lyth Valley, in southern Westmorland, is the site of a localized damson-growing area. A variety known by the name of the county is the chief kind which has been planted, and it is unfortunately very prone to the attacks of the red spider mite *Oligonychus ulmi*. R. A. Harper Gray and H. E. Brooks have investigated methods of control of the pest by spraying (*J. Roy. Hort. Soc.*, 63, Pt. 2, 77, Feb. 1938). Five winter washes gave less control than summer sprays, but a 10 per cent emulsion of tar oil and petroleum was the most satisfactory of those applied in the dormant period. Successful fluids for summer application were refined white oil emulsion, lime-sulphur, and a 2 per cent petroleum wash. In spite of the increased efficacy of the summer treatment, however, control by the winter emulsion is likely to prove a more practicable means of control, since its application would not compete with other pressing work in summer.

Protein Breakdown in Germinating Sweet Peas

CARBOHYDRATES form the chief food store in the seeds of the sweet-pea (*Lathyrus odoratus*), but proteins also are an important factor. In his investigations into the protein breakdown in sweet-pea seeds, W. E. Isaac has shown that these seeds have a protein content amounting to 29·13 per cent, or 33·6 per cent on a dry weight basis (*Ann. Bot.*, New Series, 2, No. 5, January 1938). It was found that during the experimental period of ten days germination about one third of the protein content was broken down. During the first two days, breakdown was slow; until the sixth day it was more intense, and thence until the tenth day it continued at a uniform, though reduced, rate. These and other results are discussed with reference to the utilization of the energy released by this breakdown.

Climate of North East Land

FROM an account of the meteorological observations of the Oxford University Expedition to North East Land in 1935–36 by Mr. R. A. Hamilton, which was read before the Royal Meteorological Society on February 16, an impression can be obtained of the climate of that remote Arctic island beyond Spitsbergen, which is about equal in size to Wales and lies in about latitude 80° N. The observations cover the period August 24, 1935–August 12, 1936, which is much longer than any previous period of observation. The author states that arctic tradition credits North East Land with very severe and cold winters and with almost continuous gales of between 40 and 100 miles per hour. Such were not the characteristics of the climate during the period under review, but there is reason for believing that the expedition chanced upon an unusually mild winter. A number of observing stations were set up, one of which, on Mount Toil, was 2,060 feet above mean sea-level. A striking feature of the climate at the main base, near the entrance to Brandy Bay, was the concentration of winds into two opposing directions, south-east and north-west, and there was evidence that this peculiarity was shared by an extensive area including most of the Bay. Temperature at all stations was liable to the sudden changes so common in many parts of the Arctic, in winter and spring, variations of about 30° F. in one day being observed. A big fall of pressure generally brought strong winds or gales from south-east and a rise of temperature, followed by a big fall of temperature with increasing pressure and a north-west wind. At the main base the extreme range of temperature was from – 26° F. on an occasion in March to 52° F. in June and 51° F. late in August, and the high-level stations on the permanent ice cap on West Ice, although much colder, especially in summer, showed nothing below – 26° F. Temperatures above 15° F. were recorded in every month. All through the summer, with very few breaks, the ice-cap was shrouded by mist, which generally began at about a height of 300 ft. on the hills around the base. The observations definitely disproved the tradition of continual violent gales; some months in the winter half of the year, indeed, passed without any gales.

Hydrides of Boron

THE structure of B_2H_6 has been represented by Wiberg as $H^+(H_2B{=}BH_2)H^+$ and this 'acidic' representation has been supported by the formation of a supposed diammoniate, $B_2H_6.2NH_3$. H. I. Schlesinger and A. B. Burg (*J. Amer. Chem. Soc.*, 60, 290; 1938), who found that by interaction of this compound with sodium in liquid ammonia only one equivalent of hydrogen was liberated per mol of diborane, forming a stable salt NaB_2H_8N, and that on allowing the temperature to rise more hydrogen is evolved, but never more than 1·4 equivalents, now describe experiments in which it is shown that borine trimethylamine does not react with sodium. They propose to regard the so-called diammoniate as a mono-ammonium salt in which an atom of nitrogen is interposed in the boron chain, B—N—B. The evidence is indirect. The production of one equivalent of hydrogen by reaction with sodium is explained by assuming the composition $NH_4{}^+[H_3B.NH_2.BH_3]^-$. The slow reaction with further evolution of hydrogen is explained if ammonia removes a BH_3 group by a reversible reaction with production of $NH_4BH_3NH_2$. This is supported by the reaction of $(CH_3)_3N$ with $B_2H_6.2NH_3$ to give borine trimethylamine. The reaction of the new compound $(CH_3)_2OBH_3$ with ammonia and sodium produces the salt $NaBH_3NH_2$, which strongly absorbs B_2H_6; this justifies the assumption that the negative ion of the above structure is easily formed by addition of BH_3 to $BH_3NH_2{}^-$ and is capable of stable existence. The new compound B_2H_7N, having the skeleton B—N—B, is easily prepared from $B_2H_6.2NH_3$.

Crystal Chemistry

A VALUABLE review of progress made in the crystal chemistry of non-metallic inorganic substances during the years 1927–36 by F. Machatschki appears in *Die Naturwissenschaften* (26, 67, 86; 1938). The review deals first with elements, and then with compounds, particularly silicates, borates and complex compounds. There are plentiful references to the literature.

The Lightning Discharge

B. F. J. SCHONLAND (*Proc. Roy. Soc.*, A, 164, 132; 1938) has now given some conclusions on the mechanism of the lightning flash, resulting from his study of the flash by moving-image cameras. The discharge, in all the cases observed, makes the cloud a cathode, and the first discharge advances in a series of steps. It seems certain that a hitherto unobserved pilot streamer moves downwards comparatively slowly into virgin air, and that a bright streamer follows it with higher velocity, pausing whenever it catches up with the head of the pilot. This leader stroke lowers into the channel an appreciable part of the thundercloud charge, and it is followed by a positive streamer moving upwards along the same channel and neutralizing the charge in it. Subsequent strokes involve a fast 'dart' streamer advancing downwards along the ionized channel and followed by return strokes. Evidence is given that successive strokes involve separate charge-generating centres in the cloud. The mechanism of streamer advance is discussed. Where a previous supply of electrons exists, the mechanism of impact ionization leads to velocities of advance of the order observed for the dart and return streamers, assuming reasonable values for the electron fields at the tip of the advancing discharge. It seems probable that the same mechanism can also explain the slower advance of the pilot streamer into virgin air.

John Hunter as a Pioneer of Veterinary Science

THE annual oration of the Royal College of Surgeons commemorating the life and work of John Hunter, was delivered at the Mansion House on February 28, by Sir Frederick Hobday, emeritus professor of surgery, and formerly principal and dean at the Royal Veterinary College. This made a departure from the usual tradition that a member of the medical profession delivers the address.

Sir Frederick Hobday in his introduction remarked that he felt it appropriate that a member of the veterinary profession should be honoured by the invitation to deliver the oration, for John Hunter was one of the founders of the Royal Veterinary College in 1791. He is described as being "the life and soul of the undertaking", and with him were associated Sir John Banks, Sir George Baker, the Duke of Northumberland and certain members of the Odiham Agricultural Society, who collected the necessary funds, and they were instrumental in bringing to England Prof. Charles Vial St. Bel, of the Veterinary School at Lyons, to be the first principal of the London Veterinary College. The early and unexpected death of St. Bel caused much anxiety regarding the future of the College, and Hunter helped to tide over the emergency.

Sir Frederick Hobday then proceeded to review John Hunter's contributions to veterinary science. One of the first operations performed by St. Bel in Great Britain was the removal of accessory feet that grew from the fetlocks of the two fore-legs of a horse, and it is stated that Hunter personally assisted (he was surgeon at St. George's Hospital) and gave St. Bel "some useful and friendly hints". John Hunter was a genuine lover of horses, and has left some excellent advice upon their management and on the proper way to shoe colts in order to correct defects in the manner in which they may use their fore-legs. His observations on what is termed 'roaring' are of particular interest, and although he did not correctly recognize its cause (paralysis of the left laryngeal nerve), he clearly distinguished this condition from 'broken wind'. Hunter wrote, too, "upon the effects that medicines have upon horses", and was untiring in his studies of the anatomy and physiology of animals—from the mouse to the elephant—birds, reptiles, insects and fishes. The illustrations in his book entitled "Certain Parts of the Animal Economy" cannot be surpassed for clearness and accuracy even with the aids that are now available. His chapter on the glands between the rectum and bladder, the vesiculæ seminales, describes minutely the comparative anatomy and uses of these glands both in man and in numerous animals, and the alterations that ensue after an animal has been unsexed.

The body temperature of animals was another subject to which John Hunter devoted considerable attention. He performed an experiment in which he froze the edge of the comb of a cockerel and remarks that "when I cut off a little bit it did not bleed nor did the animal show any signs of pain"—pioneer work in the use of a freezing mixture as an anæsthetic.

Hunter's writings on digestion bear witness to his keen powers of observation, for he concluded that something secreted in the coat of the stomach acts upon the food and assimilates this to the nature of the blood. He had learnt that it is not possible to make a horse vomit, and recognized the different actions that medicinal agents have upon different species of animals. In regard to the last-named, Sir Frederick remarked that this could have been only through direct observation. Thus, morphine is a narcotic for man and the dog tribe, but produces disastrous delirium in the horse and cat; strychnine and mercurials are much more toxic for the cow and dog than for the horse.

In the realm of surgery, John Hunter's classical experiment of grafting a cock's spur into its comb is well known—definite pioneer work of the various grafting operations that are performed to-day. He also made a series of observations on the reunion of divided tendons.

In conclusion, Sir Frederick Hobday alluded to the importance to a country of its agriculture, its animals and arable products, and of comparative medicine in the fight against disease, for it is here that the medical man and the veterinary surgeon meet on common ground.

Crystal Structures of the Proteins

AN X-RAY STUDY OF PALMER'S LACTOGLOBULIN

By Dr. Dorothy Crowfoot and Dennis Riley, Department of Mineralogy, Oxford

THE crystallization of a lactoglobulin from the albumin fraction of cow's milk by Palmer in 1934[1] was notable both for the size and stability of the protein crystals and for their occurrence in two different crystallographic modifications. The stable tabular form occurs alone when salt solutions of the protein are dialysed at an initial *p*H of 5·8 followed by adjustment to a *p*H of 5·2 with dilute HCl, whilst direct dialysis at a *p*H of 5·2 against distilled water produces needles which may later recrystallize in the tabular form. We have been able to study the inter-relationship of these two varieties through the kindness of Dr. R. A. Kekwick of the Lister Institute, who gave us preparations of them both.

The X-ray measurements show that the two types of lactoglobulin crystals differ not only in crystal structure but also probably in their water content. The tabular crystals are evidently, even on superficial examination, heavily hydrated. They occur commonly either as plates {001} up to 0·3 mm. across and bounded by pyramid faces or as prisms elongated along [010] and showing (100) dominating. They prove to be orthorhombic but are very markedly pseudo-tetragonal, and appear isotropic when viewed along the *c* axis. The birefringence is negative, about 0·004. When these crystals are removed from their mother liquor they shrink visibly in the direction of the c axis, and the birefringence falls to less than 0·001. This shrinkage is accurately determined by the X-ray measurements which were carried out both on the air-dried crystals and on crystals mounted in their mother liquor. For the wet crystals $a = b =$ 63·5 A., $c =$ 145 A.; for the dry crystals $a = b =$ 59 A., $c =$ 105 A. The space group in the case of the wet crystals is $P2_12_12_1$, showing, in X-ray intensities as in dimensions, a close approach to the tetragonal space group $P4_12_1$, whence there are probably 8 molecules in the unit cell. There were too few X-ray reflections from the dry crystals to indicate the space group, but it seems most probable that this unit cell also contains eight molecules, but without water of crystallization.

		Pepsin	Hæmoglobin	Chymotrypsin	Lactoglobulin tabular	Lactoglobulin needle	Insulin	Tobacco seed globulin
Wet	a	116	109	½×99	63·5	63·5		
	b	67	63·2	67·8	63·5	63·5		
	Layer-spacing	9×51·2	50·2	65	2×72·5	2×62·5		
	Molecular volume (A.³)	67,000	174,000	55,000	73,000	63,000		
Dry	a		102	45	59	54	130	2×61
	b		56	62·5	59	54	74·7	2×61
	Layer-spacing		35	53·5	2×52·5	2×62·5	30·6	2×61
	Molecular volume (A.³)		101,000	38,000	46,000	46,000	50,000	455,000
	Shrinkage per cent		42	31	37	27		

The wet needle crystals occupy a place intermediate between the wet and dry tabular crystals. They appear to be exactly tetragonal, elongated along c. The cell dimensions are $a = b =$ 63·5 A., $c =$ 125 A., space group $P4_12_1$. The fact that the needles show positive birefringence suggests that they differ from the tabular form in the orientation of the molecules as well as in water content, and this is confirmed by the drying phenomena. There is little apparent change in shape or birefringence on exposure of the needles to air, but the very weak X-ray diffraction effects obtained from the dried crystals indicate a new unit cell with approximately $a = b =$ 54 A., and $c =$ 125 A.

The unit cell dimensions of the different lactoglobulin crystals suggest that in each case there are eight protein molecules in the cell, associated with different quantities of water of crystallization. Some difficulty was experienced, however, in making measurements of the crystal density to check this, owing to the great solubility of the protein crystals in salt solutions. A value of 1·257 was obtained in sugar solutions for the density of the wet tabular crystals, and this may be regarded as an upper limit for the density (*cf.* Adair and Adair[2]). It is in agreement with the presence of a considerable proportion of water in the crystals. It has so far proved impossible to measure the density of the needle crystals in any solvent, since even in sugar solutions the crystals rapidly imbibe liquid, with resultant swelling and loss of shape. The density of the dry tabular crystals in *o*-dichlorbenzene and toluene was found to be 1·27, which is lower than might be expected, probably owing to the occlusion of air in the irregular structure formed in the drying process. The molecular weight of the protein if calculated from this value and the cell dimensions given above is 35,300, or assuming the more probable density of 1·31 (that of dried insulin) 36,500. These values are in agreement with that obtained by ultracentrifuge measurements—about 39,000[3], within the limits of experimental accuracy.

It is of most interest to compare the crystal structure of these protein crystals with those previously measured, pepsin and insulin, and with hæmoglobin and chymotrypsin (recorded below). The similarity in cell dimensions extends also to the types of photographs obtained from wet and dry crystals of lactoglobulin. The wet tabular crystals give very beautiful X-ray pictures with reflections covering the whole field and extending out to spacings of less than 2·4 A. Those from the needle crystals are less good owing to their much smaller size. But with the dry crystals the photographs are very poor indeed, and this is evidently due to the poor orientation of the protein molecules in the collapsed structure. There are no X-ray reflections with spacings less than 20 A. The sharpness of the limit is reminiscent of that already observed on the much better X-ray photographs obtained from air-dried insulin[4], and suggests that in the insulin crystals also a certain degree of molecular disorientation prevails. As might be expected the crystal structure of dry insulin is of a very compact type, while in the wet lactoglobulin crystals, as in pepsin, the molecular arrangement must be loose and extended.

MOLECULAR WEIGHT OF A TOBACCO SEED GLOBULIN

By Dr. Dorothy Crowfoot, Dept. of Mineralogy, Oxford, and Dr. I. Fankuchen, Crystallographic Laboratory, Cambridge

In order to determine the structure of protein crystals from X-ray diffraction effects it is usually necessary to measure fairly large single crystals. An exception to this rule is the case of crystals belonging to the cubic system, for which powder photographs should provide sufficient data. A preparation of a cubic tobacco seed globulin isolated by H. S. Vickery of the Rockefeller Institute, New York, was given to us by Dr. D. M. Wrinch, and this we have examined by the X-ray method in the form of the dry powder.* The crystals were very small but well-formed isotropic octahedra.

Three powder lines were recorded on the X-ray photographs which correspond in spacing to the first three reflections from a cubic face centred lattice of dimensions $a =$ 123 A. This value permits us to calculate the maximum molecular weight of the asymmetric unit as 363,000, accepting the presence of only the four molecules in the unit cell required by the symmetry, and the density of 1·287 ± 0·001, measured in a sodium phosphate buffer at *p*H 5·0. Since the crystals lose 10·4 per cent of their weight when dried in a vacuum at 100° due to loss of what may be considered water of crystallization, the maximum molecular weight of the dried protein may be calculated as 325,000. This molecular weight is in agreement in order of magnitude with the sedimentation constant of $12{\cdot}7 \times 10^{-13}$ found for the same protein by J. Philpot in the Department of

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*W. T. Astbury[5] has previously measured the large angle scattering, Biochemistry, Oxford, and is similar to those of other seed globulins, excelsin and edestin given by Svedberg as about 300,000[6]. The X-ray measurements provide some additional evidence to show that the units present in these proteins are of very considerable size, although at this stage we cannot exclude the possibility that the true chemical molecular weight of the tobacco seed globulin is a sub-multiple of 325,000.

An X-ray Study of Chymotrypsin and Hæmoglobin

By Prof. J. D. Bernal, F.R.S., Dr. I. Fankuchen and Max Perutz, Crystallographic Laboratory, Cambridge

We have recently been fortunate in obtaining well-developed crystals of two proteins—chymotrypsin and hæmoglobin. The former were prepared for us by Dr. Northrop of Princeton and the latter—methæmoglobin of horse—by Dr. Adair at the Physiological Laboratories, Cambridge. In both cases the crystals were well formed and large ($\frac{1}{2}$ mm.) and well suited for X-ray analysis.

Chymotrypsin crystallizes in thick diamond-shaped plates at first thought to be orthorhombic but afterwards discovered to be monoclinic twins. It was examined both in the native state in its mother liquor[7] and dried. The cell dimensions are $a = 49{\cdot}6$ A, $b = 67{\cdot}8$ A., $c = 66{\cdot}5$ A., $\beta = 102°$ for the wet crystals, and $a = 45$ A., $b = 62{\cdot}5$ A., $c = 57{\cdot}5$ A., $\beta = 112°$ for the dry. The space group in both cases is probably $P2_1$. The cell volumes are 219,000 and 151,000 A.[3] respectively. It is evident that very considerable shrinkage takes place on drying, nearly all of which is in the direction of the c axis. The density of the wet crystals could be measured by the methods of Adair and was found to be 1·277. If we assumed four molecules per cell this would give a molecular weight including water of crystallization of 42,300. In the case of the dry crystals it was unfortunately impossible to measure the density on account of the difficulty of removing crystallized salts. Assuming the density of the dried protein to be the same as that of dry insulin, namely, 1·31, the molecular weight is 32,000. This value for the molecular weight of a protein seems rather lower than is usually obtained by the centrifuge method, which, however, has not as yet been applied to chymotrypsin. It is difficult without a deeper analysis to say much about the inner structure of the crystals, but the extreme strength of (001) indicates a layer structure, while the weakness of (*hol*) when h is odd points to a pseudo-glide plane parallel to (010).

The hæmoglobin crystals were found to be monoclinic and usually twinned, corresponding very closely to the description given by Reichert and Brown[8]. The dimensions are $a = 109$ A., $b = 63{\cdot}2$ A., $c = 54{\cdot}2$ A., $\beta = 112°$ for the wet crystals and $a = 102$ A., $b = 56$ A., $c = 49$ A., $\beta = 134°$ for the dry. The space group in both cases is $C2$ with a face-centred pseudo-hexagonal cell. The cell volumes are 348,000 and 202,000 respectively. Here the shrinkage takes place apparently more by the increase of the β angle rather than by the shortening of cell edges. The density of the wet crystals is 1·242, which gives a molecular weight of protein and water on the assumption of two molecules per cell of 131,000. The molecular weight of the dry crystals has not been determined on account of the salt content, but taking the value of 1·26 based on that measured by Chick and Martin[9] for the closely similar serum albumin, the molecular weight is 77,000. The air-dried crystals still contain water. Taking the amount estimated by Haurowitz[10] as 9·6 per cent, the molecular weight of the dry protein becomes 69,000, which agrees excellently with the 67,000 found by chemical methods.

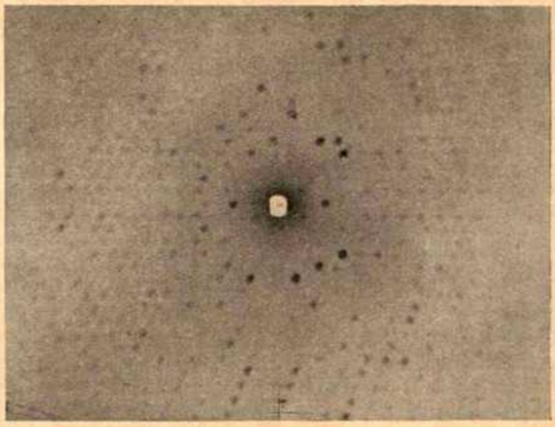

Fig. 1.

Wet hæmoglobin crystal; 5° oscillation about b-axis showing (*hko*)-zone at centre of photograph. Note the pseudo-hexagonal character of the pattern and the intensity of the reflections at high angles.

The molecular arrangement appears to be based on a layer lattice with a puckered pseudo-hexagonal network. In the dry crystals it is possible to arrive at a structure which accounts qualitatively for the

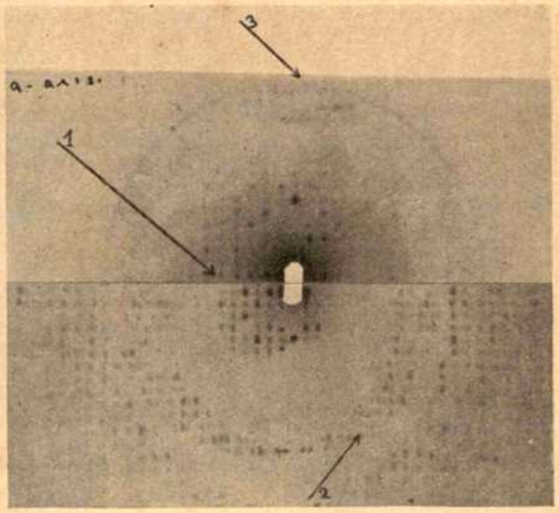

Fig. 2.

Comparison photograph of chymotrypsin: wet below and dry above; 5° oscillation about b-axis showing at centre of photograph the (*okl*)-zone. Note large difference of spacing of (00*l*)-reflections ($\uparrow_1$) and comparatively small difference of layer-line separation. The wet crystal was a twin; the (1*kl*)-reflections show doubling of spots ($\uparrow_2$). The rapid falling off of intensity in the dry crystal photographs should be noted. There is also the appearance of weak spots at a larger angle, corresponding to a spacing of 5 A. ($\uparrow^{8}$).

intensities of all the observed planes. In this structure the asymmetric unit is a half molecule of approximate diameter 35 A., linked with three others. The molecule observed in solution may be formed of two of these. The optical properties of the wet crystal point to the approximate parallelism of the hæmatin groups which lie approximately parallel to the (100) planes. As yet their position cannot be inferred, but owing to the two-fold axis of symmetry which the double molecule possesses, only two different kinds of hæmatin globin arrangements are possible. In the meantime, it is possible to draw some useful conclusions from the character of the photographs. In both cases the wet crystals showed perfectly definite reflections at spacings as low as 2 A. This proves the complete internal regularity of the protein molecules down to atomic dimensions. The dry crystals, on the other hand, show in the case of hæmoglobin no reflections of spacing less than 20 A, and for chymotrypsin, except for one or two weak reflections at 5 A., none below 8 A. Dr. Crowfoot had already noticed this phenomenon for insulin and more recently for lactoglobulin. The explanation is probably somewhat as follows. The intensity of a reflection from a protein crystal may be considered a function of three factors: the structure factor due to the position of the molecules, that due to the positions of the atoms inside the molecule, and a third factor depending on the regularity of arrangement. It is apparent that there is a general enhancement of spots in the regions of 9 A. and 4·5 A. corresponding to the two main reflections maxima of denatured proteins. In the dry protein, however, the irregularity is such that only the first of these is retained, the spots corresponding to the outer rim being generally too weak to register. If this analysis is correct, it follows that the change involved on denaturation does not require any considerable movement of atoms or amino-acid residues, but only relatively minor rearrangement together with almost complete loss of regularity, the dry protein representing an intermediate stage.

As can be seen from Fig. 2 the dried crystals of chymotrypsin show not only alterations of spacing but also of relative intensities of reflection. If we assume that drying takes place by the removal of water from between protein molecules, studies of these changes provide an opportunity of separating the effects of inter- and intra-molecular scattering. This may make possible the direct Fourier analysis of the molecular structure once complete sets of reflections are available in different states of hydration.

Already sufficient protein crystals have been examined by X-rays to be able to point to significant regularities. The table of lattice dimensions referred to three axes at right angles shows that the proteins fall into two groups: pseudo-hexagonal and pseudo-cubic, in both cases with a side of 60–75 A. This is of the order of twice the diameter of a protein molecule.

The work already done shows the wealth of new data that can be obtained by X-ray methods from reasonably well-crystallized proteins. The full advantage of the possibilities can, however, only be realized by work on a far larger number of protein types under different physical conditions, together with a more detailed application of crystal analysis.

[1] *J. Biol. Chem.*, **104**, 359 (1934).

[2] *Proc. Roy. Soc.*, B, **120**, 422 (1936).

[3] Pedersen, K. O., *Biochem. J.*, **30**, 961 (1936).

[4] *Proc. Roy. Soc.*, A., **164**, 580 (1938).

[5] *J. Chem. Soc.*, 849 (1935).

[6] *Chem. Rev.*, **20**, 81 (1937).

[7] Bernal, J. D., and Crowfoot, D., NATURE, **133**, 794 (1934).

[8] Reichert and Brown, "The Crystallography of Hemoglobin". Carnegie Inst. of Washington (1909).

[9] Chick and Martin, *Biochem. J.*, **7**, 92 (1913).

[10] Haurowitz, F., *Z. Physiol. Chem.*, **136**, 147.

Asymmetric-Sideband Broadcasting

AT a meeting of the Wireless Section of the Institution of Electrical Engineers on March 2, Mr. P. P. Eckersley read a paper entitled "A Quantitative Study of Asymmetric-Sideband Broadcasting". This paper directed attention to the fact that the progress of radio broadcasting is being hampered by the lack of a sufficient number of channels in which to contain the increasing number of transmissions. In the present state of the art, few, except local, stations can be received without interference from other broadcasting stations on adjacent frequency channels, unless the upper modulation frequencies of the wanted programme are severely attenuated. This inter-station interference can be reduced if all or part of one sideband of the transmitted spectrum is cut away; and it is the object of the asymmetric-sideband system of transmission to cut away part of one sideband without loss of the higher modulation frequencies and without introducing audible harmonic distortion.

Mr. Eckersley then gave a quantitative analysis of the phase and amplitudes of the sideband components and the effect of these factors in producing distortion. Curves have been derived, which show the required attenuation-constant of filters which cut away part of one sideband but produce no more than a constant, small distortion. A description was also given of practical tests in which the quality of reproduction obtainable from an asymmetric transmitter was compared with that given by orthodox modulation. It is claimed that while a highly trained ear may occasionally be able to detect some slight differences between the two types of reproduction when they are directly compared, no difference is detectable with modern broadcast receiving apparatus.

The last part of the paper showed that the asymmetric system has three possible applications to broadcasting as it is practised to-day. First, it could be used to allow carrier frequency differences of 11 or 12 kc./sec. without introducing any sideband overlap interference. Secondly, it could be applied to existing conditions in which the carrier frequencies differ by about 9 kc./sec., and it would then reduce inter-station interference to about one tenth of its present value. Thirdly, if the existing interferences are considered to be tolerable, then the differences between the carrier-frequencies of stations can be reduced to 6 kc./sec., without increasing the interference; this implies that one and a half times the number of stations working in Europe to-day on exclusive wave-length channels could be accommodated in the existing wave-band.

University Events

CAMBRIDGE.—The degree of Sc.D. has been conferred on C. H. Waddington, of Christ's College, lecturer in zoology.

The Faculty Board of Economics and Politics has appointed M. Paul van Zeeland, of Brussels, to be the Alfred Marshall lecturer for the year 1938–39.

The General Board has made the following grants from the income of the Worts Fund: £25 to F. H. Stubbings (of Emmanuel College) towards the expenses of a visit to Ithaca for archæological purposes; £12 to C. G. L. Shankland (Queens' College) towards the expenses of a visit to Italy to study the architecture of that country; £30 to L. H. McCabe (Peterhouse) towards the expenses of an expedition to Iceland to study the geography of that island; £100 to N. E. Odell (Clare College) towards the expenses involved in accompanying the Mount Everest Expedition 1938 for geological and glaciological study; £40 to G. E. Daniel (St. John's College) towards the expenses of a journey in France for the study of certain megalithic monuments in that country; £40 to F. J. Simonds (St. John's College) towards the expenses of a visit to Yugoslavia for a study of the ecology of certain insect larvæ in the streams of that country; £40 to M. Ballinger (St. John's College) towards the expenses of a visit to the Marine Biological Station, Tamaris, South France, to study the metabolism of the electric organ and muscular tissues of the torpedo; £60 to D. M. Carmichael (St. John's College) towards the expenses of an expedition to West Greenland to study the social habits and psychology of the Eskimo.

CAPE TOWN.—Prof. A. W. Falconer, professor of medicine in the University, has been appointed principal and vice-chancellor in succession to Sir Carruthers Beattie, who has retired.

LONDON.—Prof. I. M. Heilbron has been appointed as from October 1 to the University chair of organic chemistry tenable at the Imperial College of Science and Technology. Since 1935 he has been Sir Samuel Hall professor of chemistry and director of the chemical laboratories in the University of Manchester.

Mr. W. J. John has been appointed as from October 1 to the University chair of electrical engineering tenable at Queen Mary College. Since 1936, he has been University reader in electrical engineering at that College.

MANCHESTER.—Dr. Willis Jackson has been appointed Edward Stocks Massey professor of electrotechnics and director of the Electro-Technical Laboratories of the University as from September 29, when the appointment of Prof. Robert Beattie expires. Dr. Jackson is at present research engineer to Metropolitan-Vickers Electrical Co., Ltd.

MELBOURNE.—Dr. J. S. Turner has been appointed professor of botany. Dr. Turner is at present senior demonstrator of botany in the University of Cambridge.

OXFORD.—Dr. J. R. Baker, New College, lecturer in zoology, has been granted the degree of D.Sc. for his work in zoology and biological chemistry.

SHEFFIELD.—Dr. W. H. Pearsall has been appointed professor of botany in succession to Prof. B. H. Bentley, who is retiring at the end of the present session.

Science News a Century Ago

The Copper Mines of Cornwall

AT a meeting of the Statistical Society held on March 19, 1838, Sir Charles Lemon read a paper entitled "An Account of the Origin and Progress of the Copper Mines in Cornwall" in which he dealt with the history of the mines, the adoption of steam pumps and steam winding engines, production, employment, wages, consumption of coal and timber and the health of the workers. Newcomen engines were introduced early in the eighteenth century, but these had all been superseded by the improved engines of Boulton and Watt.

The total amount of coal reported to have been used in 1837 was 1,213,439 bushels, of 84 lb., and the total amount of water pumped by 60 engines was 31,141,800 tons. The production of ore and its value at various intervals between 1771 and 1837 was given as follows:

		Ore (tons)	Copper (tons)	Value of ore in £
1771	..	27,896	3,347	189,609
1800	..	55,981	5,187	550,925
1821	..	98,426	8,514	605,968
1837	..	140,753	10,823	908,613

The total number of persons employed in 59 mines was 10,624 men, 3,802 women and 3,490 children, and it was calculated that in 1836 about £482,000 was paid in wages. The average wages of a miner was 51*s*. 6*d*. per week.

Flooding of the Thames Tunnel

THE *Annual Register* for 1838 under the date of March 20 gives the following account of an irruption of the river into the Thames Tunnel on that day:

"One gang of labourers had been relieved by another when the water began rushing in with a loud noise. . . . In a few minutes the tunnel was filled. . . . Since the last irruption in Oct. 1837 the excavations had proceeded with more than usual rapidity owing to great increase in the enormous quantity of clay thrown down over the tunnel which formed an artificial bed of great consistency past which the works were advanced 3 ft. making in all 20 ft. added to the tunnel since the break-in six months before. At the beginning of the week the soil became loose, a vein of sand was encountered and it was found necessary to proceed with more than ordinary caution. On the night before the irruption the ground presented some indication of giving way, and much difficulty was experienced in going on with the excavations, the entrance of the sand and water being only prevented by the intrepidity of some of the old miners. Every precaution was consequently taken to prevent the loss of life which has sometimes attended the breaking-in of the river and the previous indication of danger, and the formation of the double gangways, enabled the workmen to get away without losing one of their number. Immediate measures were taken to stop up the aperture, which was soon ascertained to be of no very great dimensions. Several large loads of clay were thrown down immediately above the spot; and the shore engine employed to pump the water from the tunnel, which by the end of the month was completely cleared so as to allow of the works being resumed."

A New Tide Gauge

AT a meeting of the Royal Society held on March 22, 1838, Mr. T. G. Bunt gave a description of a new tide gauge constructed by himself, and erected on the eastern bank of the River Avon, in front of the Hotwells House, Bristol. In this apparatus a float was connected by a wire to a wheel and drum, 1/18 of the vertical motion of the float being given to a bar carrying a pencil which recorded the rise and fall of the water on a paper on a cylinder driven by an eight-day clock.

Dublin Zoological Society

"THIS institution," said the *Mechanics' Magazine* of March 24, 1838, "has in some degree overcome the difficulties whose occurrence seemed to threaten its very existence a short time ago. Extraordinary means, however, are obliged to be resorted to, in order to make up the deficiency of funds under which it labours. Among these is a series of lectures on Natural History delivered gratuitously by some of the most eminent physicians of the Irish capital, under the patronage of the Lord Lieutenant. It would be a pity indeed, if 'the second city in the Empire' should, like too many of our large provincial towns, suffer its Zoological Gardens to fall into decay after a short season of flattering success."

New Professorships in Paris

THE *Athenæum* of March 24, 1838, stated that "Dr. Duvernoy, of Strasbourg, at which place he holds a high situation in the university, has been appointed to the new professorship at the Collège de France, named the 'Natural History of Organised Bodies'. M. Poncelet, of the Academy of Sciences, has also been elected to the new chair of Physical and Experimental Mechanics, belonging to the Faculty of Sciences, and which has been created in consequence of the increasing manufactures and industry in France. A third chair has been instituted at the Jardin des Plantes, viz., that of Comparative Physiology, which has been given to the Chevalier Cuvier. To this list may be added the election of M. Audouin, the entomologist to the Academy of Sciences".

James Lowe's Screw Propeller

Two years after John Ericsson and Francis Pettit Smith patented their screw propellers, James Lowe (1798–1866) took out patent No. 7599 of March 24, 1838 for improvements in propelling vessels "by means of one or more curved blades set or fixed on a revolving shaft below the water line of the vessel". His propeller was tried in H.M.S. *Wizard* and afterwards in H.M.S. *Rattler* and H.M.S. *Phœnix*. In 1844 he brought an action against Penns of Greenwich for infringement, and the evidence showed that although Lowe was not the original inventor of screw propellers he was the first to use the combination of a segment of a screw, and of a segment applied to an axis below the water and with the segment totally submersed. Lowe, who was born May 13, 1798, was an apprentice of Edward Shorter, the London inventor of "the perpetual sculling machine", and became a merchant and smoke jack maker. He met his death by being run over by a wagon on October 12, 1866. He is buried in the churchyard at Ewell, Surrey.

Societies and Academies

Dublin

Royal Irish Academy, January 24.

B. N. SINGH: Cytoplasmic bodies in the oogenesis of the vulture (*Neophron percnopterus ginginianus*), with special reference to the effect of ultra-centrifuging on the oocytes of the pigeon. After ultra-centrifuging, the cytoplasmic bodies in the oocytes of the pigeon are stratified as follows: fat and cholesterol at the centripetal end; next, a layer of Golgi bodies, followed by a layer of mitochondrial yolk, and the mitochondria which are the heaviest components in the cell and occupy the extreme centrifugal end. No relationship exists between sudanophil fat and the Golgi bodies. Cholesterol bodies filter in from the egg membranes to the oocytes in the pigeon. No pre-existing 'vacuome' could be seen.

R. W. DITCHBURN: Diffraction by irregular gratings. The properties of gratings in which the spaces between the lines and the intensity scattered by a given line are not constants are discussed. It is shown that general expressions of a fairly simple type can be given for the diffraction functions but that it is difficult to apply these general expressions in the design of gratings. By computation and trial and error it is, however, possible to design gratings which have interesting and useful properties. In particular, it is possible to increase the resolving power considerably by the omission of some of the rulings of an ordinary grating. Examples of the application of the theory to line and echelon gratings are given.

ARCHIE LAMONT: Contemporaneous slumping and other problems at Bray Series, Ordovician, and Lower Carboniferous horizons in County Dublin. Accounts are given of submarine sliding of sediments. These appear to have been a surface expression of deep-seated tectonic adjustments. The Ordovician slumping corresponds with a horizon close to the transition between Caradocian and Ashgillian, and evidence of movement of a fault at this juncture is adduced. Carboniferous landslides, apparently set off by seismic agencies, were intensified during the Nassauian and Sudetic phases of mountain-building on the Continent. Anti-dune structures produced by anomalous marine currents are described.

J. SELWYN TURNER contributes a revision of the Carboniferous stratigraphy of the district.

Paris

Academy of Sciences, January 17 (*C.R.*, 206, 137–220).

EMILE BOREL: The laws of the probable evolution of finite ensembles of segments.

HENRI COLIN: Affinity and specific chemism in grafted *Helianthus*.

GABRIEL BERTRAND: An unexpected intervention of the manure industry in reducing the fertility of soils. It has been shown that boron is an essential element for certain crops. Potash from Alsace contains boron, but the purification of the crude sylvinite, while raising the percentage of potassium substantially, reduces the proportion of boron, with a possibly prejudicial effect on the crops.

FRANÇOIS GRANDJEAN: The ontogeny of the Acarians.

HYACINTHE VINCENT: Experimental typhoid infection by the method of protected inoculations.

GUSTAVE MALÉCOT: The analysis of chances and the problem of heredity.

H. ADAD: Circles paratactic to two given circles and surfaces several times encircled.

André Lichnerowicz : The singularities of the exterior ds^2.

Gustave Choquet : Study of plane homeomorphies.

René Hirsch : The stabilization of aeroplanes.

Léopold Escande : Flow through a submerged valve gate.

Henri Mineur : The dynamical equilibrium of galactic clouds.

Junior Gauzit : The spectrum of the Finsler comet in the visible region. Outline of results obtained at the Lyons Observatory, with a criticism of the conclusions drawn by R. Minkowski regarding the presence of the red spectrum of cyanogen in the Finsler comet.

Jean Xanthakis : The variation of azimuth of the line of the meridional sights of the Strasbourg Observatory.

Louis Routin : An improvement in the applications of the gramophone to teaching.

Emile Pierret : The electronic oscillations of triode valves. Experiments showing that triode valves with unsupported spiral grid can give rise to electronic oscillations of well-defined frequency.

Charles Haenny : Photographs of multiple rays in the subsoil.

Maurice Rey, Henri Herbiet and Pierre Coheur : The influence of cobalt salts on the anodic behaviour of lead in a sulphated electrolyte.

Mlle. Yvette Cauchois and Horia Hulubei : Non-characteristic white and dark lines in the spectra of X-rays obtained by crystalline diffraction.

Roger Arnoult : The continuous β-spectrum of thorium-B.

Marie Louise Delwaulle, Félix François and Joseph Wiemann : The application of the Raman effect to the study of the constitution of solutions of zinc iodide and cadmium iodide.

P. Bellair : The origin of the Pelvoux granite.

Andre Wahl, Martinus Goedkoop and Edouard Heberlein : α- and β-naphthoylacetic esters.

Arnold Bersier : The character and meaning of the sedimentation in the alpine pre-fosse (external phase).

Marius Dalloni : Intrusion of the Cenomanian on the primary axial zone of the Ariegeois Pyrenees.

Georges Choubert : The Dogger of the eastern Haut-Atlas.

André Meyendorff : The primary series of Gourara.

Gérald Andrew and Jean Cuvillier : The discovery of the marine Oligocene in the region of Borg el-Arab.

Pierre Dangeard : A new *Cystoseira* from the Cap Vert Peninsula, *C. senegalensis*, and on some other African *Cystoseira.*

Jean Fleckinger : The size of the flowers and pilosity of the calyx in relation to polyploidy in the apple tree.

Léon Acolat : Comparative study of the blood pressure in the pulmonary circuit and in the general circuit in Batrachians and reptiles.

A. Jullien and D. Vincent : The action of acetylcholine on the heart of molluscs. The curare-acetylcholine antagonism.

Henry Schwab : The opposed effect of small and large doses of aluminium salts in hypoglycæmia due to insulin and hyperglycæmia due to adrenalin.

Gabriel Florence and Mme. Andrée Drilhon : The absorption in the ultra-violet of blood ultra-filtrate.

Emile Rousseau : Differential reaction between blood or urine of cancerous and normal subjects.

Michel Flanzy and Marcel Banos : The presence of secondary propyl alcohol in alcohol from wine. Secondary propyl alcohol appears to be a normal constituent of alcohol from wine.

Moscow

Academy of Sciences (*C.R.*, 17, No. 6, 1937).

S. Bernstein : Some modifications of the inequality of Tchebysheff.

M. Kravčuk : Some approximations in the problem of moments for the functions with two variables.

B. Lewitan : (1) A new generalization of quasi-periodic functions. (2) Linear differential equations with quasi-periodic coefficients.

N. Kotchin : A particular case of Riemann's problem.

I. Vécoua : General representation of solutions of equations with partial derivatives of the second order.

N. Moisseiev : Problem of the localization of dynamic trajectories in the space of phases.

L. Landau : Origin of stellar energy.

N. Wassmuth : Contributions to the theory of Brownian movement.

G. L. Shnirman : An elementary theory of the spring suspension of the vertical seismograph.

M. K. Tikhonov : Corrosion of iron at the boundary : metal-liquid-gas and metal-liquid-liquid.

N. A. Dziuban : Nutrition of some Cyclopidæ (Crustacea).

I. A. Filippenko, E. H. Gerber and O. K. Elpidina : Photosynthesis as applied to citrous plants in natural conditions.

I. A. Filippenko : Formation of bios in the vernalized embryos of winter wheat.

C.R., 17, No. 7, 1937.

N. Cudakov : Problem of Goldbach.

W. Liukshin : Bending of rotation surfaces with negative curvature and a single point.

I. Petrovskij : Systems of differential equations all solutions of which are analytical.

J. G. Metschwarischwili : Limit solutions of differential equations of hyperbolic type with variable coefficients, in the case of two independent variables.

W. W. Shoulejkin : Theory of monsoons. (3) The importance of the size and shape of continents and seas.

A. E. Ostrovskij : Measurements of the rate of propagation of elastic vibrations on small bases.

N. N. Vorožcov, A. P. Alexandrov and T. I. Berkova : A new product of reaction between anthraquinone and alkali.

E. V. Zmačinskij and L. I. Mališevskaja : New method for obtaining benzil from benzoin.

M. M. Kacnelson and M. S. Kondakova : Investigations on normal acids with a long chain, which is closed by a cyclohexyl or a cyclopentyl.

L. L. Ivanov : A chemico-microscopic study of a meteorite from the Yurtuk village, Dnepropetrovsk region, which fell on April 2, 1936.

I. Sedleckij : Genesis of minerals from soil colloids of the group of montmorilonite.

N. A. Iljin : Parallel variability in phenogenesis of the ear shell in Canidae.

O. G. Alexandrova : Anatomy of various types of wheat grain.

V. G. Alexandrov : Morphology of the grain of cereals.

A. A. Voitkevič : Morphogenetic activity of different parts of the hypophysis. (9) On the gonadotropic action of the substance from the "basophile zone" of the anterior lobes of the hypophysis.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Monday, March 21

Royal Geographical Society, at 8.30.—J. M. Wordie: "An Expedition to Baffin Bay and Arctic Canada in 1937".

Tuesday, March 22

Eugenics Society (in the rooms of the Royal Society, Burlington House, Piccadilly, W.1), at 5.15.—Miss Evelyn Fox: "Modern Developments in Mental Welfare Work".*

Birkbeck College, Physical Society, at 6.—E. G. Dymond: "Cosmic Rays in the Arctic" (Distinguished Visitor's Address)

Thursday, March 24

Royal Society, at 2.30.—Discussion on "The Application of Quantitative Methods to Certain Problems in Psychology".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Teacher of Chemistry in the Northern Polytechnic, Holloway, London, N.7—The Clerk (March 23).

Assistants (grade III—radio engineering) at the Bawdsey Research Station, Woodbridge, Suffolk—The Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, N.W.1 (March 25).

Head of the Chemistry Department of the Coventry Technical College—The Director of Education, Council House, Coventry (March 26).

Inspector for Livestock in the Department of Agriculture for Scotland—The Secretary (Establishment Branch), 29 St. Andrew Square, Edinburgh, 2 (March 26).

Lecturer in Gardening, Biology and Elementary Science in the Caerlon Training College—The Higher Education Department, County Hall, Newport, Mon (March 28).

Assistant Adviser in Mycology at the Long Ashton Research Station—The Registrar, University of Bristol (April 2).

Assistant Lecturer and Demonstrator in Dietetics and Physiology in the King's College of Household and Social Science, Campden Hill Road, London, W 8 (April 11).

Analytic Chemist in the Medical Department of the Gold Coast and **Government Analyst** in Mauritius—The Director of Recruitment (Colonial Service), 8 Buckingham Gate, London, S W.1 (April 15)

Assistant Keeper in Entomology in the Manchester Museum, University of Manchester—The Registrar (April 20).

Lecturer in Physics in University College, Hull—The Registrar (April 23)

Lecturer in Physics and Lecturer in Mathematics in King's College, Newcastle-upon-Tyne—The Secretary to the Council (April 30).

Director of the National Institute of Agricultural Botany—The Chairman of the Council, N I A.B., Huntingdon Road, Cambridge (May 9)

University Lecturer in Geology in the University of Cambridge—Secretary of Appointments Committee, Department of Mineralogy and Petrology, Cambridge (April 19).

Research Assistant in the Oxford University Observatory—The Savilian Professor of Astronomy.

Investigator on welding to the British Non-Ferrous Metals Research Association, Regnart Buildings, Euston Street, London, N.W 1—The Secretary

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Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

The Physical Society. Reports on Progress in Physics, Vol. 4. General Editor: Allan Ferguson. Pp. vi+389. (London. Physical Society.) 20*s*. net [142

ULAWS Monographs and Reports. No. 4F: Some Facts and Queries relating to the Wild-Rabbit Problem By Capt. C. W. Hume. A Paper read before the Conference of Corresponding Societies of the British Association for the Advancement of Science, 6 September 1937. Pp. 16 (London: University of London Animal Welfare Society.) Free. [142

Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.). No. 56: The Preparation, Properties and Mode of Occurrence of Laminarin. By Vincent C. Barry. Pp. 615–622. (Dublin: Hodges, Figgis and Co., Ltd., London: Williams and Norgate, Ltd.) 6*d*. [142

Commission Internationale de l'Éclairage en succession à la Commission Internationale de Photométrie. Neuvième session, Berlin et Karlsruhe, Juillet 1935 Recueil des travaux et Compte rendu des séances Publié sous la direction du Bureau Central de la Commission, the National Physical Laboratory, Teddington, Angleterre. Pp. viii+681. (Cambridge: At the University Press.) 20*s*. net. [152

Liverpool Observatory and Tidal Institute. Annual Report, 1937. Pp. 19. (Liverpool. The Observatory) [162

Committee of Imperial Defence. Sub-Committee on Oil from Coal: Report. (Cmd 5665) Pp. 71. (London: H.M. Stationery Office) 1*s*. 3*d*. net. [162

Report for 1937 (No 50) of the Marine Biological Station at Port Erin, Isle of Man. Drawn up by Prof. R. J. Daniel. Pp. 24. (Liverpool: University Press of Liverpool.) 1*s*. 6*d* net. [172

Astronomical Society of Edinburgh. Report by the Council and Accounts for the Period to 31st December 1937 Pp. 8. (Edinburgh. Astronomical Society of Edinburgh) [172

Hastings Natural History Society. Report and Balance Sheet for the Session 1936–37, Council and New Members. Pp. 8. (St Leonards-on-Sea: Hastings Natural History Society.) [172

Economic Proceedings of the Royal Dublin Society. Vol. 3, No 5: Mineral Oils as Insecticides By J. Carroll. Pp. 73–74 (Dublin Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 6*d*. [172

Empire Cotton Growing Corporation. The Work of the Experiment Stations, Season 1936–37, an Explanatory Review. By W. Nowell. Pp. 36 (London: Empire Cotton Growing Corporation) 1*s*. 6*d*. [172

International Institute for Psychical Research, Ltd. Bulletin 4: Horizons of Immortality and the Subconscious Mind. By Baron Erik Kule Palmstierna Pp 16. (London: International Institute for Psychical Research, Ltd.) 2*s*. [192

Imperial Forestry Institute. University of Oxford. Thirteenth Annual Report, 1936–37, and Prospectus Pp. 34. (Oxford: Imperial Forestry Institute.) [212

British Association for the Advancement of Science. Report of the Annual Meeting, 1937 (107th Year), Nottingham, September 1–8 Pp. xliv+524+129. (London British Association) [212

Other Countries

Nigeria Report on the Forest Administration of Nigeria, 1936. Pp. 30 (Lagos: Government Printer, London. Crown Agents for the Colonies.) 2*s* 6*d*. [142

Bulletin of the Madras Government Museum. Supplement to The Littoral Fauna of Krusadai Island in the Gulf of Manaar. By Dr M. Burton. Pp. 58+9 plates. (Madras: Government Press.) 1.14 rupees. [142

Memoirs of the Asiatic Society of Bengal Vol. 9, No. 8 Geographic and Oceanographic Research in Indian Waters. Part 8: Studies on Coral and Coral-Formations in Indian Waters. By Lieut-Col. R. B. Seymour Sewell. Pp. 459–540+plates 11–15. (Calcutta: Asiatic Society of Bengal.) 5.10 rupees. [142

Merentutkimuslaitoksen Julkaisu No. 114: Über die Eisverhältnisse des baltischen Meeres an den kusten Finnlands. Von Risto Jurva. Pp. viii+248+51 plates. (Helsinki: Merentutkimuslaitos) [142

Proceedings of the United States National Museum. Vol 85, No 3030: A Miocene Booby and other Records from the Calvert Formation of Maryland. By Alexander Wetmore. Pp. 21–26. Vol. 85, No. 3031: Another Fossil Owl from the Eocene of Wyoming. By Alexander Wetmore. Pp. 27–30 (Washington, D.C.: Government Printing Office.) [162

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 2 Biennial Survey of Education, 1932–1934 Pp. iii+14+vi+112+v+380+vi+492+v+76+72+30+38+7. (Washington, D.C.. Government Printing Office) [162

Anthropological Records. Vol. 1, No 2: Culture Element Distributions. 6. Southern Sierra Nevada By Harold E. Driver. Pp iii+53–154. 1 dollar. Vol 1, No. 3: Culture Element Distributions. 7: Oregon Coast. By H. G. Barnett. Pp iii+155–204. 50 cents (Berkeley, Calif.: University of California Press; London: Cambridge University Press) [162

U S Department of the Interior Geological Survey. Bulletin 872. The Yukon-Tanana Region, Alaska. By J. B. Mertie, Jr. Pp. v+276+15 plates 70 cents. Water-Supply Paper 679–B. Thermal Springs in the United States. By Norah D. Stearns, Harold T. Stearns and Gerald A Waring. (Contributions to the Hydrology of the United States, 1935.) Pp. iv+59–206+plates 7–16. 35 cents. Water-Supply Paper 796–D. Geology and Ground-Water Resources of Ogden Valley, Utah. By R. M. Leggette and G. H. Taylor. (Contributions to the Hydrology of the United States, 1937) Pp iv+99–162+plates 35–40 10 cents Water-Supply Paper 796–E. Ground Water in the Avra-Altar Valley, Arizona. By David A Andrews. (Contributions to the Hydrology of the United States, 1937) Pp. ii+163–180+plates 41–44. 10 cents. Water-Supply Paper 798: The Floods of March 1936. Part 1 New England Rivers. Pp. x+466+14 plates. 70 cents. Water-Supply Paper 807: Surface Water Supply of the United States, 1936. Part 7. Lower Mississippi River Basin Pp. 149+1 plate 25 cents. Water-Supply Paper 814: Surface Water Supply of the United States, 1936 Part 14: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. 186+1 plate. 25 cents. Water-Supply Paper 817: Water Levels and Artesian Pressure in Observation Wells in the United States in 1936; with Statements concerning Previous Work and Results. Pp. iii+512 75 cents Water-Supply Paper 819. The Warm Springs of Georgia, their Geologic Relations and Origin: a Summary Report. By D. F. Hewett and G. W. Crickmay. Pp. iv+40+8 plates. 25 cents. (Washington, D.C.: Government Printing Office.) [172

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Ethics and Ethnology

ALTHOUGH nearly fifty years lie between T. H. Huxley's Romanes Lecture on "Evolution and Ethics", delivered at Oxford in 1892, and the recent address on "Science and Ethics" by Dr. E. G. Conklin as outgoing president of the American Association for the Advancement of Science (see NATURE, January 15, p. 101), there is in them a striking congruity of outlook. In both, the ethical idea is paramount in the application of evolutionary doctrine to the problems of man's advancement. While for Huxley the blind struggle for existence, which had brought subhuman forms to the threshold of intelligence, henceforward in human society is dominated by moral and intellectual forces in a conflict—in the ultimate resort, one of ethical ideals—for Dr. Conklin determinism, to many an inescapable corollary of the modern approach to evolutionary problems, is mitigated by the selective powers of the human will, which can mould the forces governing human development to such ends as the ethical standard—the ideals of justice, truth, beauty, sympathy—may formulate. Nor does it affect materially the argument of either that the end to which the selective process is directed may vary with time, place and circumstance. Its virtue lies in the control which it exercises over material forces to make man potentially master of his fate.

That the ethical ideal, like the organic world, is subject to a process of development, and that it is variable according to chronological period, geographical distribution, and social environment is a matter of common observation. Morality, it has been remarked, is a question of latitude; and as Huxley pointed out, systems of ethics evolve. Nowadays modern ethnological inquiry would stress rather their relative character, the function of a specific ethical system in relation to a particular society and ritual of religious belief. Take, for example, some of the Bantu peoples of South or Central Africa, more especially those of Amazulu stock, which before effective control by British rule were organized mainly, if not entirely, for war. The whole ethical code with its 'religious' sanctions—penalties inflicted by spirits for the breaking of taboos—was directed to the avoidance or performance of actions affecting the success of the community in war. Among tribes, however, whose social organization was based on pasturage or agriculture rather than on war, the moral code was directed to the preservation of the community through the promotion of fertility. The diverse aims and preoccupations of the two types of community produced moral codes of an entirely different character, but each in complete harmony with its particular social environment. The detribalized natives of Africa illustrate the dangers of interference by well-intentioned, but ill-considered, effort with moral codes and attendant beliefs without effective substitutes which will ensure continued stability in that society.

The ethical system which derives its compelling force from reference to the claims and needs of a given form of society, affords no guidance for conduct as between man and man outside the group. In many primitive societies, members of the group alone are held worthy of the collective title of 'men'; and the implication of this group particularity absolves its members in contact with outsiders from the moral obligations and restraints observed in the relations of members of the group one with another. This is well illustrated in the history of the peoples pictured in the Old

Testament, in which the moral code imposed by the Decalogue is a matter for strict observance only as between the people of Israel. They are a 'chosen' people; and neither the sanctity of personal possessions nor the injunction "Thou shalt not kill" affect the warlike and aggressive followers of Jehovah when they fall upon and despoil a neighbouring tribe.

The teaching of Christ and the missions to the Gentiles inculcated a broader conception of the ethical relations which should subsist among the various branches of mankind; while the concept of catholicity was still further reinforced in the early Church through the influence of the Stoic doctrine of the brotherhood of man and the citizenship and *Pax Romana* of the Empire. The humanistic ideal, however, could not withstand such disintegrating forces as the Great Schism between the Eastern and Western Church, the growth of nationality and that reaction against freedom of thought which found expression in the Papal Bulls against heretics and the persecutions of schismatics, witches and such heathen as the Indians of America. The touchstone of the relations between individuals ceased to be in conformity with a standard resting on the broad basis of humanistic ethics and a sanction derived from religious belief, and became a question of adherence to an ecclesiastical organization, which claimed to be universal and of supreme authority in conduct and doctrine.

It is unnecessary to recall in any detail the disastrous consequences of this imposition of conformity to ecclesiastical authority in its effect in checking freedom of thought and intellectual progress for centuries—they are too familiar to need recapitulation; but recent pronouncements of members of the Church of England on questions amenable to the evidence of scientific investigation, for which at one period of the world's history they would have been burned at the stake, are some measure of the irreparable loss which science and humanity would have suffered had freedom of thought and the teaching of observation and experiment not resisted successfully the dictates of authority.

After fifteen years' deliberation, the Archbishops' Commission on Christian Doctrine has issued a report, which has been received with widespread astonishment, some bewilderment, and in certain quarters with something like dismay. The Commission disclaims judicial functions, nor is it unanimous: its findings are a statement of views on certain doctrinal matters, which have been the subject of controversy, held by various bodies of opinion within the Church of England and represented on the Commission.

The more outstanding of the Commission's pronouncements deal with such matters as the inerrancy of the text of the Bible, which it is stated in view of increased knowledge can no longer be maintained; the Creation, which it is acknowledged is regarded by many Christian thinkers as a continuous process; evil spirits, which may be taken symbolically, though, it is important to note, it is added that when Christ spoke of Satan, he may have shared the current belief of his time; miracles, a matter upon which some members believe it to be "more congruous with the wisdom and majesty of God that he should never vary the regularities of Nature"; the Virgin Birth, and the Resurrection in its physical features, which are interpreted symbolically.

This report will be a landmark in the history of Christian doctrine, even though it may be that the Rev. Dr. Inge, who seems to stand among those not least bewildered, is correct when he says that it "marks the position of King Canute's chair in this year of grace". It is unnecessary to stress the fact that it includes within the orthodox fold, or at least as maintaining a position not incompatible with Christian doctrine, those who now accept the more salient of the 'heresies' of scientific thinkers, which convulsed English society in the nineteenth century from the days of Dean Buckland down to the pitched battles which took place on the scientific positions of Darwin, Huxley, Tyndall and their successors.

Some critics would stigmatize the report as a capitulation to the forces of modernism and scientific materialism. This argues a failure to appreciate the findings of ethnological science and the history of religious belief. From such studies, the salient fact emerges that religious beliefs, when viewed objectively, are seen, like other component elements in human society, and most conspicuously, perhaps, the ethical standard, to be conditioned by time and place—the products of a specific tradition and culture, and in the course of time to undergo a process of development, or evolution in the more popular sense of the term. To illustrate this, it is unnecessary to go outside the Christian religion itself. The prominence given to the Virgin Mary in the Roman Church was undoubtedly fostered and reinforced by folk-memory of the cult of the mother goddess in Mediterranean belief; and hence the Reformation may, in part, be regarded as a revolt from an alien, southern form of ritual by peoples of northern Europe, to whom the belief in a God of Battles was more congenial. One of the effects of this diversion of emphasis in cult is to be seen in the predominating influence of the Old Testament in the life of the peoples of England and Scotland in the seventeenth century. This influence continued to be marked until superseded by the humanitarian ideals and missionary spirit of the New Testament, with the aid of philosophic doctrine, in the late eighteenth and nineteenth centuries.

The attitude, then, of the members of the Commission on matters of disputed doctrine must be construed as more than one of toleration only. It implies recognition of the fact that, just as in scientific investigation, hypothesis—for example, as to the nature of the universe, or as to the antiquity and descent of man—is subject to modification in the light of increased knowledge, so in matters of theological doctrine, orthodoxy is not static, but must vary in connotation with increase of understanding and a clearer view of the cosmic process. Further, that such understanding may bring about change in forms of belief, without affecting faith in the central doctrine of Christianity. The findings of the Commission would have been impossible a hundred years ago.

It may seem that to hold such a view of the relation of the evolution of theological dogma to the development of scientific thought is to make the validity of religious belief dependent upon the finite intelligence of man and to be incompatible with the tenets of a religion which takes its stand upon divine revelation. Yet is it not possible to regard both the growth of scientific knowledge and the development of dogma, each in its respective field, as two sides, two aspects of the same process—the search for truth, in which the Divine Purpose is revealed gradually to man *pari passu* with the preparation of his heart and intellect to receive it with understanding.

Whether the preparation of man's heart to accept the advances of science and the enlargement of theological doctrine, in other words the ethical ideal, has kept pace with development is more open to question. The prostitution of scientific discovery to the forces of destruction, and the economic dislocation, of which the consequences have more than neutralized the advantages of the application of scientific results and methods to production, would argue strongly to the contrary—and these are two only of numberless disharmonies. For this lag of the ethical ideal, the divorce of faith and reason, one of the most outstanding features of intellectual development in the nineteenth century, must be held largely responsible. It was, in fact, the diverging tendencies of scientific thought and theological doctrine in the hundred years before the Great War which for a large part of that period went near to sterilizing the more progressive thinkers in contributing to social advancement.

Dr. Conklin, in opening his address, stressed the advantage that might accrue from more effective co-operation between science and religion in the field of practical ethics. Many will feel that serious obstacles standing in the way of such co-operation have now been removed by the acceptance or toleration of certain of the principles fundamental in the scientific approach to problems of human betterment. The materialistic position into which scientific thought was virtually forced by nineteenth century orthodox rejection of evolutionary theory was saved from ultimate sterility and negation by a fervid belief in the perfectability of man. Notwithstanding a wave of pessimism now current, such optimism remains the philosophic postulate of much of the activities of research, justifying scientific wisdom of her children.

In the course of social evolution, the lesson of evolutionary ethics is that the ethical bond is accepted by an ever-widening circle from intimate family group to nation. In a modern world in which separatist ideas are paramount, this tendency to larger aggregation has suffered a check; and among modern social and intellectual forces, science alone speaks clearly in a tongue which meets with universal understanding. This has been shown in the recent fraternization of Indian, British and foreign men of science during the Indian Science Congress, though that meeting took place among peoples heated in political controversy. Yet religious toleration, at least among the more advanced, has now reached a point at which the English Church can not only unite with British Nonconformity in the attack on social problems, but also can seek a measure of union with the Eastern Church and other communions. The time has surely come for co-operation between religion and science in an endeavour to unite all men of good will, irrespective of creed, race and nationality, in seeking to arrive at a solution of the problems, fundamentally ethical, which now confront mankind.

Regiomontanus and his Calendar

Der deutsche Kalender des Johannes Regiomontan, Nürnberg, um 1474
Faksimiledruck nach dem Exemplar der Preussischen Staatsbibliothek. Mit einer Einleitung von Ernst Zinner. (Veröffentlichungen der Gesellschaft fur Typenkunde des XV Jahrhunderts—Wiegendruckgesellschaft, Reihe B: Seltene Frühdrucke in Nachbildungen, Band 1.) Pp. 80. (Leipzig: Otto Harrassowitz, 1937.) 20 gold marks.

FOR thirty years, the Gesellschaft für Typenkunde des XV Jahrhunderts has issued facsimile examples of print characteristic of that period: not for the sake of the text, but in aid of typographical study. These are being continued as Series A; but the Society has now taken over the publishing function of the younger Wiegendruckgesellschaft, and under the heading Reihe B it has begun, with the present small volume, a series of facsimiles (with suitable introductions) of complete printed works belonging to the fifteenth century. By means of this new series, the Society hopes to spread sympathy for its field of study not only among typographic scholars but also among persons learned in other fields, whose interest will be gained through reading characteristically fifteenth century works that are too rare in the originals for any but bibliographers and collectors to meet. This is an admirable plan; and to judge from this first example, it ought to succeed in its object; for the work now chosen is capable of interesting students of almost any aspect of the Renaissance.

Johann Müller, born in 1436 in the Franconian village of Königsberg, was variously called Johan von küngsperg, Hans von Königsberg, Joannes Königisberger, Joannes de Monte Regio, de Regiomonte, or, with the elevated simplicity which beseemed his fame, as Regiomontanus. He was one of those men of versatile genius—our own Robert Hooke, two centuries later, was of kindred stuff—who combine all sorts of practical ingenuity with accurate observation and with a strong capacity for abstract calculation in the service of concrete problems. A founder of the modern study of cometary movements and a fine general astronomer, the chief pre-Gregorian clarifier of the complex medieval calendar, and a founder of trigonometry (to mention no other activities), his masterliness was long acknowledged; and, but for his death at forty years of age, he might have put his name among the really great. A new account of his life is being produced by Prof. Ernst Zinner, director of the Observatory at Bamberg, and should afford a thorough and authoritative judgment.

Among Müller's subordinate feats was the setting up of his own press at Nuremberg, about 1472, mainly for the sake of printing his own and allied works correctly. Because of the need for methods of printing ruled tables of data, geometrical diagrams, accurately divided scales, and instruments of calculation, this was a courageous and innovating enterprise, especially at so early a point in the growth of the art. Müller's ingenuity was equal to the task; moreover, a young Augsburg man then in his employ, Erhard Ratdolt, soon carried his Nuremberg training to Venice, and later back to Augsburg, with such effect as to become the foremost astronomical and mathematical printer of the century; and he inaugurated this career by re-printing at Venice his former master's calendar, just as Müller himself had chosen as the first work for his press an astronomical treatise of his own former teacher at Vienna, Peuerbach. Müller's press lapsed in 1475 when he was summoned from Nuremberg to Rome by Sixtus IV to reform the calendar, and died there; but his quick technical success as a printer, no less than his merit as a chronologer and astronomical reckoner, can be gauged from the slim quarto under review.

Prof. Zinner gives a biographical notice and a clear and helpful commentary on the use and the vocabulary of the facsimile of Müller's (1474) printing of his German calendar, which is prefaced also by a short bibliographical note. Most fifteenth-century calendars were, like ours, for the current year only: they were single broadsides for putting on the wall, and sometimes bore New Year greetings in their initial letter. That of Regiomontanus, however, was a much more thorough-going and more valuable affair. How valuable may be judged from the facts that between 1474 and the end of the century it went through more than fourteen editions—Latin, German and Italian—and that it is recorded to have been used by Columbus and by Vasco da Gama on their voyages. Its first part is a semi-perpetual tabular calendar of twelve leaves, covering especially the two-cycle period from 1475 to 1513. Besides giving full data for the days of the week and month, Church feasts fixed and movable, the courses of sun and moon and the hour and minute of new and full moon at Nuremberg for any year of the period, it gives a conversion table for some sixty other localities, with their latitudes. (The only English place is Ochsenfurt, of lat. 53°—it is now 51° 46′—while Hibernia and Schotlant are both compressed to lat. 59°—about that of the Orkneys. But European cities are better defined.)

There follow orderly predictions of each of the sixty eclipses of sun and moon from 1475 to 1530, giving for each its date, times to the nearest minute, half-duration, and maximum obscuration to the nearest 1/12 diameter, this latter being also depicted by a large and exact woodcut in each case. The explanatory text follows, in a kindly Bavarian dialect—"nach meinem slechten tewtsche und chlainem vermögen"—and goes on, with tables, to define the paths of sun and moon up to 1532, including a short divagation on the best times for letting blood, which is the only relic of astrology admitted by this scientific observer.

Finally, there are instructions on the making and use of sundials and other chronological instruments, the woodcut patterns of which form the last four of the thirty leaves. One of these has three concentric disks with circularly graduated scales, two of which can be rotated, for the purpose of reading off corresponding values, on a central thread dangling from the leaf. The fourth cut lacks in facsimile what still survives in some originals as a most unusual component of any book, a doubly pivoted brass arm with a radial cord; but such an omission can scarcely be grudged, and is made good by Prof. Zinner's account of it in the preface.

The whole facsimile seems to be scrupulously exact (except, naturally, that it does not attempt to imitate the paper or the quiring of its original). Mention must also be made of the very agreeable roman fount in which the modern introduction is set. One's only qualm is caused by the price, which is likely to prevent the edition from doing what it was meant to do; and one may venture the hope that the Gesellschaft für Typenkunde will make the margin between cost and purchase-price as small as possible, so as to ensure the wide sale which this promising series deserves.

IRVINE MASSON.

Clinical Studies of the Heart

Diseases of the Heart:
described for Practitioners and Students. By Sir Thomas Lewis. (Department of Clinical Research, University College Hospital, London.) Second edition. Pp. xx + 297. (London: Macmillan and Co., Ltd., 1937.) 12*s*. 6*d*. net.

THE first edition of this book was published in 1933; it was reprinted in 1933 and in 1934, and translations have also been made into German, Dutch, Italian, Spanish and Portuguese, sufficient proof of the help which medical men all over the world have found in its teaching. A second edition has now appeared, though with few changes requiring note. The printing is on a slightly better paper which gives a most comfortable page for the reader's eye, but the illustrations are all unaltered and the only part that has been freely re-written is the chapter on pericarditis.

Research in heart disease has not slackened during the five years since the first edition came out, but Sir Thomas Lewis has not spoiled his book by yielding to the ordinary temptation to add to it every new theory or observation, irrespective of whether it has been fully tested and proved to be of value to the medical man. Even for that much debated and common malady, high blood pressure, he is content to describe its features and treatment, while for its cause he states with simple brevity, refusing all discussion of theories, that it has not yet been discovered.

The bane of most of the modern text-books of medicine is their incomprehensible comprehensiveness. Every rare event or complication is mentioned, to lie there for reference; every remedy that has been tried is listed; and all the modern as well as many of the older theories of causation are cited, often with only the labelling name of the sponsor of each as though that were enough for the sorting of such baggage without any description of contents. The accumulated mass hides the thought of the writer and chokes the reader's mind.

Lewis has deliberately avoided these faults. "An ideal that I have striven hard to attain is simplicity in teaching"—that is the wish emphasized in the preface to his book, and he has achieved it by restricting himself to a clear, though of necessity dogmatic, statement of his personal ways of thought and practice. But his views are those of a master of the subject, both in its experimental and clinical aspects, who for thirty years has continued to publish a succession of monographs and papers describing the rigid scientific analysis of problems dealing with the heart and circulation, and who through all that time has sought to translate such refinements of knowledge into practical modes that will guide thought and observation at the bedside to an equal scientific accuracy.

It may be recalled how Lewis's "Mechanism of the Heart Beat", an elaborate treatise on electrocardiography, was followed a year later in 1912 by a booklet of 100 pages on "Clinical Disorders of the Heart Beat", which gave to medical men the simple rules that all have since adopted for analysis at the bedside, without electrocardiograms, of the ordinary irregularities of the pulse. His present text-book on the whole subject of diseases of the heart summarizes the new attitude to those clinical problems that he himself has progressively taken and described in a series of papers with such clear argument that it has already been accepted by many leading teachers throughout the medical world. He writes with the aim of showing medical practitioners how to deal with living patients, of making them alert to judge each symptom that can tell of derangement of function in the living man; and so he refers but little to the older classifications of disease that were based on the isolated anatomical lesions to be revealed after death. Morbid physiology rather than morbid anatomy is the derangement that the clinician is invited to study and seek to correct. With all possible simplicity, this central idea is developed in its logical sequence through each chapter of the book.

For the reader who can forget much that he has been taught in the past, and look on his own clinical experiences in this fresh light, the book is an inspiring guide. Sir Thomas Lewis has thought as a physiologist, but his clinical work has always driven him to find out the meaning of physiology for practical medicine; and his matured teaching in this book has the conciseness gained by twenty years of testing and shaping it against the minds of his undergraduate students at University College Hospital. It is a model of what clinical science can achieve to help the practising profession.

Polymerization

Polymerization: and its Applications in the Fields of Rubber, Synthetic Resins, and Petroleum. By Prof. Robert E. Burk, Howard E. Thompson, Archie J. Weith, and Ira Williams. (American Chemical Society Monograph Series, No. 75.) Pp. 312. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) 37*s*. 6*d*. net.

THE chemist at one time was mainly engaged in analytical activities; since 1900 he has set to work to make in the laboratory the less complicated natural crystalline substances of which he had discovered the constitution. Now that this task is largely completed, the urge is to polymerize, which means to build up very large molecules of amorphous colloid character, starting, however, from relatively simple substances. Promising fields of practical application of such effort have been found in rubber, synthetic resins and petroleum. This book deals with these; their magnitude and complexity are witnessed by the fact that four authors are required, whose names are attached to their respective chapters.

An immense amount of work has evidently been done in mastering the literature of the subject and sorting it into an accessible form, and perhaps chief praise will be given to the chapter headed "Catalysis and Polymerisation" by R. E. Burk, in which a table some sixty pages long is given, listing in alphabetical order the polymerization catalysts, the conditions under which they are used, the compounds polymerized and the results obtained.

Reference to this list is facilitated by a special index of the compounds. The research worker who uses it is able either to choose the best catalyst for a specific purpose or to ascertain the various methods of polymerizing a particular substance: references are given to the original papers. The chapter might appropriately be headed "Polymerization made easy" in view of the immense amount of time it is going to save for future workers.

Prof. Burk is responsible for the chapters on the mechanism of polymerization and the structure of polymers.

The second half of the book deals with the specific industries, rubber by I. Williams, resins by A. J. Weith and petroleum by R. E. Burk. The first two are engaged in the respective industries, and may be judged competent to give reliable and practical reports.

There is a useful theoretical chapter by H. E. Thompson on the relation between molecular structure and polymerization.

The book will undoubtedly command a wide and appreciative public among present and future 'polymerizers'.

E. F. A.

Entwicklungsbiologie und Ganzheit:

ein Beitrag zur Neugestaltung des Weltbildes. Von Prof. Dr. B. Dürken. Pp. vi+207. (Leipzig und Berlin: B. G. Teubner, 1936.) 6.80 gold marks.

THIS book is addressed not so much to the professional biologist as to the intelligent public and the philosopher. Its aim is to discuss anew what sort of mental picture we shall form of living organisms, and thus what kind of problems we shall formulate about them and what kind of answers we shall consider satisfactory. The question is discussed primarily with reference to the data of experimental embryology, which have so often led to similar disquisitions in the past. The fundamentals of our knowledge in this field, including the more important recent advances, are very clearly summarized in the middle section of the book, and this forms a valuable introduction to the subject, illustrated with admirable diagrams.

The philosophical point of view of the author is that of *Ganzheitsbiologie*, which corresponds more or less to what is known as organicism in Great Britain. This involves a rejection of both vitalism and mechanism, which, it is claimed, are characteristic products of the last century, with its over-emphasis on elementary particles. Biology, and the whole outlook of the present day, require a totally different method of approach, which is formulated thus: "The whole is not determined by the specific characters of its parts, but conversely the specific character of the parts depends on the primary whole".

There is probably, in spite of Viennese philosophers, a certain meaning and even truth in this statement. But what is required at the present juncture is an exact definition of what is meant by the 'primary whole'. Until this is provided, the statement is so vague that almost any conclusion can be drawn from it at will. In this book there creeps in at the end the deduction, which most scientific workers will have learnt to regard with some suspicion, that "Gemeinnutz geht vor Eigennutz". But in general the book is free from obvious politics.

An Introduction to Projective Geometry

By C. W. O'Hara and D. R. Ward. Pp. ix+298. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 12*s*. 6*d*. net.

THIS text-book should evoke in the student a realization of the infinite possibilities opened up by the many geometries included in the general scheme in which the classical geometry of his curriculum occupies a very subsidiary place. Starting with the initial propositions of incidence of lines and points, the synthetic method is developed up to the interpretation of the more complex properties of the conic. Then, co-ordinate systems are introduced projectively, to lead to the definition in projective terms of distance and angle. The various metrical geometries, both Euclidean and non-Euclidean, are discussed, and Euclidean geometry is shown to be a special case of the general projective metrical geometry.

The authors maintain that in two-dimensional projective geometry most of the fundamental ideas pervading the whole subject are developed, and that an introduction to these ideas in the simplified fields of points and lines is better than in the more complicated fields of the higher dimensions. In the last chapters, possible developments are indicated and the application of the subject to physical geometry is shown. Furthermore, the part played by the special theory of relativity in the theory of physical geometry is shown to be an application of the principles which have been developed in the book.

The book is intended for scholarship candidates and first-year university students. A. v. Z.

Einführung in die chemische Physiologie

Von Prof. Dr. E. Lehnartz. Pp. viii+420. (Berlin: Julius Springer, 1937.) 19.60 gold marks.

AN enormous amount of information has been packed into this attractively produced volume. The first hundred pages give the chemical structure of all the more important substances found in living tissues. Forty pages are devoted to physical chemistry. Vitamins, hormones and enzymes are then discussed in separate sections, and the last 130 pages are devoted to metabolism. Generally speaking, the book is very complete and up-to-date (1937) and is clearly based on a wide knowledge of the German literature, but the work of Rowntree on the thymus, for example, is omitted, presumably because the results were published in America. The author is to be congratulated on the tables he gives showing the distribution of vitamins in different foods. A few years ago such tables were vague and qualitative, but so much progress has been made recently, that it is now possible to give the actual concentrations of vitamins A, B_1, B_2, C and D in terms of the weight of vitamin in 100 gm. of material.

The main users of this book, in Great Britain, at any rate, will probably not be biochemists, but those others whose research work sometimes brings them in contact with biochemical problems. Information is easy to find and references are given, not to original papers, but to more complete monographs.

Schwingende Kristalle:

und ihre Anwendung in der Hochfrequenz- und Ultraschalltechnik. Von Prof. Dr. Ludwig Bergmann. (Mathematisch-Physikalische Bibliothek, Reihe 1, Band 93.) Pp. 47. (Leipzig und Berlin: B. G. Teubner, 1937.) 1.20 gold marks.

THIS is a remarkable *tour de force*. In five brief but lucid chapters on piezo-electric phenomena, piezo-electric crystals in high-frequency fields, the application of oscillating crystals in high-frequency technique and electro-acoustics, the applications in ultra-sonic technique and the significance of ultrasound in science and technics, the author presents a simple and amazingly complete picture of the applications of oscillating crystals. The book has a wealth of illustrations (more than one per page of text), of which neither half-tones nor line diagrams suffer any loss in value from the smallness of size which is imposed by the attractively compact form of this popular monograph.

Crop Production without Soil

By Prof. W. F. Gericke, University of California

THE tenets of water culture are known to plant physiologists from an extensive literature. The first papers appeared more than three-quarters of a century ago. Although water cultures are used widely in experimental studies of plant physiology and soil science, the literature is singularly devoid of any suggestion of the economic possibilities of the method—crop production without soil. A brief paper in 1929 was the first announcement that crop production by water culture is practicable[1]. Beginning in 1935, a number of growers, convinced that the method had possibilities, established the first production plants; these are under the author's supervision and, although organized as commercial ventures, are administered as the author's experiments. The largest plant covers two acres.

While a history of the development of the economic use of water culture would not be complete without mention of the laboratory experiments, nevertheless the idea was not born wholly out of the laboratory concepts. Crop production by water culture is not a large-scale use of previously employed technique. Much of the idea was developed from extra-laboratory observations and considerations, from studies and analyses of the physiological and ecological conditions of practical farming operations; and these gave the cue to the devising of suitable techniques, and providing favourable ecological conditions. The technique of the laboratory as heretofore used and that of practical operation differ not only as to physical features but also primarily in physiological concepts and interpretations.

With the establishment of the economic use of water culture, it appeared well to have a word that would distinguish between the two uses. It was found that 'aquiculture' had already been appropriated. 'Hydroponics'[2] was then suggested by Dr. W. A. Setchell, University of California, to designate the "art and science of crop production in liquid culture media". The term 'water culture' can thus be reserved to its historic use and meaning—the growing of plants in nutrient solutions for experimental studies in plant physiological laboratories.

In order to prove the economic feasibility of water culture, evidence was needed that yields sufficiently large were possible to warrant the investment for the equipment required. Consequently, experiments were designed to obtain data on productive potentiality of unit areas of nutrient water surface so that comparison could be made with known production by agriculture.

The 'limiting factor' in yields by agriculture in climates suitable thereto are usually pedological. If these inhibitions could be overcome by water culture, then it should be possible to increase yield per unit area of surface by closer spacing of the plants. Increase in yield would then simply be a function of increase in stand, granted, of course, that the individual plants grown by water culture are as good as those grown by soil. Experiments showed it was possible to use closer spacing for some crops in hydroponic production than in field production; this gave, therefore, expectation of corresponding increase in yield.

Crop production comes as the result of many processes, some of which oppose each other in operation. Ideal conditions could not be prescribed from the findings of laboratory experiments, because these were designed to study specific plant processes as phenomena more or less detached from their agricultural concept and interpretation. Ideal conditions for crop production are virtually compromises between or among various opposing elements and represent essentially the best coordination which the circumstances permit of all important growth-affecting factors. The physiological basis of hydroponics lies in the functions of cultural technique and equipment, designed to obtain yields of crops which, when measured by the standards of the farmer, compare favourably with those of agriculture. Heretofore no comparison was possible because the scale of the water culture experimentation employed in plant physiology laboratories was far too small and restricted to warrant interpretation of data in the standard of the farmer's 'yield per area'. But more serious, however, was the fact that the ecological conditions created by the technique used was quite foreign to the natural pattern for plant growth, so that the data had very restricted interpretation and application. Essentially it was not the physical limitation of size of equipment used which obscured the productive potentiality of water culture, but rather that small size created unfavourable ecological conditions. These in turn created physiological limitations.

While the importance of climatic and ecological conditions to crop production is so widely and generally recognized that it seems presumptuous to make allusion thereto, nevertheless, in view of the historic use of water culture in scientific studies, it appears not out of place to direct attention to the conditions under which the experiments were conducted, and invite comparison of the laboratory with that of Nature. Essentially, the temperature of the soil, except the surface layer, does not vary from day to day; the air temperature varies according to the diurnal changes of solar radiation. It follows, therefore, that the gradient of the root-top temperatures of the plants must change therewith. Complete reversal of gradient comes in the course of twenty-four hours wherever a marked difference prevails in the air temperature of day and night. It is obvious where plants are grown in small containers set on laboratory benches that either a maintained or changing temperature of the room creates a different ecological condition from that which exists in Nature with respect to the root-top gradient. The different parts of most economic plants do not have the same climatic requirements, and consequently cultural technique which exposed the different parts to the same temperature environment cannot be expected to favour growing conditions. The more or less rhythmic change in root-top gradient by virtue of change of the air temperature from day to night and constant root temperature, is an ecological condition that the laboratory climate did not provide.

Classical water-culture experimentation required pure or refined chemicals, pure water, and glass or glazed earthenware containers which resisted solvation. The nutrient solutions were therefore of fairly well-defined character and composition. Obviously these materials are economically prohibitive for economic use of water culture. Consequently investigation had to be undertaken to determine the suitability of ordinary and less expensive materials. Hitherto untried materials had to be studied: crude chemicals and ordinary ground water for the nutrient solutions; building materials—concrete, wood, sheet metal, and various plastics for containers; and various kinds of vegetable litter for the seed-bed.

The equipment must supply the functions of a fertile soil—supply vegetation with water, with the necessary elements, and provide support to hold the seed and growing crops in proper juxtaposition to the environment (Figs. 1 and 2); the feeding roots in the water, the root crown in moist porous media above the water, the leaves in the air.

Basins now in use are constructed of the following materials: concrete, wood, sheet metal (iron) and various asphaltic preparations. The concrete basins constructed as trays range from 2½ ft. to 6 ft. in width with 50 ft. as the maximum length of single units. In some cases units are joined end to end, making even longer basins. Also basins 50 ft.×100 ft., providing continuous water surface of 5,000 square feet, are being tried. Wooden basins range from trough-like structures 1 foot wide and 40 feet long to flat tanks 12 feet wide and with length sufficient to provide 1/200-acre water surface in single units. Black iron sheet metal has proved serviceable for smaller basins; the largest used are 2½ feet wide and 10 feet long. Certain asphaltic preparations, where proper care was taken in construction, have made fairly serviceable equipment—that is, more or less durable. The depth of the basins range from 4 inches to 8 inches; 6 inches is probably the most satisfactory for most crops.

Remedial measures taken to overcome harmful substances in the materials were as follows. For the alkalinity of the concrete, leaching with water, treating with acid, and coating with non-toxic, water-resistant paints proved effective. For unknown organic substances that may diffuse from wood, brush treatment with strong alkali solution gave good results. Black iron sheet metal gave no trouble—it is conceivable that iron which has appreciable quantities of zinc, copper, manganese, nickel, and presumably other metals, would give trouble unless the iron is coated with a non-toxic paint or enamel. Some of the asphaltic preparations used were found to be toxic and care must, therefore, be taken in the choice of all asphaltic or bituminous materials which are used as plastics or to coat and waterproof equipment.

While the size of basins in the several plants was determined wholly from mechanical considerations, observations, however, have shown that size has physiological importance. This was suggested in several ways, but the information available does not yet warrant a definite statement.

The seed-bed is a mat of vegetable litter—excelsior, straw, sawdust, peat moss, etc., mounted over the surface of the nutrient solution. It rests on wire netting strongly secured to a portable frame. This rests on the top of the basins. The seed-bed provides support for the seed and growing plants, and by protection against sunlight inhibits the growth of algæ. It also protects against desiccation, and extreme temperature fluctuations. The nature and quantity of litter used reflects itself in the water-air properties of the seed-bed and thereby affects ecological conditions. The greater the amount of water that can be held in the seed-bed, compatible with good air supply therein and with other plant requirements, the less fluctuation will there be in the temperature of the roots and of the root-crowns of the plants with changes in the air temperature, because of the high specific heat of water. The root-crown requires different ecological conditions from the feeding roots immersed in the solution. Classical technique with the plants held in the solution by a nonporous support precluded the attainment of these important conditions.

The elements essential to plant growth in liquid culture media are generally known. These elements can be grouped into three classes. First those required in fairly large amounts, which can be supplied in considerable excess without toxic effect, and each of which is absorbed in varying quantities, so that the composition of the plants will thereby vary; these elements are nitrogen, phosphorus, potassium, calcium, magnesium. Their range as possible variants in the plant composition must be considered in devising formulæ. In the second class is the element which can be supplied in large excess without toxic effects and is not absorbed in markedly varying amounts, hence is a minor variant in plant composition. This element is sulphur; the sulphate, therefore, becomes in effect a balancing agent. The third class includes the elements required in small amounts and which are toxic if the concentration exceeds certain low values—fractions of a part per million. These elements are iron, manganese, copper, zinc and boron.

The salts should be chosen so that mixtures can be made which will conform in a general way to the proportions found in the composition of the plants, considered as the aggregate of the compositions of different parts. The salt which provides the cation required in largest amount shall provide the anion required in largest amount. Likewise the cation required in smallest amount can be supplied with the anion required in smallest amount, and for those elements between these extremes, the same principle holds. Thus, potassium nitrate, calcium phosphate, and magnesium sulphate are the chief commercial sources of the major elements. In the original experiments, magnesium phosphate and calcium sulphate were used instead of the last two of the above, but, inasmuch as the desired combinations can also be obtained from chemicals already extensively used as land fertilizers, the former set is recommended. Whenever it is desirable to have some combinations which the above three salts cannot provide, a fourth salt can be added; sulphuric acid is added to the mixtures to obtain any required reaction. Sulphates as already noted are not absorbed in great excess of the plants' need and, therefore, large quantities can be used if necessary. The sources of the minor elements is essentially immaterial, unless plant products relatively high in

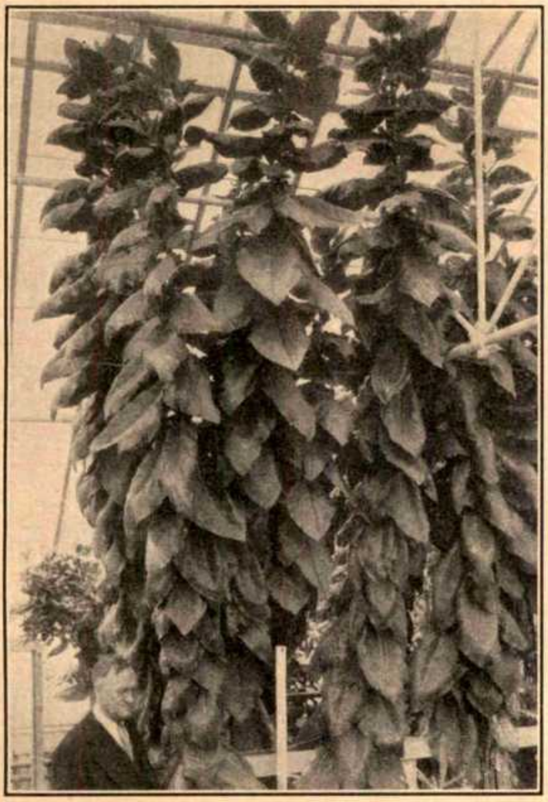

Fig. 1.
TANK OF TOBACCO.

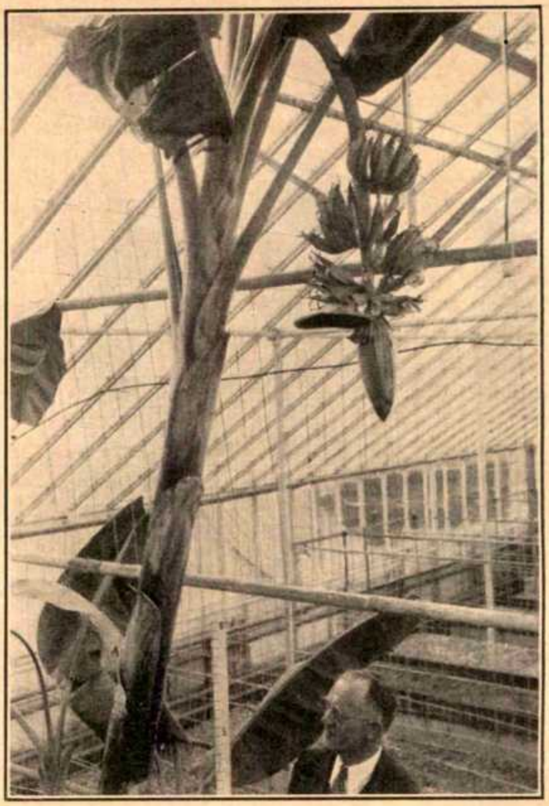

Fig. 2.
BANANA, ONE YEAR FROM BUD.

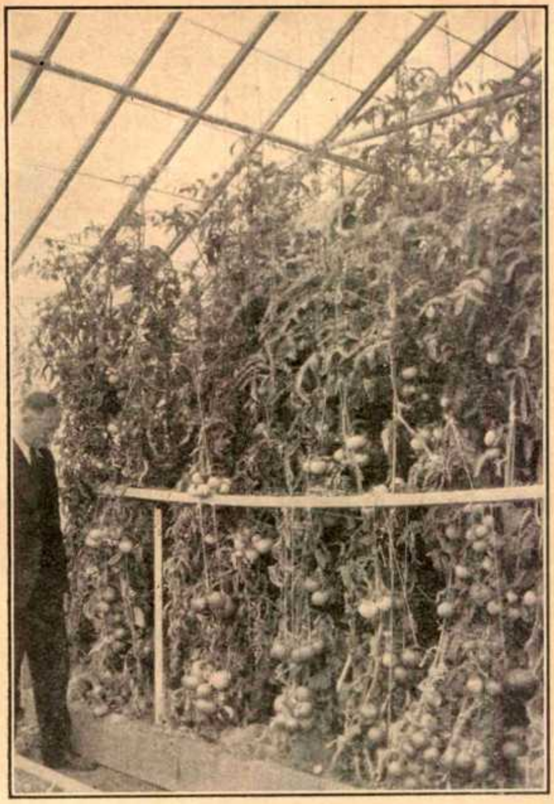

Fig. 3.

TOMATOES, 4¾ MONTHS AFTER PLANTING.

some of these elements are desired. In such cases one would choose the least toxic forms, which in some cases would be organic compounds.

The purpose of having the nutrient solutions conform as nearly as possible to the composition of plants, is to preclude excessive absorption of certain elements causing an abnormal composition. The fact that plants vary as to composition is in itself evidence that nutrient solutions, somewhat different in chemical composition from those compounded by the principles stated above, will support plant growth with more or less satisfactory results. But excessive absorption of any element, especially in the early growth stage, may have unfavourable effects on subsequent plant activities. On the other hand, the early growth stage is also most labile, permitting use of stimulatory conditions which can be very beneficial if not too greatly prolonged. For example, a relatively large supply of certain elements in the culture during the early growth stage, which in case of nitrogen could be supplied both as cation and anion, and more or less complete absence of them in the latter growth period, will be more effective for certain crops than a maintained supply—the quantity absorbed being equal in both cases.

Answer to the question "How much plant food shall be added to a given quantity of water ?" can be given by the description of experiments with some of the crops, for example, with tomato (Fig. 3) : 20 plants set in a basin 10 feet long, 2½ feet wide, and 8 inches deep (thus 16⅔ cubic feet of water) received nutrients in 1-pound lots, supplied as a mixture of dry salts. When the plants were about two months old, the nutrients were practically exhausted and then another pound was added. Subsequent additions were made at shorter intervals, 7 pounds being the total amount supplied; but the solution was exhausted two months before the experiments were concluded, being then one year old. (The average yield of ripe fruit per basin was 306 pounds—more than five sixths of the total was harvested nine months after planting. There were four basins, each a different treatment; the largest yield was 532 pounds. The basins, including space between, occupied 130 square feet of greenhouse floor.) No difference was noted when smaller applications were made at frequent

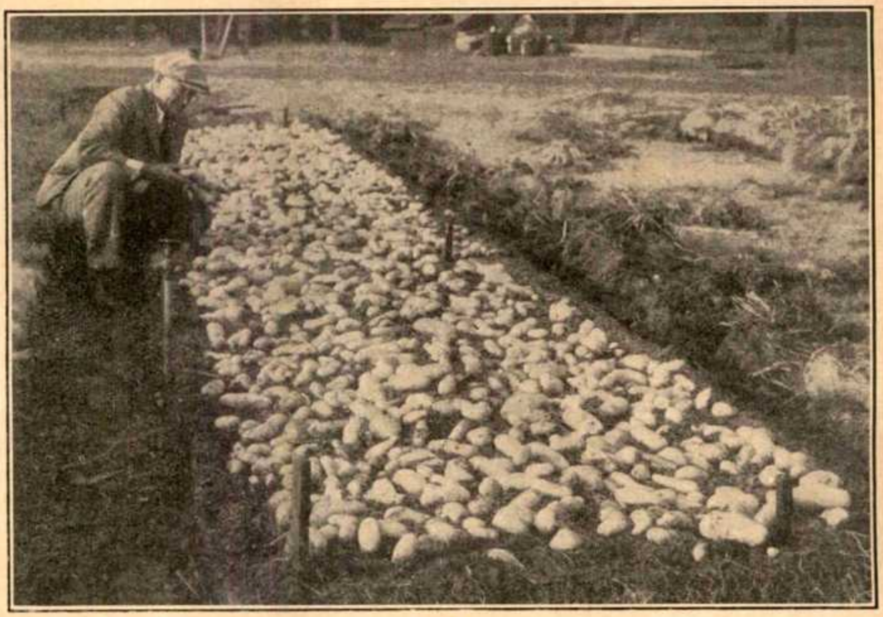

Fig. 4.

HARVEST OF 1/100-ACRE POTATO CROP, 18 WEEKS AFTER PLANTING.

intervals or larger applications at less frequent intervals. Apparently any concentration within the range defined for the lower limits of about half a pound, and the upper limit of about two pounds per 16 cubic feet of water, gives satisfactory results. This means that the stirring in of additions of nutrients was not necessary; the mixture was merely added at one point. Obviously there is a practical limitation to the distance salts will diffuse and consequently appropriate means must be employed where large basins are used.

A field of 1/100 acre area planted to potatoes produced a yield of 24·65 bushels, or 1,479 pounds (Fig. 4); 40 lb. of chemicals was used. This experiment was in 1934. In subsequent trials each year thereafter, the above-stated large yields were not obtained; apparently certain features of the techniques, ideal in 1934, did not produce ideal growing conditions in the subsequent tests. I believe, however, that the technique can be designed to obtain consistent results with the potato.

The retail market price of the chemical used in largest amounts, and the most costly, namely potassium nitrate, was 70 dollars per ton. Chemicals were of the grade used in compounding fertilizers for land.

The greatest item of cost in crop production by hydroponics is the investment in basins. Also the cost of the chemicals will be a major item in some crops. For example, about two pounds of chemicals were required to produce four pounds of dry wheat grain. Even though the yield per unit area of water surface in basins of the size mentioned for tomatoes was exceptionally high (computed to acre basis it was 142 bushels), the ratio of the quantity of plant food required (at first glance one may think this quantity too high; the weight of oxygen accounts for the apparent large quantity of plant food required) to that of yield obtained makes the cost of production of wheat and other crops that are predominantly 'dry matter' prohibitive by water culture under present conditions. Crops the marketable products of which are characterized by high water, starch, or sugar content, give promise in an economic appraisal of production by hydroponics.

It is, of course, not inconceivable that industry may develop and manufacture equipment at markedly greater economy than prevails at present, thereby increasing the number of crops that can be grown economically.

There are no specific formulæ or cultural techniques that can be prescribed to be followed too literally because of the somewhat unknown character of the materials and equipment that will be used; cultural technique must be designed to meet the conditions where the crops are grown. The principle of making the adjustments, the elucidation of the physiological basis for all features of the method, together with concrete description and data of experimental plants, need to be made available for the guidance of prospective hydroponicists. To provide this is the programme of research now being pursued.

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[1] Gericke, W. F., "Aquiculture—A Means of Crop Production", *Amer. J. Bot.*, **16**, 862 (1929).

[2] Gericke, W. F., "Hydroponics—Crop Production in Liquid Culture Media", *Science*, **85**, 177 (1937).

Centenary of the Atlantic Steam Ferry

IN April 1838, the paddle steamer *Sirius*, 703 tons gross, won for herself the distinction of being the first vessel to cross the Atlantic Ocean under continuous steam power. To celebrate the centenary of this notable achievement, a special exhibition, "One Hundred Years of Transatlantic Steam Navigation", is being held at the Science Museum, South Kensington, and will be open until mid-September, to show in outline the developments that have marked the growth of this service. An illustrated handbook bearing the same title (London: H.M. Stationery Office. 6*d.* net) prepared by Mr. H. P. Spratt, the Museum officer responsible for the organization of the exhibition, gives a brief account of the history of the Atlantic steam ferry together with descriptive and historical notes on each of the steamships represented. These exhibit the striking developments which have taken place in naval architecture and in the methods of steam propulsion.

The change from wooden hulls, first to wrought iron construction and finally to steel, is exemplified in the size of the vessels and in new methods of construction. Paddle wheel propulsion gave way to single screws; twin, triple and quadruple screws followed in quick succession. The early engines derived most of their power from the condensation of the steam, and the nature of the evolution was first to simple expansion engines and then to compound, triple and quadruple expansion engines which, in their turn, have been superseded by the Parsons direct-drive, then single-reduction and now double-reduction turbines. It is to be remembered that each of these developments has been due not only to the progress of design but also to the improvements in ancillary departments, such, for example, as the manufacture and treatment of steel and other materials and in the production of accurately cut gears. As a means of visualizing the increase in size of the vessels, it is pointed out that the hull of the *Britannia*—the first of the Cunarders, 1,156 tons, built in 1840 at Greenock—could be fitted into the restaurant and foyer of the R.M.S. *Queen Mary*.

A visit to the exhibition is most instructive, as it epitomizes in the models which have been gathered together from various sources these and other aspects of the technical developments which the century has witnessed. A visit is the more desirable in that such an opportunity of seeing so many closely related models in so favourable a setting can only occur at rare intervals. As the models are, with a few special exceptions, to the same scale of 1 to 48, it is possible to obtain a clear idea of the relative sizes and forms of these historic vessels. Among them are several foreign ships, notably the *Bremen*, the *Conte di Savoia*, and the *Normandie*, while another exhibit which has a special importance as the representative of steam's competitor in ship propulsion is the model of the Swedish diesel motor-liner *Gripsholm*. The *Conte di Savoia*, built at Trieste in 1931, was the first Atlantic liner to be fitted with gyroscopic stabilizers. These were made in England and the installation is calculated to limit the roll of the ship to 3° on either side of the vertical.

As to which is the most interesting vessel represented, opinions differ, but the *Great Eastern* (1858) has some claim as being a premature leviathan conceived and built forty years or so in advance of practical experience. She was designed by Brunel and was about five times the size of any then in use. Built at Millwall, many unsuccessful attempts were made to launch her, and finally she was launched sideways into the Thames. A unique feature was that she was propelled both by paddle wheels and a screw propeller. The paddle engines of 3,411 I.H.P. had four oscillating cylinders and received steam at 24 lb./in.^{2} from four double-ended tubular boilers of box pattern. The screw engines of 4,886 I.H.P. had four horizontal direct-acting cylinders and received steam at 25 lb./in.^{2} from six double-ended tubular boilers. Though she had no commercial success as a liner, she did most valuable work between 1865 and 1873 in laying a number of submarine cables. Not until the *Oceanic* was built in 1899 was the size of the *Great Eastern* exceeded.

As a further mark of the importance of the occasion, a lecture entitled "The Centenary of Transatlantic Steam Navigation" was delivered before the Newcomen Society at the Science Museum on March 16 by the president, Engineer Captain E. C. Smith, in which he dealt particularly with the construction and experiences of the early vessels on this service. Prior to 1838, many voyages across the Atlantic had been made by steam-engined vessels, but so far as it is known, all were made partly under sail. The first three to cross by steam power were the *Sirius*, built for the London and Cork service, which arrived off New York on April 22, 1838, the *Great Western*, built for the Atlantic service, which arrived on the next day, and the *Royal William*, also built for the Atlantic, which after some misfortunes completed the crossing on November 23. These vessels were, in a sense, sailing ships, as they carried sail and took advantage of the wind, but they were intended when necessary to steam against wind and sea. Therefore, although in effect sailing ships fitted with engines, they embodied important constructional modifications so that they could carry the machinery stresses and bear the severe shocks inevitable in a seaway. Sleepers or platforms were built in to carry the boilers and engines, strong beams were necessary to support the paddle shafts and the sponsons housing the paddle wheels. Sir Robert Seppings, surveyor to the Navy, was responsible for many of the devices adopted, and it was he who introduced a method of fitting the frames close together and caulking them to form a solid hull before the external planking was fixed. He also devised an arrangement of internal diagonals, which later took the form of diagonal iron bars, so as to make the hull a rigidly trussed structure.

Early engines were very similar to the land engines made by Boulton and Watt, of the two cylinder side-lever type with cranks at right angles, and used steam at a pressure of 2–5 lb./in.^{2} Condensers were essential at first as the bulk of the power was derived from the vacuum; later they were discarded and afterwards were re-introduced. Sea water was used in the boilers, which were practically rectangular tanks with internal flues. It was an important duty of the engineer to keep the density of the water low to prevent incrustation. Three methods were in use, the earliest being to stop the engines every third or fourth day, empty the boilers and refill from the sea. This was superseded by frequent blowing down which, in turn, gave place to the use of brine pumps.

The reprint of the lecture contains extracts from the "Field Papers" preserved in the Science Museum Library, which give much information not obtainable elsewhere on this subject.

A contemporary view of the prospects of the Atlantic crossing under steam appears on p. 566 of this issue.

Obituary Notices

Mr. T. W. F. Gann

We regret to record the death of Mr. Thomas William Francis Gann, archæologist and explorer of Central America, which took place in London on February 24, in his seventy-first year. He was the son of William Gann of Whitstable, and was born at Murrisk Abbey, Co. Mayo, the home of his mother, who before her marriage was Miss Rose Garvey.

Gann was educated at King's School, Canterbury, and at Middlesex Hospital, where he qualified as M.R.C.S. and L.R.C.P. in 1890. Later he went to Central America with a medical expedition to relieve distress after an earthquake in Guatemala, and from that time forward his life was devoted to Central American studies. He entered the Government service of British Honduras at Belize, becoming in due course principal medical officer of the colony and a member of the Legislative Council.

Although Gann was keenly interested in the study of tropical medicine, he was even more deeply devoted to study of the archæology of the Mayan civilization of Central America. Taking advantage of the numerous journeys to various parts of the colony, which it was necessary for him to make, he explored the country for previously unrecorded ruins, at the same time observing the character and customs of the natives, which he appreciated might serve to throw light on the peoples of the ancient civilization. It was not long before he was recognized as an authority on Central American archæology. He contributed papers to the British Association and the publications of the Smithsonian Institution of Washington, and later was appointed lecturer on Central American archæology in the University of Liverpool. In 1926 he represented the British Government at the International Congress of Americanists in Rome.

After the Great War, Gann's work, already recognized by specialists, became more widely known through the travel books of a semi-popular character which appeared annually over a number of years. In each of these he described a journey of archæological exploration which he had made in the preceding year, and on nearly every occasion he had some outstanding discovery of previously unknown ruins to record. Of these, one of the most remarkable was the city of Coba, with its wonderful stone causeway of approach, extending for many miles. He also discovered some important date-inscribed stelæ, one of which was deciphered as giving the earliest date in Mayan chronology then known. As Captain T. A. Joyce has pointed out, it was owing to his interest in following up rumours of ruined cities in the depths of the tropical forest that attention was directed to the remarkable series of stone buildings which link the temples of Yucatan to the ancient Mayan centres of Guatemala and Honduras. Gann also shared in the work of the British Museum's expedition, of which Captain Joyce was in charge, when the great ruins of Lubaantum, Pusilhà and Minanhà were excavated and explored. An explorer rather than an excavating archæologist, owing mainly to lack of opportunity, Gann was conspicuously generous in placing his knowledge at the services of others whose opportunities were more favourable. His collections enrich both the British Museum and the Liverpool Museum.

In addition to the series of volumes recording his journeys of exploration, and papers in the journals of learned societies, Gann was the author of a number of works dealing with Central American archæology and prehistory, of which the latest was "Mexico from the Earliest Times to the Conquest" (1936). With J. Eric Thompson he also wrote "A History of the Maya" (1931).

Dr. Francis G. Pease

The Mount Wilson Observatory has suffered a severe loss by the death on February 7, at the age of fifty-seven years, of Dr. Francis G. Pease.

For many years Dr. Pease was in charge of instrument design at the Observatory. When the United States declared war in 1917, he became chief draughtsman to the National Research Council, Washington. He gave a great deal of thought to the design of very large telescopes, and his investigations showed that the construction of a 200-in. telescope presented no insuperable difficulties : he has been closely associated with the design of this telescope, which is to be erected on Mount Palomar.

Dr. Pease did a great deal of nebular photography, and many of his beautiful photographs of nebulæ are celebrated. He determined the line-of-sight velocities of a number of the extra-galactic nebulæ and investigated the rotation of some of them. In association with Dr. W. S. Adams, the spectra of various novæ were obtained after the novæ had become faint, and the novæ were shown to have become Wolf-Rayet stars.

Dr. Pease collaborated with Prof. Michelson in the application of the interferometer to the measurement of stellar diameters. With a special interferometer, 20 ft. in length, mounted on the end of the tube of the 100-inch telescope, he succeeded in measuring the angular diameter of Betelgeuse on the night of December 13, 1920, a memorable observation because it was the first measurement of the diameter of a star ever made. The measures of stellar diameters with this interferometer, and afterwards with a specially constructed 50-ft. interferometer telescope, have mostly been made by Dr. Pease. They demanded considerable skill in adjustment and great patience, qualities which Dr. Pease possessed in a unique degree.

When Prof. Michelson repeated the famous Michelson-Morley experiment with a large steel and invar interferometer in the years 1927–29, Dr. Pease collaborated in the observations. The purpose was to investigate the possible ether-drift which D. C. Miller claimed to have established. No displacement of the fringes so great as one fiftieth of that to be expected if such an ether-drift existed was obtained.

Dr. Pease was working with Prof. Michelson on the measurement of the velocity of light, in a pipeline one mile in length evacuated to a pressure of a few millimetres, when Prof. Michelson died in May 1931. This investigation was then placed under the direction of Dr. Pease, who succeeded in holding a pressure of 2–3 mm. in a line built up of 60-ft. sections of steel pipe, 3 ft. in diameter. Multiple reflections from mirrors at the two ends of the pipeline increased the effective length of path. The mean velocity obtained from several sets of measures, comprising in all 2885 determinations, was 299,774 ± 11 km./sec., which must be regarded as the best determination of this velocity. H. S. J.

Prof. Max Neisser

THE death on February 25 of Prof. Max Neisser in his sixty-ninth year creates another blank in that distinguished roll of German bacteriologists who have occupied chairs of hygiene modelled on the Koch tradition. The name of Neisser bulks largely in bacteriological literature. Albert Neisser of Breslau, the discoverer of the gonococcus, was an uncle of Max; and the veriest tiro in bacteriology is, at a very early stage, introduced to at least one achievement of the latter—the Neisser stain for *C. diphtheriæ*.

Born in 1869 at Liegnitz in Silesia, Max Neisser removed with his parents to Berlin, where he received his schooling and his medical training. The work involved in the preparation of his thesis for the doctorate in medicine, which he obtained in 1893, was carried out in Rubner's laboratory. In 1899 he met Paul Ehrlich—a great event in his life. In the same year he went to Frankfort-on-Main, where he was given charge of the department of bacteriology and became a professor in 1901. In 1909 he was appointed director of the new Städtisches Hygienisches Institut, later to be named the Stadtisches Hygienisches Universitats-Institut when the University of Frankfort was founded in 1914.

During the Great War, Neisser did valuable service first in a field dressing station and later as a consultant on hygiene.

When the War ended, Neisser returned to his professorial duties, resumed his scientific work, and took a prominent part in the organization of public hygiene in Frankfort. In April 1933 he retired, at the age of sixty-three years, and has since held the title of professor emeritus.

Since he embarked on his research career forty-five years ago, Neisser has been a most devoted and assiduous student, and his contributions, which cover a surprisingly wide range, embracing bacteriological, immunological and hygienic studies, have been many. Before me is a list of no fewer than 156 titles of contributions by him in the period 1893–1935. Here I can do no more than refer briefly to some of the more outstanding achievements to his credit in the field of bacteriology and immunology.

His sojourn at Breslau under Flugge in the closing years of the nineteenth century gave Neisser an opportunity of studying what was then a very acute and pressing problem, the differentiation of diphtheria bacilli from other diphtheroids, and the elaboration of a working technique for use in institutions concerned with the diagnosis of diphtheria.

The well-known Neisser stain for demonstration of the metachromatic bodies in diphtheria bacilli dates from this period. As one of Ehrlich's band of workers in the Frankfort Institute, Neisser, with his colleague Wechsberg, took a prominent share in those pioneer studies conducted under Ehrlich's guidance on the nature and mode of action of hæmolysins, antitoxins and bactericidins in immune sera during the early years of the present century. The Neisser-Wechsberg phenomenon (1901), which disclosed the fact that excess of immune body in relation to available complement interfered with bactericidal action, was an important outcome of this period of his activity. Its precise mechanism is perhaps not even now elucidated and may have to await progress in the physicochemical attack now being made on the nature of antigen-antibody combinations.

Neisser devoted much attention to the elaboration of accurate plating technique for evaluating bactericidal action, and in connexion with the staphylococcus, on which he wrote widely, he explored with Wechsberg the possibility of detecting by aid of methylene blue the killing power of staphylococcal leucocidin on leucocyte suspensions (so-called bioscopic method).

In 1903 Neisser's demonstration of the fact that influenza bacilli can be grown on ordinary agar in symbiosis with *B. xerosis* is of considerable historical interest in the light of later developments in our knowledge of the essential growth factors of the hæmophilic group of organisms.

In 1906 a most interesting and fruitful field in bacterial variation was opened up by Neisser's observations on an organism (*B. coli mutabile*) which, when grown on lactose-agar, was capable of throwing off variants endowed with the power of fermenting lactose. The analysis of this 'mutation' phenomenon, pursued by Massini and Reiner Muller and particularly by Penfold in Great Britain, added much to our knowledge of variation phenomena in bacteria, in so far as their fermentative properties are concerned.

During the period of his directorship of the Hygienic Institute (1909–33), Neisser's activities, so far as one may judge from the titles of his numerous papers, were, for the most part, bound up with problems of public hygiene over which he freely ranged, the care of the tuberculous, milk provision, bacteriological water analysis, disinfection and water purification being particularly favoured subjects. In the later years of his directorship he devoted much attention to the possibilities of water purification by employing the bactericidal action of silver ions.

There can be no doubt that Max Neisser was an unusually gifted and versatile occupant of the first Frankfort chair of hygiene, beloved of his students and ever ready to spend himself freely in furthering every project likely to raise the standard of public hygiene in the city of his adoption. J. C. G. LEDINGHAM.

Dr. Gilbert Slater

We regret to record the death of Dr. Gilbert Slater, the economist and an authority on the culture and village life of southern India as it existed twenty years ago, which took place at Oxford on March 8 at the age of seventy-three years.

Slater was born in Plymouth on August 27, 1864, the son of Daniel Slater, a schoolmaster. A member of St. John's College, Cambridge, he was also a D.Sc. in Economics of the University of London, a degree to which, however, he was admitted so late as 1905. After leaving Cambridge he was for a time a schoolmaster; but he left the profession to take up lecturing, social work and political activities. In 1905 he was elected the first Labour mayor of Woolwich. The publication of his doctor's thesis in enlarged book form under the title "The English Peasantry and the enclosure of Common Fields" (1907) led to his appointment as head of Ruskin College, Oxford, in 1909. Here he remained until 1915, when he accepted the newly founded chair of Indian economics at the University of Madras. In 1921 he became publicity officer for Madras and a member of the Legislative Council. Slater returned to England in the following year, and in addition to lecturing at the London School of Economics and to Indian Civil Service students at Oxford, wrote a number of books on social and economic subjects, among which may be mentioned "The Growth of Modern England" (1932) and a final work on India, "Southern India, its Political and Economic Problems" (1936), as well as a chapter on the social and industrial history of Kent in the Victoria County History.

Of Slater's more active years, viewed in relation to scientific thought, the period which he spent in India was the most productive and influential. "Some South Indian Villages" (1917), which he edited, was based on surveys made by his students, whom he sent out with a questionnaire of his own devising to make first-hand observations of conditions in the villages with which each was well acquainted by residence. These intensive studies produced a mass of ethnographic and economic data, variable in quality, it is true, but of very considerable value. In the final form given by the editor, this report has had a profound effect on subsequent Indian political and sociological theory and practice. His analytical faculty also turned to the study of Indian culture and in his "The Dravidian Element in Indian Culture", published in 1923 after his return to England, he gave an orientation to the study of the place of the Dravidians in the development of Indian civilization, which, like his work on the Indian village in its special field, has greatly influenced the development of later Indian studies, although in directing attention to and emphasizing the affinities of the Dravidian and Mediterranean peoples, he was developing ideas already adumbrated by Mr. F. J. Richards, as Dr. A. C. Haddon has pointed out (see "The Races of Man", by A. C. Haddon, 1924, p. 150, where Slater is, curiously, miscalled "Scott").

Mr. F. J. Hanbury

Mr. F. J. Hanbury, who died on March 1 at the age of eighty-six years, was the son of Cornelius Hanbury, of the firm of Messrs. Allen and Hanbury, wholesale druggists. He was educated at the Friends' School, Tottenham, and afterwards studied pharmacy, passing with honours the two examinations of the Pharmaceutical Society. He joined his father's business in 1872, becoming a partner and eventually chairman of the firm in 1916.

In the 'eighties Mr. Hanbury formed a friendship with the late Rev. E. S. Marshall and became interested in British flowering plants. The two explored the northern Scottish Highlands together, and Hanbury began a study of the difficult genus *Hieracium*. Of this group he described several new species, and in 1889 published the first instalment of a sumptuously illustrated monograph. Before this work had proceeded far, however, it was found impracticable to continue it in the manner contemplated, and it was abandoned. Mr. Hanbury then turned his energies to the production of a flora of Kent, with Marshall as collaborator, and this was completed and published in 1899.

From this date Hanbury did little further botanical work, but he continued to act as editor of the "London Catalogue of British Plants". For some time he took a keen interest in entomology, but after his removal to East Grinstead he devoted himself to the development of his magnificent garden and the cultivation of tropical orchids. He was a prominent member of the Royal Horticultural Society, serving on the scientific and other committees, and was a recipient of the Society's Victoria Medal of Honour. He was almost the 'father' of the Linnean Society, which he had joined in 1873. He recently presented to the Botanical Department of the British Museum (Natural History) the important herbarium of Dr. Boswell Syme, which he had acquired many years previously.

H. W. PUGSLEY.

We regret to announce the following deaths:

Prof. J. E. Coover, emeritus professor of psychology in Stanford University, on February 19, aged sixty-five years.

Sir Raymond Crawfurd, registrar of the Royal College of Physicians of London, known for his work on the history of medicine, on March 9, aged seventy-two years.

Sir Reginald Fleming Johnston, K.C.M.G., C.B.E., formerly commissioner for Wei-hai-wei, an authority on the Chinese language and people, on March 6, aged sixty-four years.

Major A. D. Lumb, of the Scientific and Technical Department of the Imperial Institute, known for his work on the geology and mineral survey of southern Nigeria and the Udi Okana coalfield.

Prof. A. Magnan, professor of animal mechanics applied to aviation in the Collège de France, aged fifty-seven years.

Mr. Melville Hilton-Simpson, the distinguished traveller and ethnologist, on March 17, aged fifty-seven years.

News and Views

New Fellows of the Royal Society

AT the annual election of fellows of the Royal Society held on March 17, the following were elected: G. D. Bengough, consultant to the Chemical Research Laboratory, Department of Scientific and Industrial Research; C. H. Best, professor of physiology, University of Toronto; W. Brown, professor of plant pathology, Imperial College of Science and Technology; J. W. Cook, professor of chemistry, The Research Institute, Royal Cancer Hospital; T. L. Eckersley, research physicist, Marconi's Wireless Telegraph Co.; G. I. Finch, professor of applied physical chemistry, Imperial College of Science and Technology; W. E. Gye, director of the laboratories of the Imperial Cancer Research Fund; W. V. D. Hodge, Lowndean professor of astronomy and geometry, University of Cambridge; J. S. Huxley, secretary of the Zoological Society of London; J. Jackson, H.M. Astronomer at the Cape; Sir Robert Mond, chemist and Egyptologist; J. E. Richey, district surveyor, H.M. Geological Survey; F. S. Russell, naturalist at the Marine Biological Association; B. F. J. Schonland, professor of physics, University of Cape Town; F. S. Sinnatt, director of fuel research, Department of Scientific and Industrial Research; K. M. Smith, senior research assistant, Plant Virus Station, Cambridge; E. Stedman, lecturer in the Department of Chemistry in relation to Medicine, University of Edinburgh; C. E. Tilley, professor of mineralogy and petrology, University of Cambridge; W. E. S. Turner, professor of glass technology, University of Sheffield; H. H. Woollard, professor of anatomy, University College, London.

Presentation to Sir Arthur Harden

AT the annual general meeting of the Biochemical Society held on March 11, a presentation was made by the Society to Sir Arthur Harden, on the occasion of his retirement from the editorship of the *Biochemical Journal*. The presentation took the form of an inscribed salver, bearing the signatures of all those still living who have served on the Committee of the Society during the twenty-five years of Sir Arthur's editorship. In making the presentation on behalf of the Society, the present chairman of committee, Prof. H. J. Channon, recalled the early history of the *Biochemical Journal*. Founded by Prof. Benjamin Moore and Mr. E. Whitley in 1906, it was first issued as a private venture from the Department of Biochemistry in the University of Liverpool. In 1911, at the instance of Dr. (now Prof.) R. H. A. Plimmer and Mr. J. A. Gardner, there was formed an organization of biochemists, called at first the Biochemical Club, the members of which soon came to feel the need for a journal to cover the widest interests of the growing science of biochemistry in Great Britain; negotiations were therefore started which led, in October 1912, to the acquisition of the *Biochemical Journal* by the Biochemical Club, which at the same time changed its designation to Biochemical Society; the editors appointed by the newly formed Society were Arthur Harden and William Bayliss. Prof. Channon traced the remarkable growth of the *Biochemical Journal* from its modest beginning to its present position as one of the outstanding biochemical publications of the world, and in thanking Sir Arthur for his great services to the Society he paid an eloquent tribute to his qualities as an editor.

IN supporting Prof. Channon, Sir Frederick Gowland Hopkins emphasized the importance of Sir Arthur Harden's own work in influencing the development of biochemistry in Great Britain, and the advantage which had accrued to that science in its early days from the entry into it of an accomplished chemist. Sir Frederick referred to the sacrifice of time involved for an active investigator in editing a scientific journal; but pointed out that, regrettable as such loss of time might be, it was only an active investigator who could give full and sympathetic understanding to the difficulties of his colleagues in presenting the results of their researches; such understanding Sir Arthur had always given in full measure. Sir Arthur Harden, in acknowledging the presentation, expressed his appreciation of the help which he had received from his various co-editors. Sir Arthur stated his conviction of the importance of free and reasonably detailed publication of results in the development of a growing science such as biochemistry and indicated the way in which as an editor he had attempted to give effect to this conviction. The occasion of the presentation constituted something of a landmark in the history of biochemical publications in Great Britain since the increasing size of the *Biochemical Journal* has necessitated a further subdivision of the editorial work. It will be hoped by all who are interested in the progress of biochemistry that it will be possible under the new arrangements to maintain the high standard which has been reached as the result of Sir Arthur Harden's work during the past twenty-five years.

Dr. W. H. Pearsall

DR. W. H. PEARSALL, whose appointment to the chair of botany at Sheffield has recently been announced, was educated at Ulverston Grammar School and the University of Manchester, where he continued his studies after graduation. In 1921 he was awarded the D.Sc. for his work on the aquatic vegetation of the English Lakes. During the Great War he served with a battery of the Royal Garrison Artillery and later with the Royal Engineers. He joined the staff of the Botany Department at the University of Leeds in 1919 and was appointed reader in 1922. Dr. Pearsall has taken an active part in many scientific societies; he acted as secretary to the Society for Experimental Biologists in 1928–33, and has just completed his term of office as president of the British Ecological Society; this year he has also taken over the editorship of the *Journal of Ecology* from Prof. A. G. Tansley. He acted as joint secretary of the Yorkshire Naturalists' Union with the late Mr. F. A. Mason in 1919–29 and since 1933 has been co-editor of *The Naturalist* with Mr. W. R. Grist; in 1937 he served as president of the Union. From 1931 until 1937 Dr. Pearsall acted as honorary director of the Freshwater Biological Station at Wray Castle, Windermere, where he has taken an active part in organizing most successful short courses in freshwater biology for senior university students; his guidance has also been of great value to a series of investigators, who have studied problems of freshwater biology at this centre.

DR. PEARSALL's published scientific work has been mainly upon problems of ecology and upon various aspects of the physiology of growth in plants, with especial reference to problems of nitrogen nutrition. His work, with which his father was associated at its inception, upon the freshwater biology of the English Lakes, is very widely known. It has provided an admirable basis for many of the more intensive investigations that can now be attempted with the establishment of a permanent centre of investigation upon Lake Windermere. Dr. Pearsall's interests in ecology have ranged very widely; his recent presidential address to the British Ecological Society dealt especially with soil factors in relation to plant distribution. The importance of the oxidation-reduction potential is stressed, and Dr. Misra under his guidance has recently shown the significance of this factor in connexion with the mud deposits in the Lakes. Dr. Pearsall's studies upon plant metabolism have been linked up with his extensive studies of the growth of algæ, especially *Chlorella*, in pure cultures. This work has been extended recently with the aid of a grant from the Leverhulme Fund, but already many studies of plant metabolism have been published by Dr. Pearsall and his students in the last few years, including (with Dr. M. C. Billimoria) some very suggestive notes upon nitrogen loss from plants.

Atlantic Meteorology and Trans-Atlantic Flight

MR. F. ENTWISTLE, head of the Overseas Division of the Meteorological Office, Air Ministry, delivered the Symons Memorial Lecture before the Royal Meteorological Society on March 16, taking as his subject, "Atlantic Flight and its bearings on Meteorology". Mr. Entwistle stated that the success of the flights across the North Atlantic last year by Imperial Airways, Ltd., in conjunction with Pan American Airways, Inc., was due in very large measure to the thorough preparations which preceded them and to the ground organization, including radio and meteorological services, which was provided. The preliminary investigations carried out by the Overseas Division of the Meteorological Office in order to provide essential operational data before the flights commenced were described. The first investigation, commenced early in 1936, had as its object the determination of the maximum average head wind component that would be experienced on an east to west track along the great circle route between Ireland and Newfoundland. The results, which were based on an examination of data covering a period of ten years, indicated that while the maximum wind speed likely to be encountered at any point was 95 m.p.h., the maximum average speed over the whole route was 60 m.p.h. This average speed, however, occurred only once in ten years, and if, in the operation of a trans-Atlantic aircraft, an allowance was made for a maximum head wind on the east–west track of 40 m.p.h., there would be very few occasions in any one year when it was necessary to cancel the flight. A more comprehensive investigation followed in which the times of flight of aircraft of different air speeds on alternative trans-Atlantic routes were compared.

LATER investigations were concerned with the meteorological conditions affecting the operation of aircraft in Newfoundland, the variation of wind with altitude over the North Atlantic and the frequency and minimum heights of low cloud. For one year from November 1936 a technical officer of the Overseas Division of the Meteorological Office was attached to the *Manchester Port*, a cargo ship operating between Manchester and Canada. He completed eight round voyages, in the course of which he made regular pilot balloon observations to determine the wind speed and direction at different altitudes, constructed daily weather charts from observations received by radio from Europe and North America as well as from ships at sea, and studied in detail the characteristics of the Atlantic disturbances through which the ship passed. These investigations, which are essential to the supply of accurate meteorological information for trans-Atlantic flying, will benefit meteorological science generally and, in particular, the weather forecasting services of the countries of western Europe, the greater part of the weather of these countries developing over, and moving from, the Atlantic. The development of long-distance air routes in various parts of the world is stimulating similar meteorological activity and is providing data for investigation on a scale hitherto unknown.

Air-Raids on Barcelona

LAST week in the House of Commons, Mr. Chamberlain expressed his own and indeed the general view of the recent air-raids on Barcelona when he said that no one could read the reports "without horror and disgust". This feeling must be aroused by the whole practice of bombing from aircraft, especially from great heights, for it is inevitable that there should be loss of many innocent lives and destruction of buildings of no military significance such as universities and scientific and other learned institutions. In this connexion we have received a copy of the following cable from the "Subsecretario Instruccion Publica" addressed to the president of the Royal Society of Medicine: "The Regular Air Force of Germany and Italy is demolishing the cities of Spain. The University of Barcelona like the Cajal Institute in Madrid has been almost completely destroyed. The same has happened to other centres of culture. During the last three days of terrible and continuous bombing, more than a thousand people were killed in Barcelona alone. We Spaniards of liberal and democratic convictions who only devote ourselves to literary and scientific activities protest against these monstrous crimes. At the same time we appeal to the sensitivity of our English colleagues and ask for their help in the defence of the independence of our country as well as of the universal principles of humanity, justice and law which the Spanish Republic implies. We ask you to bring to bear all your influence on the British Government so that it may take steps to avoid these barbarous atrocities, which are directed not only against defenceless human beings but also against the civilization and peace of the world. Jacinto Benavente (Nobel Prize); Ignacio Bolivar (naturalist); Pio Del Rio Hortega (biologue); P. Bosch Gimpera (archeologue); Enrique Moles, D.Sc.; Jose Xirau, D.L.; A. Duperier, D.Sc."

Exhibition of British Archæology

THE exhibition illustrating finds in Britain and Northern Ireland in the course of archæological exploration during the last five years at the Institute of Archæology of the University of London, Regent's Park, London, which was opened by Sir Charles Peers on March 21, is unique and the occasion historic. No exhibition of the kind has been held before, nor has so widely varied a collection of archæological material been assembled for temporary exhibition previously. Considering the relatively brief period during which the work of excavation has been carried out, the exhibition shows a remarkable and healthy activity in practical archæological study in Great Britain such as, it is probable, could not be parallelled elsewhere. The area covered includes England, Scotland, Wales and Northern Ireland, and the exhibits are drawn from sites in more than thirty counties. In time they range from the pre-glacial industries of East Anglia to Stuart pottery from the ditch of the Tower of London, lent by the Office of Works. Among the sites of major importance represented are Verulamium, of which the close of excavation just comes within the period, Miss Kenyon's excavations at the Old Jewry Wall of Leicester, with its evidence of Belgic occupation, and Dr. R. E. Mortimer Wheeler's exploration of Maiden Castle, with the interesting evidence of cannibalism and the remains of the last defenders of the fortress in A.D. 43. Material which should prove of intense popular interest is that from Castle Dore in Cornwall, which removes King Mark, father of Iseult, from the category of legendary figures and makes him a historical personage. Recent activities in, and discoveries by, air photography are well displayed. The exhibition will remain open daily from 11 a.m. to 4 p.m. until May 2.

Electron Diffraction and Surface Structure

IN opening the discussion on electron diffraction and surface structure before a joint meeting of the Physical and Chemical Societies held on March 17, Prof. G. I. Finch compared electron diffraction with other methods of surface structure examination, and cited cases where the microscope or X-rays may give a wrong impression of the structure of deposits and of the size, shape and chemical nature of thin crystalline films. He described, among others, a striking experiment on the orientation of fatty acids by friction, which seems to have a direct bearing on the nature of the mechanism of lubrication. Thus the previously unorientated molecules in a stearic acid layer deposited on a metal surface can be made to point in a common direction by rubbing. If the surface be rubbed in all manner of ways, it is the last stroke only which determines the final direction of orientation of the stearic acid chains. Prof. Finch also gave an account of new experiments which confirm the conclusions previously arrived at by electron diffraction as to the structure of the polish layer on calcite. Sodium nitrate crystals were found to orientate in such a way as virtually to continue the structure of calcite when deposited on the polish layer on a cleavage face and which electron diffraction had shown to be of single crystal structure integral with the main crystal. A calcite surface cut and polished in such a manner as to be steeply inclined to all cleavage planes, however, gives a halo pattern characteristic of an amorphous layer, and on such a surface the nitrate crystals do not orientate but point in all directions just as they do when grown, for example, on a glass surface. After heating, which causes this amorphous polish layer to recrystallize, the sodium nitrate crystals orientate once more.

The Fulham Power Station

THE Institutions of Civil Engineers and Electrical Engineers had a joint meeting on March 22 to discuss the new Fulham Power Station, which when complete will be the largest municipally owned base-load station in the British Isles. The station lies east and west, with the boiler house on the east, and is situated 60 ft. from the river frontage along the west bank of the Thames from Wandsworth Bridge. The first half of the paper was written by J. F. Hay and describes the constructional work, and the second half, by W. C. Parker and H. Clarke, discusses mechanical and electrical considerations. A point which has come prominently forward during recent years is the necessity of having as wide a specification as possible for the coal used. The effect of having two of the base-load stations on the Thames equipped with the same kind of stoker and similar methods of feeding is making a considerable demand for a special type of coal from the coalfields, and this both increases the price of this type of coal and brings about a shortage of supply for it. The Ministry of Health requires constant tests to be made of the sulphur content of the flue gases, but the difficulty of doing this, even when working to so low a sulphur content as 0·006 grain per cubic foot, was overcome by means of a new recording device. Continuous tests of the sulphur activity in various parts of London since April 1, 1936, prove that the starting of the Fulham Power Station on November 1, 1936, has had no apparent effect on the atmospheric pollution. The pollution varies with the season and with the weather, being large in winter and during cold winds. The two chimneys are built of reinforced concrete and rise 300 ft. above ground-level. The gas-washing plant runs on a non-effluent system which is similar to that devised concurrently by Imperial Chemical Industries, Ltd.

Science and Socialism

THE first of a "Social Science Series" of pamphlets edited by W. P. Dreaper is entitled "The Future of Civilisation and Social Science" (London: E. T. Heron and Co., Ltd. 1*s*.). In it Mr. Dreaper presents a study of the principles of scientific meliorism based on Jane Hume Clapperton's book published in 1885, in which socialism is defined as concerted aims for social ends, and scientific meliorism may be regarded as a form of socialism under which progress must come through the individual social unit and not by means of social veneer. Scientific meliorism discriminates between benevolence which is beneficial and that which is not, giving no support to charities which injure the independence of the poor, or relieve them of parental responsibility. It opposes the social forces of sympathetic selection which result in the survival of the unfit and seeks to promote intelligent selection which would result in the birth of the fit. It strenuously supports co-operation in industry as a means of progress and harmony of interests, and proper distribution as a means of improving human conditions. Scientific meliorism also advocates a rational treatment of crime, in which vindictiveness has no ultimate place, and calls for a similar rational attitude to such questions as manners, dress, the equality and relations of the sexes, marriage laws, laws of inheritance, etc., the regulation of population in relation to the natural and industrial position of a nation, and Mr. Dreaper briefly discusses the bearing of its principles on the study of international problems.

Developments in Storage Batteries

DURING last year, there has been a widespread increase in the number and the variety of the applications of batteries for stand-by purposes and emergency lighting. In the annual review number of the *Electrician* of January 28, Mr. E. C. McKinnon points out that this is partly due to air-raid precautions, which naturally trust to storage batteries for emergency lighting. Manufacturers are using the popular sizes of the starting batteries used in motor-cars for this purpose when circumstances permit. In other cases, alkaline batteries or sealed-in lead-acid accumulators are employed. The vast programme for broadcasting and recording the incidents of the Coronation ceremony and processions was largely dependent upon batteries. Car radio equipment has been applied to police patrol cars and to police patrol pedal-cycles. Many systems of battery-controlled fire alarms have also been installed. There has been a considerable increase in the demand for accumulators for deaf-aid equipment.

VERY small batteries have been developed for use in meteorological balloons. These are made up into low-tension cells weighing 1 oz. each, and 60 cell (144 volts) high-tension batteries weighing only 9 oz. when complete with electrolyte. There has been a great demand for batteries for auxiliary propulsion of trolley buses. This system is most useful for manœuvring the vehicles at termini or at special points such as football grounds or on the route lines in the event of power supply failure. There has been an increase in the number of electric vehicles in operation last year of 31 per cent. Bakeries, dairies and salvage departments are using large fleets of electric vehicles. Fleets of 100 to 150 electric vehicles are now not uncommon. Air conditioning by the aid of storage batteries has made great progress in India, but the need for it in Great Britain is not large at present. There have been more than a hundred patents in connexion with accumulators applied for last year, but none of them proposes any radical change in design. Special batteries are much used in aeroplanes and submarines. The standardization of accumulators is receiving attention both in Great Britain and internationally.

Journal of Marine Research

DURING the past several years there has been increasing interest in oceanographic research in the United States, which led to the foundation of the Woods Hole Oceanographic Institute and a special department of the University of Washington, both with well-equipped vessels. From these, and the already established laboratories, there has come very real contributions to our knowledge of the oceans—the nature and causes of the current systems on one hand, and, on the other, studies in the varying productivity of the waters in plant and animal life. It is gratifying that Great Britain is now engaging in active co-operation with the Woods Hole Institute in a survey of the fluctuations from year to year in the current system of the north-west Atlantic, for which the Royal Society is now fitting out a vessel. The annual crop of scientific papers dealing with oceanography has grown rapidly. American contributions appear in rather many and diverse journals, both American and European, so the birth in November last of the *Journal of Marine Research* comes at a time when its growth is likely to be rapid. It is published by the Sears Foundation, Oceanographic Laboratory of Yale University, and its scope includes articles on physical meteorological theory, owing to the "intimate connection between hydrospheric and atmospheric events in nature, and to the virtual identity of dynamic methods and theory in Meteorology and Oceanography". The six contributions appearing in the first number are equally divided between physical and biological subjects, and include an article on evaporation from the oceans by H. U. Sverdrup, now director of the Scripps Institute, on seasonal variations in the water of San Juan Channel, and on a survey off the mouth of the Mississippi, showing effects of river water and the distribution of phytoplankton.

Medical Milestones

UNDER this heading, the *Medical Record* of New York for January 5 mentions the following notable events in the history of medicine which occurred in the course of 1838: foundation of the University of Messina, which later developed a remarkable medical curriculum, and of the Medical College of Richmond, Virginia; publication by Malgaigne of his treatise on experimental surgery and by Johannes Müller of his treatise on tumours; the first accurate description of pulmonary tuberculosis by Corrigan; performance by Mettauer of the first operation for vesico-vaginal fistula; description by Southwood Smith of conditions, especially fevers, among the poor in London in his reports to Parliament, and the foundation of the Royal Orthopædic Hospital of London.

Anti-Rabic Treatment in Southern India

THE director, Major Iyengar, in his annual report for 1936 of the work of the Pasteur Institute of Southern India, Coonoor, states that 493 patients underwent a full course of treatment, an increase of 60 compared with the previous year. For the fourth time during the thirty years of its existence, no deaths occurred from hydrophobia among those treated at the Institute. In addition to the treatment at the Institute, 15,302 courses of anti-rabic vaccine were issued for use at out-centres. Semple's carbolized sheep vaccine was in use, prepared from Paris fixed virus, which was in its 978th passage at the close of the year. In addition to human beings, 659 animals also received anti-rabic treatment during the year.

The Day Lily

MEMBERS of the genus *Hemerocallis* enjoy an increasing popularity as garden plants. The name signifies 'beauty for a day', and is a reliable description for individual flowers. The plant, however, maintains a succession of bloom, and is tolerant of a wide variety of cultural conditions. Mr. G. P. Baker has prepared a short monograph of the genus (*J. Roy. Hort. Soc.*, 62, 9, 399–411, Sept. 1937). A historical summary traces the early references to *Hemerocallis flava* from the time of Dioscorides, whilst the modern uses of the plant as medicine and as a flavouring in China, are set forth. Detailed descriptions of fourteen species and their variants impart much knowledge for the gardener.

Société des Amis de Paul Painlevé

THE late Paul Painlevé made a place for himself in contemporary history not only as a great mathematician but also as a statesman of conspicuous ability. A collection of his essays and speeches are gathered together in book form (price 20 francs), and published by the "Société des Amis de Paul Painlevé", which has for its aims the cultivation of his memory and of his scientific and democratic ideals, and eventually the publication of his papers. This association has issued an appeal to all the friends of Painlevé throughout the world, and will particularly welcome adherents from Great Britain (minimum subscription, 1*s*. 6*d*. a year). The chairman of this organization is M. Pierre Appell (3 rue du Vieux Colombier, Paris), who was one of the closest collaborators of the great French statesman.

Medical Men in Austria

WE have received the following communication from the Medical Peace Mission, 12 Kent Terrace, Park Road, London, N.W.1, signed by eighteen distinguished British medical men: "In view of recent events, we desire to express our alarm at the possible fate of our colleagues in Austria. There are in that country many revered physicians and surgeons who are likely to fall into disfavour with the National Socialist Government either on account of their medical or social views or on account of their belonging to the Jewish race. Judging from what has happened in Germany in the past, we are afraid that serious discrimination will be exercised against them and that even the chance to leave a country which is no longer hospitable to them may be refused. We beg our colleagues in all countries to watch the progress of events with the closest attention and to do all in their power, whether by public protest or by public or private assistance, to stand by any members of our profession who may suffer hardship under the new régime."

The Night Sky in April

Full moon occurs on April 14 at $18\cdot3^{h}$ and new moon on April 30 at $5\cdot5^{h}$ U.T. No stars brighter than mag. 6·1 are occulted during the month; for particulars of the seven occultations visible from Greenwich, see page 526 of the "Nautical Almanac". Lunar conjunctions with the planets occur as follows: on April 1^{d} 23^{h} with Venus: April 2^{d} 6^{h} with Mercury: April 3^{d} 8^{h} with Mars: April 25^{d} 2^{h} with Jupiter and April 28^{d} 11^{h} with Saturn. On April 8^{d} 16^{h}, Mercury and Venus are in conjunction, and on April 15^{d} 20^{h} Venus and Uranus, Venus being only 0·1° north of Uranus (geocentric positions). Venus and Mars are both evening stars; Mercury is an evening star until April 21, and at greatest eastern elongation on April 2. On April 1 at about 19^{h}, the moon's slender crescent and the planet Venus will be nearly at the same altitude low in the western sky. In mid-April at 22^{h}, Orion will have nearly set in the west, but Procyon, Castor and Pollux still remain. Capella in the north-west balances Vega in the north-east. The bright star Arcturus, the spectrum of which closely resembles that of sunspots, is conspicuous east of the meridian. Arcturus has the notable proper motion of 2·3″ per annum. In its train, there is the small, beautiful constellation of Corona Borealis. On or about April 21, the Lyrid meteors may be looked for, their radiant point being at R.A. 18^h 4^m and Dec. 33° N. It should be noted that Summer Time in the British Isles commences on Sunday, April 10, at 2^h.

Announcements

PROF. F. G. DONNAN has been elected an honorary member of the Verein Osterreichischer Chemiker.

SIR ROBERT HADFIELD has been awarded the Trasenster Medal and Diploma for 1938 by the Association des Ingénieurs de Liège. This award has previously been given to M. Henry Le Chatelier, the well-known French man of science, the Marchese Marconi, M. Edouard Branly, the distinguished physicist and one of the pioneers of wireless, M. Georges Claude, inventor of the processes known under his name for the liquefaction of air and for the fixation of atmospheric nitrogen, Mr. Waldemar Lindgren, American geologist, and M. André Blondel, distinguished for his researches in electricity and illumination.

THE London Midland and Scottish Railway has appointed Dr. W. A. Macfarlane to be senior research chemist. Dr. Macfarlane was educated at Westminster School and Balliol College, Oxford ; he took a first in chemistry in 1930, and was awarded a B.Sc. for his research work in physical chemistry. He acted as demonstrator in natural science at Balliol from 1930 until 1932, and was then elected a Commonwealth Fund fellow at the University of California, where he carried out research in spectroscopy. Since 1934 he has been a scientific officer at the Fuel Research Station, where he specialized on the production of synthetic oils, and later acted as personal assistant to the Director of Fuel Research.

MR. F. H. Wynne, deputy chief inspector of mines, has been appointed chief inspector of mines in succession to Sir Henry Walker. Sir Henry Walker, who entered the Mines Inspectorate in 1902 and has been chief inspector for nearly fourteen years, retired on March 17 on reaching the age limit.

THE sixth of a series of public lectures on "Science in the Social World", which has been organized by the Left Book Club Scientists' Group, will be held on March 28, at 8 p.m. at the Conway Hall, Red Lion Square, W.C.1, when Prof. P. M. S. Blackett will speak on "The Social Background of the Rise of Science in the Seventeenth Century".

DR. H. H. VÖLCKERS, Plenipotentiary Minister of the German Reich at Havana, has been elected an honorary member of the Cuban Society of Biology, and Dr. Hans Boker, professor of anatomy at Jena, an honorary member of the Cuban Society of Natural History.

DR. FRIEDRICH BERGIUS has been made an honorary member of the Physical Association at Frankfort, and Dr. Eduard Richters, senior veterinarian in the Army Veterinary Investigation Department, a member of the Imperial Leopold Caroline German Academy at Halle.

AN anti-alcohol museum at Warsaw has recently been opened by the Polish Minister of Social Welfare.

THE eighth International Congress of Thalassotherapy will be held at Montpellier on June 3–5 under the presidency of Dr. A. Aimes, when papers will be read on the meteorological factors of sea climate. Further information can be obtained from the general secretary, 8 rue André-Michel, Montpellier.

The annual Conference of the Museums Association will be held in Belfast on July 4–9, under the presidency of Dr. R. E. Mortimer Wheeler. Further information can be obtained from the Secretary, Museums Association, Chaucer House, Malet Place, London, W.C.1.

THE Chicago Tumor Institute, which is a non-profit-making corporation at 21 West Elm Street, Chicago, was opened on Monday last, March 21. The scientific committee consists of Dr. Max Cutler (director), Sir G. Lenthal Cheatle, Dr. Henri Coutard, Dr. Arthur H. Compton and Dr. Ludvig Hektoen. The Institute will offer consultation service to physicians in the diagnosis and treatment of cancer and radiation facilities for cancer patients. It is also proposed to conduct research at the Institute and to offer training to physicians who may wish to qualify as specialists in the study and treatment of this disease.

THE Cambridge University Press announces two developments in its policy of providing the increasing number of readers not engaged in science, but interested in the advance of knowledge, with informative books by men who are authorities in their own subjects. The first is Einstein's own account of his great discovery of relativity, "The Evolution of Physics", by himself and Dr. L. Infeld, which on March 28 will inaugurate a new series, "The Cambridge Library of Modern Science". Later in the same week will come the first number of a new series of *Discovery*, the popular scientific monthly, which has been taken over by the Cambridge University Press and will provide the general reader with a regular link with the latest discoveries and developments in all branches of knowledge. Dr. C. P. Snow, of Christ's College, is the new editor of *Discovery* and also general editor of "The Cambridge Library of Modern Science".

ERRATUM. In NATURE of March 12, p. 471, letter by Dr. P. Suomalainen entitled "Magnesium and Calcium Content of Hedgehog Serum during Hibernation", par. 4, line 6, for "Kursiv" read "*Helix*".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 559.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Rate of an Atomic Clock in Motion

ACCORDING to the theory of the relation between matter and the luminiferous ether, as developed by Larmor and Lorentz, a moving clock should assume the rate

$$\nu = \nu_0 \sqrt{1 - \frac{V^2}{c^2}},$$

where ν_0 is the stationary rate, V the measured velocity of the clock with respect to the observer, and c the velocity of light.

It was pointed out by Einstein in 1907 that the newly discovered Doppler effect in canal rays offered a means for making a test of this prediction. This experimental test, the crucial nature of which has been emphasized repeatedly in the last thirty years (under the designation of the 'transverse Doppler effect') has not heretofore been performed. It has been commonly considered as beyond experimental practicability, chiefly on the ground that as the moving canal rays are not homogeneous in velocity, the 'displaced' line is too diffuse for sufficiently exact measurement.

This objection has recently been removed, due to the development, by Dempster, of a design of canal ray tube which gives displaced lines of a sharpness comparable with the undisplaced. In this form of tube, the positive ions produced behind the electrode are accelerated between two slightly separated pierced plates between which a high potential difference exists.

Recently, with the assistance of Mr. G. R. Stilwell, I have made an experimental test of the Larmor-Lorentz prediction, using canal ray tubes of the Dempster type. The hydrogen line 4861 A. has been used, observations being made by means of a plane grating of metal on glass of 15,000 lines to the inch, made by Prof. R. W. Wood, which, in conjunction with two 5-in. diameter, 5-ft. focus telescope objectives, formed a sufficiently powerful spectrograph for the purpose. By means of a small concave mirror mounted on the pierced electrodes, end-on observation gave, on one plate, the displaced lines due to motion toward and away from the spectrograph slit. The apparatus was arranged to turn in any desired direction in the horizontal plane.

For the voltages used, which were about 18,000, the displaced H_2 lines, which were the most feasible for study, should, according to the theory, have their common centre of gravity displaced, with respect to the undisplaced line, by approximately 0·05 A. towards the red, which is readily detectable with the dispersion employed.

The result of the experiment was to show a displacement in the predicted direction, independent of the orientation of the apparatus, and agreeing, within the errors of measurement, with the value indicated by theory.

The importance of this experiment lies in the fact that it yields a positive effect, as distinct from the null effects obtained in other optical experiments, which latter might be explained by an entrained ether. It is therefore decisive in favour of the Larmor-Lorentz theory.

A full account of the experiment will be published shortly.

HERBERT E. IVES.

Bell Telephone Laboratories,
New York, N.Y.
Jan. 27.

Effect of Solvents on the Absorption Spectrum of Vitamin A

IT has long been known that some substances, for example, indigo, yield variously coloured solutions in different solvents. Change of solvent may affect the intensity and position of absorption maxima in the ultra-violet as well as in the visible spectrum. The fact that this phenomenon has been observed with a related substance, carotene, makes it the stranger that various solvents are commonly accepted as interchangeable for the spectrophotometric assay of vitamin A. Thus ethyl alcohol and cyclohexane received equal sanction at the 1934 International Vitamin Conference and in the 1936 "Addendum to the British Pharmacopœia"; ether is also used in some laboratories, but chlorinated solvents, particularly chloroform, have been regarded with suspicion.

We now find that the vitamin A absorption bands of fish-liver oils and concentrates may vary somewhat with change of solvent, both in position and in magnitude. The values of $E^{1\%}_{1\text{cm}}$ 328 mμ, for three oils and two concentrates, in five solvents are summarized in the accompanying table. For ease of comparison, the values in solvents other than alcohol are expressed as percentages of the absorption in alcohol. Each figure represents the mean of two to four highly concordant independent determinations. Consistently higher results were obtained with alcohol than with cyclohexane or hexane as solvent, and we believe that the differences have real significance.

Substance	$E^{1\%}_{1\text{cm}}$ 328 mμ in alcohol	Absorption at 328 mμ relative to 100 for alcohol				
		Alcohol	Cyclohexane	Hexane	Ether	Chloroform
Halibut-liver oil 12/186	40·8	100	99	102	110	93
Halibut-liver oil 12/214	30·1	100			116·5	93·5*
Fish-liver oil 11/323	52·7	100	97	95	90·5	85·5
Concentrate 12/099	630	100	99	96·5	105	86·5
Concentrate 12/168	480	100	95·5	97	106	86
Average		100	97·5	97·5	107·5	89

* One determination only.

The high results in ether (4 samples out of 5) and the even more markedly low results in chloroform certainly differ from those in alcohol by amounts well outside the limits of experimental error. Chloroform also caused a shift in the position of the maximum to approximately 333 mμ; the other solvents caused no shift detectable with certainty, except that with cyclohexane the maximum appeared to be nearer 330 mμ than 328 mμ. Morton[1] found that chloroform gave low results, but attributed the phenomenon to instability of vitamin A in this solvent. Although vitamin A certainly is unstable in chloroform, this is not sufficient to explain our findings. A chloroform solution of halibut-liver oil gave a value $E^{1\%}_{1\text{cm}}$ 328 mμ $= 26{\cdot}4$; the chloroform was evaporated from this solution under reduced pressure and replaced by an equal volume of ether: this ether solution gave $E^{1\%}_{1\text{cm.}}$ 328 mμ $= 31{\cdot}7$; a direct solution in ether gave $E^{1\%}_{1\text{cm.}}$ 328 mμ $= 31{\cdot}8$.

The materials listed in the table fall into two groups, comprising on one hand the first two oils, and on the other the third oil and the two concentrates. Relative in each instance to the absorption in alcohol, the first group shows greater enhancement of the absorption in ether and less depression in chloroform than does the second group. These irregularities are probably due to differences in the proportion of *cis-trans* isomers of vitamin A. These isomers may not only have different absorption coefficients in any one solvent, but also the ratio of these coefficients may vary from solvent to solvent. Possible differences between the biological activities of the isomers may help to explain the various factors reported relating $E^{1\%}_{1\text{cm.}}$ 328 mμ to biological units.

We have further observed that irradiation of solutions of vitamin A sometimes increased and sometimes decreased (by so much as 40 per cent) the absorption at 328 mμ, but that the absorption almost returned to the original value after the irradiated solution had stood in the dark. Variations in the proportion of *cis-trans* isomers might explain these results and also some of the spontaneous increases as well as decreases in absorption of liver oils and concentrates during periods of storage which have been observed by ourselves and others (*cf.* Heilbron, Gillam and Morton[2]; *cf.* also the experiences of Holmes and Corbet[3] with crystalline vitamin A and of Zechmeister and Tuzson[4] with lycopene).

It is intended to publish full details elsewhere of the work summarized here and additional work now in hand.

Note added to proof. Since submitting this letter for publication we have learned that Dr. A. E. Gillam and Dr. M. S. El Ridi have—independently of ourselves—studied the effect of solvents on the vitamin A absorption spectrum.

E. LESTER SMITH.
BABETTE E. STERN
F. E. YOUNG.

Technical Research Laboratory,
Glaxo Laboratories, Ltd.,
Greenford, Middlesex.
Feb. 21.

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[1] Morton, private communication.

[2] Heilbron, Gillam and Morton, *Biochem. J.*, 25, 1352 (1931).

[3] Holmes and Corbet, *J. Amer. Chem. Soc.*, 59, 2042 (1937).

[4] Zechmeister and Tuzson, NATURE, 141, 249 (1938).

THE above authors have been good enough to show me their letter. The 1934 Conference was concerned with a substitute for the bio-assay with its experimental error of perhaps ± 25 per cent for individual assays. The fact that variations of a few per cent for spectrophometric assays in different solvents like alcohol and cyclohexane are now being noted is an indication of the progress made. Such variations are usual for polar molecules and do not invalidate the spectrophotometric method.

The possibility of variable proportions of geometrical isomerides in different vitamin A containing materials has been obvious since the polyene formula was established. So many isomerides are theoretically possible with five ethenoid linkages (four in a straight chain) that the problem of their occurrence has long defied experimental attack, and it has been reasonable to assume a balancing of effects.

With one double bond as in *cis* and *trans* stilbene and cinnamic acid[1], differences in ε max. are of the order 2 : 1, an effect much larger than that observed except in the valuable irradiation experiment.

I have approached the problem from another angle. Hitherto the ultra-violet absorption (328 mμ) and the $SbCl_3$ colour test maximum (620 mμ) have shown a nearly constant ratio $E^{1\%}_{1\text{cm.}}$ 328 mμ/620 mμ of 0·32 for rich preparations. A halibut intestinal oil prepared by Dr. Lovern has been subjected to molecular distillation by the courtesy of Dr. F. H. Carr of Messrs. British Drug Houses, Ltd. In the different fractions the ratio varies from 0·21 to 0·38 and for a range of very rich ester fractions it is *c.* 0·28. A partial separation of *cis-trans* isomerides is a plausible explanation.

R. A. MORTON.

The University,
Liverpool.

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[1] Smakula and Wassermann, *Z. phys. Chem.*, A, 155, 353 (1931)

Specificity of Disaccharide-splitting Enzymes

DISAGREEMENT exists concerning the substrates which maltases of different sources can hydrolyze. According to the view advanced by Leibowitz[1], there occur in Nature two types of maltase, a gluco-maltase and a glucosido-maltase respectively. The gluco-maltase which occurs in malt and in moulds splits maltose but is inert towards alpha-glucosides and sucrose: the glucosido-maltase which occurs in yeast splits alpha-glucosides as well as maltose. Different investigators[2] have applied the two maltase classification over a wide range of maltases from various sources. Weidenhagen[3], however, has denied the validity of this view, and claims that in sufficient enzyme concentrations, even malt and taka-diastase hydrolyze alpha-methyl-glucoside. All maltases in Nature are said therefore to be glucosido-maltases; they are considered to be identical with the gluco-sucrase among the sucrases, and to split alpha-glucosides and sucrose as well as maltose.

In the course of a series of tests on the heat stability of different lots of taka-diastase, taka-maltase preparations were found which were peculiarly resistant to inactivation by heat. This property has enabled us to make additional observations on the question of the specificity of taka-maltase. If a solution of the enzyme is heated to boiling point, these resistant preparations lose their ability to split sucrose and also what slight activity they formerly possessed to split alpha-methyl-glucoside; they retain, however, or regenerate after the heating, most of their ability to split maltose.

It follows, therefore, that the inversion of sucrose by taka-diastase is not even partially due to taka-maltase but to a distinct taka-sucrase. It seems reasonable also to believe with Pringsheim that the slight alpha-glucosidase action observed by Weidenhagen in concentrated taka-diastase preparations was due to the admixture with the predominant gluco-maltase in mould of a small quantity of glucosido-maltase.

A further proof that yeast maltase and taka-maltase are different was furnished by a study of the effect of taka-diastase on yeast maltase solution. Yeast maltase solution incubated for a definite time interval with a sufficient concentration of taka-diastase loses completely its ability to hydrolyze either alpha-methyl-glucoside or maltose. The ability of the taka-maltase to split maltose is not, however, removed under these conditions. Taka-diastase thus contains an inhibitor for yeast glucosido-maltase. The inhibitor is heat labile, non-dialyzable and distinct from taka-maltase.

The nature of the 'heat-stable' taka-maltase, the manner of inhibition of the yeast maltase, and in particular the effect of the inhibitor in taka-diastase upon maltose fermentation by zymase will be reported in detail elsewhere.

J. LEIBOWITZ.
S. HESTRIN.

Department of Hygiene and Bacteriology,
The Hebrew University,
Jerusalem.
Feb. 6.

[1] Leibowitz, J., *Z. physiol Chem.*, **149**, 184 (1925), Leibowitz and Mechlinsky, *ibid*, **154**, 64 (1926)

[2] See, for example, Pringsheim, Borchardt and Loew, *Z. physiol. Chem.*, **202**, 23 (1931), Pringsheim and Loew, *ibid*, **207**, 241 (1932), Karstroem, H, *Biochem Z*, **231**, 399 (1931), Tauber and Kleiner, *J Gen Physiol*, **16**, 767 (1932–33), *J Biol Chem*, **105**, 679 (1934)

[3] Weidenhagen, R., "Ergebnisse der Enzymforschung", Vol. 1 (1932); *Z physiol Chem*, **216**, 255 (1933), and elsewhere.

Action of Molybdenum in Nutrition of Milking Cattle

A LARGE area under pasture in Somerset cannot be grazed by cows during the normal grazing season (April–October) without milk yields falling rapidly, causing marked loss of condition and even death. The disorder, which has been known for very many years, is marked by extreme diarrhœa; other cattle and sheep also scour on such herbage, though the loss of condition is not so obvious as with the milking animal. Such fields are described as being 'teart'. The area involved is estimated at about 20,000 acres by Gimingham[1], and the annual loss to the farming community must be very great. The available information seems to rule out bacteria, parasites, water supply or a particular herb as causal agents, and points to the presence of some constituent of the soil taken up by the herbage[2].

Spectrographic examination of a few samples kindly supplied to us by Mr. A. W. Ling and Mr. W. R. Muir of the University of Bristol showed the presence of molybdenum in 'teart' herbage. A more extensive and systematic examination which we have since conducted on 'teart' and 'non-teart' fields in Somerset has confirmed the fact that the molybdenum content of 'teart' herbage is considerably higher than that of the 'non-teart' fields situated close by.

There is no apparent correlation between the total or HCl-soluble molybdenum of the soil and that of the herbage. Comparisons are, however, complicated by the fact that 'teart' and 'non-teart' fields are managed in such a way that the herbage is at different stages of growth at any one time of the year.

We have fed soluble molybdates in quantities equivalent to those provided in an average daily ration of really 'teart' herbage (1·36 gm. Mo per head per day) to five dry cows at Jealott's Hill, and in three cases have produced extreme scouring and loss of condition similar to that which occurs in 'teart' fields in Somerset. Whether the molybdenum is directly responsible or whether it catalyses a toxic product in the rumen we do not yet know. It is generally stated in the 'teart' areas that horses are not affected, but it is impossible to say at present if this is due to the simple stomach or to differences in grazing habit.

The investigation is still being pursued. Our thanks are due to Mr. Milbourn of I.C.I. (Metals), Ltd., for the spectrographic examination of the early samples from Bristol.

W. S. FERGUSON.
A. H. LEWIS.
S. J. WATSON.

Jealott's Hill Research Station,
Bracknell,
Berks.
Feb. 22.

[1] Gimingham, C. T., *J. Board Agric.*, **17**, 529 (1910)

[2] Muir, W R, *Agric Progress*, **13**, 53 (1936).

Potential Changes in the Ears of Reptiles and Fish

Wever and Bray's work has shown that in mammals the cochlea behaves like a microphone, giving electric oscillations which are an accurate transcription of the sound waves. The most plausible explanation of the effect is that of Hallpike and Rawdon Smith, namely, that it is due to the vibration of a polarized membrane separating endolymph and perilymph, but other hypotheses have been put forward.

The object of this communication is to direct attention to the similar effect in the inner ears of cold-blooded vertebrates. In alligators there is a cochlea, and it is not surprising to find potential changes, as in mammals, copying the sound waves. In lizards the potentials which can be detected in the inner ear are of the same form, but are much smaller. In tortoises they are often too small to be distinguishable from artefacts due to electrode movement. In the eel, however, the inner ear structures are more accessible and large potential oscillations can be recorded from the saccule when the head is exposed to vibration. The saccular response in the pike, described by Piper (1910)[1], is presumably due to the same cause. The frequency of the potential changes which can be induced in the inner ear seems to be limited merely by the frequency at which the structures can be made to vibrate; the maximum frequency of response in the fibres of the auditory nerve is much lower, since there must be time for recovery after each impulse.

E. D. ADRIAN.

Physiological Laboratory,
Cambridge.
March 7.

Piper, H, *Arch. Anat. u. Physiol.*, Physiol. Supp, **1**, 1910 (1910).

Activity and Insect Survival

WHILE laboratory experiments have revealed new facts of insect biology, some have given results which have been interpreted in such a way as to cause confusion. Experiments measuring longevity have often given ambiguous results. At present, much work is being done on the survival of the bed-bug, *Cimex lectularius*, and as this insect is a domestic pest usually found in confined spaces, it appears at first sight admirable for laboratory study. Imprisonment among paper in a tube differs little from the conditions of the normal environment. Yet the times of survival found by various investigators[1,2,3] working under similar climatic conditions are so different that it is, for example, quite impossible to say how long bugs must be left in an unoccupied house with no sources of food before they will all die from starvation.

Recent experiments throw some light on the subject. When newly emerged, unfed and unfertilized females of *Cimex lectularius* were starved, singly, in 3 in. × ½ in. glass tubes at 30° C. (86° F.) and 25 per cent relative humidity, in darkness except when examined, they survived on an average 134 days (limits 116 and 145 days, standard deviation 9·1). The insects seldom moved more than a few millimetres. Now if similar bugs after only one week's starvation were put on an open and well-illuminated surface, they would run about rapidly. If they were kept running for several minutes, and then allowed to feed, they survived; but if they were *not* fed, they died in a few hours. The extra activity due to running for several minutes was apparently sufficient to exhaust reserves which would have kept a resting bug alive for several months. In the longevity experiments mentioned above, I took particular care not to disturb the insects when examining them, and thus obtained a length of life far longer than that previously found by other workers under similar climatic conditions.

It is not unlikely that by using suitable methods we shall find that at temperatures comparable with those occurring naturally in Great Britain, bugs will be able to survive for years. The variability of previous workers' results appears to depend on the extent to which their technique disturbed the insects; in the field, conditions which affect activity will affect longevity, not only with *Cimex* but also with other species. Experiments must be planned to make allowances for this important factor. In the case of the bed-bug we must discover what internal and external stimuli cause activity and hunting for food, and how often unsuccessful individuals die from exhaustion.

KENNETH MELLANBY.

Sorby Research Laboratory,
University, Sheffield.
Feb. 22.

[1] Geisthardt, G., *Z Parasitenkde*, 9, 151 (1937)
[2] Johnson, C G., *Proc Zool Soc. Lond*, A, 107 (1937).
[3] Kemper, H, *Z Morph u Okol*, 19, 160 (1930).

Occurrence of young *Ophiothrix fragilis* within the Genital Bursa of the Adult

IT has been recorded by Mortensen[1,2,3] that young specimens of the ophiuroids *Ophiothrix fragilis* Abildgaard, *O. triglochis* M. and Tr. and *Ophiactis Kröyeri* Ltk. are sometimes to be found clinging to the arm spines of the adults. The occurrence of the young individuals on the adults does not, in Mortensen's opinion, indicate a viviparous habit in these ophiuroids since one, at least, namely *O. fragilis*, is known to have pelagic larvæ; rather, it is "quite by chance that the young ones, after their metamorphosis from the pelagic larvæ, happen to settle down on adult specimens in places where these latter occur in good numbers"[2].

In view of this 'accidental' appearance of the young ophiuroids on the arm spines of the adult, it would be unwise to assume that their presence, even within the adult genital bursa, was, in itself, an indication of a viviparous habit. Fedotov[4], who found a specimen of *Gorgonocephalus eucnemi* M. and Tr. with a young individual in the depth of the bursa was inclined to regard *Gorgonocephalus* as viviparous, although he considered the question, on such evidence, as not being entirely solved.

While working at the Plymouth Marine Biological Laboratory in December last, I examined some two hundred specimens of *O. fragilis* and found that about 10 per cent of that number had young *Ophiothrix*, of a disk diameter of 0·25–0·5 mm., clinging to the spines and tube feet of the oral side of the arms. The number present on a single individual varied from one to fifteen. In five of these individuals, however, much larger specimens (of about 2 mm. disk diameter) were found *within the bursa*, one in each adult. The presence of young brittle-stars within the bursa of an oviparous species demonstrates conclusively that their presence does not necessarily indicate viviparity.

In the case of *O. fragilis*, the young post-metamorphic stages find shelter among the spines of the older individuals, from which they can only be dislodged with difficulty owing to their habit of wrapping round the spines and attaching themselves by means of their arm hooks. With increasing size, attachment becomes a matter of greater difficulty and it may be supposed that the larger specimens, in search of better shelter, occasionally move towards the openings of one of the bursæ and crawl inside, there to settle until they become too large to be housed in comfort. They would then leave the bursa and seek the shelter of a rocky crevice or stone as is the habit of the species.

On this assumption, the bursa would be regarded as a convenient habitation, rather than a nursery, for the post-metamorphic brittle-stars.

J. E. SMITH.

Zoology Department,
The University,
Sheffield, 10.
Jan. 27.

[1] *Acta Zoologica*, 1–2 (1920).
[2] *Vidensk. Meddel f. Dansk. naturhist.*, 93 (1932–33).
[3] *Danish Ingolf Exped.*, 4, Nr 8
[4] *Trav. Soc. Nat Petrograd*, 46 (1915).

Effects of Soft X-Rays upon Chætopods

THE effects of X-rays upon *Tubifex tubifex* and some other members of the class Chætopoda have been investigated by Stone, Turner, Zhinkin and others. They have reported, in general, that hard X-rays inhibited or destroyed the capability of regeneration, because it destroyed the neoblasts, although in appearance the general body tissue was little affected by their dosages.

It occurred to us to investigate the behaviour of *Tubifex tubifex* when irradiated with soft X-rays from a copper target X-ray tube operated at 30 kv. and 10 ma. The most intense part of the radiation had a wave-length of 1·54 A., which, being less penetrating, might be expected to produce more drastic effects. The radiation was collimated by a narrow slit and allowed to strike selected somites of the animals placed 1 inch from the focal spot of the X-ray tube.

It was expected that the irradiated somites would be injured or killed, so that the animals would break into two parts, each of which would live just as though the animals had been cut into two parts with a scalpel. Actually it was found that irradiation of the first three to five somites resulted in the formation of protuberances of various sizes. These were either reabsorbed or the anterior section disintegrated. When the heart region was irradiated, no injuries were observed in a majority of the animals. Irradiation of the somites approximately in the middle of the animal caused it to break at the site of irradiation into two parts, but in more than 70 per cent of the cases the posterior section died, whereas had the animal been cut into two, both sections would have survived in almost every case.

The time of irradiation was 3 minutes in each set of irradiations. Histological studies are to be made of the injured sections, and further irradiation experiments are planned. We expect to publish a fuller treatment of the data at an early date.

H. KERSTEN.
H. BRANSON.

Department of Physics,
University of Cincinnati,
Cincinnati, Ohio.
Jan. 10.

Band Spectrum of Indium Hydride

IN connexion with investigations now in progress on some hydrides in the third group in the periodic system, I have studied the spectrum of indium hydride. The bands were obtained in the emission from an arc burning between electrodes of indium and carbon in hydrogen at high pressure, using the same conditions as in a previous investigation of the thallium hydride[1].

The spectrum of InH was photographed between 2200–8500 A. (dispersion 1·9 A./mm.). In the range between 5600–8500 A. several bands were observed, which probably belong to InH. Three of these bands with $\nu_0 = 16{,}904{\cdot}9$, $17{,}574{\cdot}1$ and $16{,}148{\cdot}2$ cm.$^{-1}$ were analysed.

The band, $\nu_0 = 16{,}904{\cdot}9$, consists of single P-, Q- and R-branches, corresponding to a ${}^1\Pi \rightarrow {}^1\Sigma$ transition. This band is degraded toward the violet, but at high J-values all three branches form 'secondary' heads. In the Q-branch all lines up to $J = 31$ are intense. $Q(32)$, however, does not appear, even if the pressure in the arc is increased to ten atmospheres, which indicates a pronounced predissociation. In the secondary head of the P-branch, above $P(20)$, the lines are too crowded to be distinguished, but the R-branch can be followed steadily up to $R(33)$. The intensity distribution in the R-branch is perfectly normal, and no sudden interruption of the branch can be observed. All this indicates a case of predissociation similar to that earlier known in the spectrum of MgH.

The two other bands with $\nu_0 = 17{,}574{\cdot}1$ and $16{,}148{\cdot}2$ consist of single P- and R-branches, degraded to the red, and correspond to a ${}^1\Sigma^* \rightarrow {}^1\Sigma$ system with (0,0) and (0,1) transitions, the lower state of (0,0) being identical with that of ${}^1\Pi \rightarrow {}^1\Sigma$. The following rotational constants have been calculated :

$$\begin{aligned} {}^1\Sigma\ , \quad B_0 &= 4{\cdot}921, \quad D_0 = 2{\cdot}24 \times 10^{-4}. \\ {}^1\Pi\ , \quad B_0 &= 5{\cdot}266, \quad D_0 = 3{\cdot}28 \times 10^{-4}. \\ {}^1\Sigma^*, \quad B_0 &= 4{\cdot}883, \quad D_0 = 3{\cdot}77 \times 10^{-4}. \end{aligned}$$

Besides these some bands appear in the red and infrared. The more intense heads can be classified in the following two groups :

Band heads, degraded to the	
violet	red
16,906 cm.$^{-1}$	17,724 cm.$^{-1}$
16,828	16,788
16,163	16,467
	16,366
	15,981
	15,506
	14,227

The search for the still unknown spectrum of gallium hydride is now in progress.

Further details concerning the band spectrum of indium hydride will be published later.

BIRGER GRUNDSTRÖM.

Department of Physics,
University of Stockholm.
Feb. 21.

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[1] Grundstrom, B., NATURE, 140, 365 (Aug 28, 1937); Grundsstrom, B., and Valberg, P., *Z. Phys.*, 108, 326 (1938).

Science and the Unobservable

IN his Royal Institution discourse, published in a Supplement to NATURE of January 1, Prof. H. Dingle has made an attempt to show that, if we regard the recent trend of physics (expressed by the principle : "nothing which is logically or physically unobservable is significant") as legitimate, we are idealists. This is no new conclusion and the very thing to which M. Maritain[1] and R. J. Dingle[2] object.

It seems that Prof. Dingle does not realize exactly for what reasons we can disagree with Einstein when he says that : "The concept [of simultaneity] does not exist for the physicist until he has the possibility of discovering whether or not it is fulfilled in an actual case. . . . As long as this requirement is not satisfied, I allow myself to be deceived as a physicist (and of course the same applies if I am not a physicist), when I imagine that I am able to attach a meaning to the statement of simultaneity".

When we speak as physicists, we consider only phenomena which are observable with physical means. When we speak as non-physicists, we consider, besides physical observation, also other means of apprehension. We can only pretend that the two ways of speaking are the same, if it is proved that we have no other means of apprehension than physical ones, that is, sense-perception. But if we do have such superior faculties, we cannot conclude that our limitations when we are using only a part of our faculties (physical means) are the same as when we are using all our faculties.

In the particular case considered here, the question therefore comes down to this : Can we, by means of our present human faculties, reach the idea of simultaneity without observing it physically ?

In order to make it easier to answer this question, let us apply the above-mentioned principle (rejection of physically unobservables) to Prof. Dingle's article. What will be the result ? By means of pure sense-perception, we see black signs on white paper; we can measure these signs and investigate the physical properties of the materials. But if Prof. Dingle says that there is more than that in his paper, we will be obliged to reject this opinion because the reasoning which he wants us to understand is physically unobservable. This is our attitude as a pure physicist. But man has an intellect; he not only *knows*, he can also *understand*. He can have abstract ideas: 'the unobservable', 'truth', 'simultaneity', etc. In practice we cannot talk as 'pure' physicists. As human beings we always use our reason in addition to our sense-perception and we always reach to some extent the physically unobservable. It is for this reason that Prof. Dingle's article means more to us than paper and ink.

It seems clear that universal ideas, first notions on which all our reasoning is based and on which mathematics and science in general rest (axioms, postulates), are beyond sense-perception and physical observation. Our mind enables us to escape from the relative and reach the absolute.

Prof. Dingle's words: "M. Maritain and those who agree with him claim that the simultaneity of spatially separated events is something independent of our means of observing it. When asked what it is, they claim that its nature is immediately evident and that everyone knows it. But Einstein says he does not know it, and Einstein is an honourable man. And the only reply is that Einstein and his followers must be speaking as physicists" do not correctly state the question. Simultaneity is independent of *physical* observation, but not necessarily of the 'observation' of our minds. The abstract idea of simultaneity is immediately evident in the sense that we have (or should have) this evidence because we are rational beings. If Einstein believes that he has not this evidence, it may be because he did not consider sufficiently the question from this angle, or because he did not fully appreciate the power of mind[3].

In order to check idle invention, but to keep in mind our intellectual faculties, we need only replace the word "physically" by "essentially" in the above principle. Nothing which is logically or essentially unobservable is significant.

Prof. Dingle seems to be perfectly right when concluding that divergence of opinion results from a difference of philosophical attitude. One may say that physicists are not always sufficiently aware that they are sometimes talking as metaphysicists. As a physicist, Einstein may base a theory on the assumption that 300,000 km./sec. = infinity, but as a rational man he has no right to maintain this postulate, because our mind is not limited by the speed of light, a physical phenomenon.

S. VAN MIERLO.

9 Rue Pierre Bertin,
Versailles.
Jan. 14.

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[1] "Reflexions sur l'Intelligence", pp 202–261

[2] "The Faith and Modern Science", pp 40–56.

[3] Other men of science, like Prof Max Planck, who have paid a good deal of attention to the philosophical side of such questions, are fully aware of having such evidence. See "Positivismus und Reale Aussenwelt" (Leipzig 1931) and "Religion und Naturwissenschaft" (Leipzig, 1937)

PROF. DINGLE arrives at a startling conclusion, namely, that if any physicist believes that "the universe exists independently of our experience of it" he must also "presume that he is omniscient" (p. 28). This conclusion is reached in the course of an examination of the current principle in physics that only observable quantities are significant. In his reasoning, however, I think that he makes the mistake of overlooking the admittedly limited and in large part tentative character of all scientific knowledge.

To avoid misunderstandings of this sort, I think that Prof. Dingle's statement of the principle of observability needs to be amplified a little, perhaps as follows: Only that which is practicably observable —that is, only that which would be observable if we were able to use known means of observation to the known limits of their possibilities—can form part of present scientific knowledge, and only that which may hereafter become physically observable in this sense is to be admitted into the science of the future. In this form the principle does not deny the existence of what is unobservable, but merely locates it outside the realm of scientific knowledge; and it does not imply the claim that the physicist can make, here and now, a *final* classification of ideas into observable and unobservable, which would indeed partake of omniscience. More sweeping statements can be found, to be sure, among the commentators on modern physical theories, whose eloquence seems sometimes to outstrip their scientific caution, but scarcely in the professional writings of the *creators* of the new theories.

To take the example cited by Prof. Dingle, it is a fact that absolute simultaneity is unobservable in terms of modern physics, since known laws furnish us with no means of detecting it. To many minds there seems to exist a strong presumption that it will always elude detection, but this presumption can never rise to a certainty; Einstein himself would admit the possibility that a signal travelling with infinite speed may some day be discovered, and that in a certain sense absolute simultaneity would then become an observable thing. When Einstein said, in the passage quoted by Prof. Dingle, that the term had "no meaning", he was referring, I think, to a meaning in terms of present-day experience, and he ought to have said so. It can scarcely be doubted that he would allow to the concept of absolute simultaneity a meaning in the same sense as there is a meaning to the depth of the rabbit-hole down which Alice fell; in this sense we can all follow M. Maritain in distinguishing the meaning of a concept from its use.

Most physicists undoubtedly believe in the existence of a real world different from their own experiences; they feel that this concept best fits the fact that the performances of physical apparatus are largely independent of their own volition. (If I did not believe this, I should have difficulty in believing in the existence of Prof. Dingle.) But they do not claim the ability to explore this external world *completely*; and they will not bother to consider whether things that are destined to remain permanently beyond observation exist or not. "Trivial" our knowledge of the world may be, as viewed from the point of view of some non-human being; but this possibility, apparently disturbing to Prof. Dingle, is surely not a professional cause of annoyance to the working physicist, and I do not think it should seriously disturb any of us. Human experience is the ultimate source of all scientific knowledge, and what lies entirely outside of human experience, and is therefore unobservable, is no concern of science.

Recognition of the limited scope of its generalizations and indifference to the unattainable seem to be two of the most valuable traits of the modern scientific method as contrasted with the speculations of the medieval philosophers, and I think that these are features which might well be introduced in much larger measure into other realms of human thought.

E. H. Kennard.

Cornell University,
Feb. 17.

Mr. Van Mierlo makes two assumptions, neither of which accords with fact—namely, (1) that physics is distinguished from other studies by the instruments employed; and (2) that reason is not an instrument employed by the physicist properly so-called. With regard to the second, I would point out that most of the things to which the physicist attaches significance (for example, the interiors of the earth and stars, the occurrence of unobserved eclipses, etc.) are not observed by the senses, but apprehended by reason. On the first point it is surely common knowledge that the distinguishing characteristic of physics (and that purely for convenience) is not its instruments but its subject-matter. The physiologist who uses a galvanometer does not thereupon become a physicist, and if a physicist used a stethoscope, or even logic, to attack a physical problem, his work would not on that account be refused publication by the Physical Society. The determination of the time of occurrence of a physical event is a physical problem, and if the times of occurrence of two events are identical, the events are simultaneous. If Mr. Van Mierlo could determine those times for two spatially separated events *by any means at all*, and get results which are independent of his velocity (such velocity being defined, of course, in terms consistent with the definitions of the times and distances of the events, or the process would be irrational), physicists would acknowledge the obligation to revise their theories accordingly.

Prof. Kennard wants to remain a realist, that is, to believe in a world existing independently of experience; to avoid the stigma of a profession of omniscience; and to approve the scientific rejection of absolute simultaneity. Notwithstanding his letter, I do not see how this is possible.

Let A be the world in question, and A' that part of it which we can now experience. Then, as a realist, Prof. Kennard must admit that there may be a part, $A\text{-}A'$, which is not experienced. As a non-professor of omniscience he must further admit that when he has discovered A'', the portion of $A\text{-}A'$ which the complete exercise of known means of observation would allow him to discover, there may still remain a portion, $A\text{-}A'\text{-}A''$, which is beyond his knowledge. Now, absolute simultaneity does not belong to A' or A''. Hence, either it belongs to $A\text{-}A'\text{-}A''$ or it does not exist. As a realist, Prof. Kennard must admit a significant distinction between these alternatives; and, as a non-professor of omniscience, he cannot decide between them. He can therefore make no pronouncement on the matter. But the principle of relativity says: "It is impossible to detect motion relative to the ether"; and this is equivalent to a denial of existence to absolute simultaneity. It therefore *does* make a pronouncement on the matter. Prof. Kennard must therefore reject it; or cease to be a realist; or profess omniscience.

It is not a mere matter of words. Relativity does not merely say that we cannot now detect absolute simultaneity; we knew that before the theory was put forward. That is simply a statement of the *problem* aroused by the Michelson-Morley and other experiments, but relativity professes to be a *solution* of that problem. It proceeds to organize the experience we have in a way which would be invalid if absolute simultaneity were unobservable merely from temporary lack of knowledge.

I think that Prof. Kennard's reluctance to accept this conclusion arises from a mistaken notion of what idealism (in the sense implied in this discussion) means. He introduces the question of volition, but that has nothing to do with the matter. Certainly our observations are largely independent of our volition, but the question is simply whether we are to assign significance to "existence" independently of observation, voluntary or otherwise. When Prof. Kennard made the experiment of looking at Nature of January 1, he saw marks which his rational mind interpreted in terms of a hypothesis called Dingle. The performance of his eyes did not depend on his volition—the marks which he saw had nothing to do with what he would have liked to see—and he could not make rational sense of his experience without the hypothesis referred to, however much he might have preferred to ascribe it to an illusion produced directly by the devil. All that holds good whether he is an idealist or a realist. The question is simply whether scientific progress is best described by saying that we start with experience and grant existence only to that which is necessary to correlate such experience rationally, or that we start with a hypothetical world independent of experience and proceed to find out all that we can about it.

Herbert Dingle.

Imperial College of Science,
London, S.W.7.
March 8.

The Advancement of Science and Society

We are glad to read the letter in Nature of March 19, under the above heading, from Dr. F. R. Moulton, Permanent Secretary of the American Association for the Advancement of Science. It need scarcely be said that the invitation from that body to the British Association to co-operate in forming the nucleus of a wider organization for this great object is engaging our earnest attention, and has already been brought to the notice of the Council of the British Association. We look forward to meeting Dr. Moulton and some of his colleagues this summer, to discussing the project with them, and to having them with us at our meeting in Cambridge. It may be added in regard to the last clause in Dr. Moulton's letter concerning the "planning of the necessary machinery", that a scheme in rough outline has already been forwarded to him for informal comment, in the hope that it may prove possible, whether on the basis of that scheme or of some other, to lay practical proposals before the governing bodies of both Associations at an early date.

P. G. H. Boswell.
(General Treasurer).
F. T. Brooks.
Allan Ferguson.
(General Secretaries).

British Association for the
Advancement of Science,
Burlington House,
London, W.1.
March 21.

Dementia Nomenclatorica Americana

UNDER the above heading, I wrote to NATURE of November 16, 1935, expressing consternation at the ever-increasing hypertrophy in the nomenclature of the Foraminifera. I have continued to correspond with my friend Dr. H. E. Thalmann, and it may interest readers of NATURE to note that, in the last six years, more than two thousand papers have been published upon these Protozoa. These papers give us sixty new families and sub-families, two hundred new genera and sub-genera, and two thousand four hundred new species and varieties. This gives us two to three new genera per month, and two new species per day.

The brain reels and the senses gape at what might be an even partially complete synonymy to-day, and with what the systematists will be confronted in, say, *another* six years is not pleasant to contemplate.

Editors (and others) might do worse than establish a rule to the effect that henceforward no synonyms shall be allowed other than those immediately following d'Orbigny, and up to and including H. B. Brady and his contemporaries.

And—to adopt the terminal terminology of Acts of Parliament: "The Conchyliologie Systématique of Denys de Montfort is hereby repealed."

Since the above was written I have received from Java a paper upon "a second species of *Biplanispira*, etc." This starts a new group of specific names. May we hope before long to add to our nomenclature, *Monoplanulina*, *Hydroplanispira*, *Junkeria*, *Fokkerinoides*, *Handley-Paginella*, and *de Havillandia*? At any rate this would immortalize men who have left the impress of their names upon science, and convey more to posterity than the too-familiar collaborators, who for lack of early literature give us, in turn, *Smithia jonesii* and *Jonesia smithii* for slightly differing forms of *Truncatulina variabilis*—which is no longer *Truncatulina*, but has turned *Cibicides* in a single night.

EDWARD HERON-ALLEN.

British Museum (Natural History),
S.W.7.

'Convergent' Sunbeams

FROM observations made on three different occasions during past few summers, I can corroborate in every detail 'convergent' sunbeams reported by J. J. Hopfield[1]. Always in the late afternoon, the sun just having set behind the Jura and sending out 'fan-like' beams of alternating light and shade, there seemed to be issuing from the opposite horizon behind the Savoyard Mountains (Mont Blanc) similarly radiating beams. Though somewhat faint overhead, the continuous course of these bundles could be clearly traced between the eastern and western horizon.

Only recently a friend told me that flying over Mexican waters about a 1,000 ft. up during the solar eclipse he found himself to be the centre of converging beams from the corona.

ARNOLD C. KLEBS.

Les Terrasses,
Nyon (Lake Geneva).

[1] NATURE, 141, 333 (1938).

THE striking phenomenon reported by Dr. J. J. Hopfield[1] is occasionally seen in Great Britain. I have witnessed two excellent examples, one on June 24, 1935[2], and another on September 12, 1936[3], at Hastings. Mr. W. L. Baxter has recorded a similar occurrence on March 17, 1934, at South Farnborough, Hants[4]. In two of the cases mentioned, the sun had set 20–25 minutes previously. The rays were pale rose or delicate pink in two of these records and orange-yellow in the remaining one, and were of considerable width. The rays extended completely across the sky from north-west to south-east on June 24, 1935, and from west to east on September 12, 1936, and convergence due to perspective was extremely well and strikingly seen. These rays are perhaps more likely to be observed in thundery weather when hard and well-defined cumulus clouds may be ranged low down on the horizon (or even below the horizon) so that protuberances on the cloud throw shadows much in the same way as is commonly seen when the sun is shining brightly behind well-defined cumuli during the daytime. In the latter case rays may be both projected upwards and radiating from the sun as a centre if the cloud is large and unbroken and with a hard summit, or projected downwards to the ground (a much commoner occurrence) if there are breaks or holes in the cloud sheets.

In connexion with the latter example it was an old idea that these rays meant coming rain, and an old saying, "The sun is getting up his back stays, and it is time to look out for bad weather" refers to this; also these rays gave rise to a saying that the "Sun is drawing water" and rain will soon follow.

A. E. MOON.

39 Clive Avenue,
Clive Vale,
Hastings.

[1] NATURE, 141, 333 (1938).
[2] Met. Mag., 70, 158 (1935).
[3] Met. Mag., 71, 210 (1936).
[4] Met. Mag., 69, 119 (1934).

THE necessary conditions for the phenomenon of convergent sunbeams are a slight haze spread evenly overhead, and a few small cumulus clouds on the eastern horizon. The best example that I have seen was at sea while travelling from Cape Town to Durban at Easter 1899. By good fortune, Mr. R. T. A. Innes, then secretary of the Cape Observatory, and others were on board, and there was opportunity for careful observation and comparison of notes.

There was a beautiful sunset; cloud shadows radiated from the sun, converging toward a point as far below the horizon as the sun was above it. As the sun set this point rose and the rays met at the eastern horizon. Long bands of pink and blue arched over our heads and over most of the sky like markings of a huge melon. One could have sworn that they were curved—obviously curved—but they were really straight and parallel. A drawing or photograph of any small portion of the sky would have shown straight lines. To the north, south or overhead they would have been parallel, to the east or west they would have been straight but converging. After the sun had set, the converging point rose and a solid-looking blue band touching it, rose too. This was the shadow of the earth, which may often be seen in the east after sunset.

If there is a cloud partly within the band, and partly illuminated by the sun, its height may be calculated. I remember discussing this with Mr. Innes and I tried to perform the calculation, but I saw that refraction would have a considerable effect, and I did not see how to make a quantitative allowance for it. By a curious coincidence, I have just received a copy of a paper by Prof. H. Dember, of the University of Istanbul, which includes a diagram almost identical with one which I sketched in my pocket-book a couple of days ago after discussing the matter with a scientific friend, who agreed that allowance must be made for refraction.

A. P. Trotter.

Greystones,
Teffont, Salisbury.

A phenomenon similar to that described by Dr. John J. Hopfield was well seen by a colleague (Mr. H. F. Finch, then of Abinger Magnetic Observatory) and myself from the summit of Leith Hill, Surrey, in September 1926. My recollection is that the clouds casting the apparently converging shadows were a little to the east of the zenith, and the beams were no doubt brought into prominence by a slight dust haze.

The rarity of the phenomenon must be attributed to the rather precise nature of the conditions necessary; namely, a clear western sky with the sun on the point of setting and a broken line of low cloud lying approximately at right angles to the direction of the sun. The beams passing through the interstices, being practically horizontal, will then appear to converge on the eastern horizon by perspective.

W. M. Witchell.

Royal Observatory,
London, S.E.10.

Points from Foregoing Letters

By means of an improved canal ray tube of Dempster type which gives sharp displaced lines, and with a diffraction grating of 15,000 lines to the inch, Dr. H. E. Ives has observed a displacement of hydrogen lines of approximately 0·05 A. towards the red, *independent of the orientation of the apparatus*. This positive effect confirms the Larmor and Lorentz theory of the relation between matter and the luminiferous ether, according to which a moving clock (in this case the hydrogen molecules emitting the light waves) has its rate decreased in the ratio $\nu = \nu_0 \sqrt{1 - V^2/c^2}$.

A table showing the effect of various solvents (alcohol, cyclo-hexane, hexane, ether, chloroform) on the intensity of absorption in the region 328 mμ by substances containing vitamin A (halibut and fish oils and concentrates) is given by E. L. Smith, B. E. Stern and F. E. Young. The variation is about 20 per cent in the various solvents; chloroform shows a shift in the maximum absorption to approximately 330 mμ. The effect of the solvents is not the same on all the oils investigated and this, as well as the effect of irradiation and storage upon the oils, is tentatively ascribed to the presence of *cis-trans* isomers of vitamin A.

Dr. R. A. Morton, commenting on the above, states that after molecular distillation of halibut intestinal oils, different fractions show a variation in the ratio of the ultra-violet absorption to the antimony chloride colour test maximum, and this also could be plausibly explained by a partial separation of the *cis-trans* forms.

According to Dr. J. Leibowitz and S. Hestrin, certain taka-diastase preparations lose their hydrolytic activity towards sucrose and their slight hydrolytic activity towards alpha-methyl-glucosides, but retain or regenerate most of their hydrolytic ability towards maltose when heated in boiling water. By incubation with taka-diastase, a complete inhibition of yeast maltase may be obtained. Hence yeast-maltase and taka-maltase, the authors conclude, are essentially different in character.

The deleterious effects which herbage grown on the so-called 'teart' areas of Somerset has on milking cattle is due, according to experiments by W. S. Ferguson, Dr. A. H. Lewis and Dr. S. J. Watson, to the presence of excess of molybdenum in the soil and in the herbage therefrom.

Prof. E. D. Adrian reports that, as in the case of the mammals, the cochlea in the ears of reptiles and fishes behaves like a microphone; sound waves give rise in them to electrical potential changes.

Activity in bed-bugs increases the metabolic rate and causes death in a fraction of the time in which resting bugs die. Dr. Kenneth Mellanby directs attention to the importance of considering activity as one of the principal factors in laboratory experiments made to study insect biology.

The occurrence of the young of the brittle star, *Ophiothrix fragilis*, in the genital bursa of the adult is, according to Dr. J. E. Smith, an accidental occurrence, and the bursa may be regarded as a convenient habitation rather than a nursery for the post-metamorphic stage.

According to H. Kersten and H. Branson, irradiation of the first three to five somites of a chætopod usually resulted in the formation of protuberances of various sizes. The heart region was much more resistant; the majority of the animals showed no ill-effects. Irradiation of the somites approximately in the middle of the animals generally resulted in a cleavage at the point, with the death within 24 hours of the posterior section.

Details of the band spectrum of indium hydride, observed in the region 5600–8500 A., are given by Dr. B. Grundstrom. The spectrum was obtained from an arc between electrodes of indium and carbon in hydrogen at high pressure.

Commenting on Prof. Dingle's dilemma that modern physics with its assumption that *only that which is logically or physically observable is significant*, leads one either to assume omniscience, or to deny the existence of the external universe, S. Van Mierlo points out that, by using reason in addition to sense perception, one always reaches the physically unobservable. He suggests that, in the statement of the principle, the word *physically* should be replaced by *essentially*. Prof. E. H. Kennard would avoid the dilemma by admitting that the limits of the observable are being continuously extended and that, for example, if a signal travelling with infinite speed were one day discovered, simultaneity would become observable (to observers moving relatively to one another). Prof. Dingle, in reply, considers that neither of these views solves the problem.

Research Items

Natives of Bentinck Island, Queensland

An account of two islands, little known outside Australia, which lie off the coast of Queensland, is given by Mr. Ewen K. Patterson in *Discovery* of March. Of these St. Helena, about five miles from the east coast, was formerly a convict station and is now being converted into a pleasure resort. The second, Bentinck Island, is situated in the far south-eastern corner of the Gulf of Carpentaria and is rarely visited. The natives, who resent the approach of the white man, have not yet been studied at close quarters. Their number is unknown, though it is estimated at about five hundred. They have no habitations, but sleep on the ground uncovered, except for grass to keep off mosquitos, in all weathers. They wear no clothes and have resisted all attempts to civilize them. Such information as is available concerning them is derived from brief visits of missionaries and others. The island is densely covered with forest, in which the natives take cover when white men approach. They use no cooking or eating utensils, except large sea-shells, in which they carry and store water; smaller shells are used for drinking. Sharpened stones are used for opening oysters. Their food consists of oysters, fish, sharks, turtles, dugong and bush berries. All food is thrown into a fire and left to roast for a time, when it is seized and eaten in the hands. Fish are caught in primitive basket traps sunk in the sea, while turtles, dugong and sharks are speared. Canoes are unknown, but rafts are made of a type known nowhere else. These rafts resemble an elongated V, some measuring up to twelve feet in length and ten feet in width at the broad end. They are made of saplings or logs tied together with bark fibre and vines, the space between the saplings being filled with tightly rammed grass or a 'cement' made of clay, grass and small stones. They are propelled by long paddles resembling cricket bats in shape. The natives are expert in throwing a spear, which ranges in length from six to twelve feet, the heads being spines of stingray tails, bones, fire-toughened wood barbs, or pieces of sharp flint.

Large Flights of Shearwaters

That migration involves enormous mass movements of birds is obvious, but it is seldom that a computation of numbers can be made. On July 12, 1937, Henry E. Parmenter sighted a line of shearwaters off the coast at San Francisco flying northward at from three quarters to a mile off shore. The end of the line to the north could not be seen, so that it was impossible to estimate for how long the birds had been passing; from Point Pedro southwards as far as the eye (aided by a binocular glass) could see, the line was continuous and northbound. (*Condor*, 39, 253; 1937). The observer moved southwards by car keeping the line of birds in view, so that he reached a point 30 miles in a direct line from where the birds had been first seen more than three hours before. If the birds were travelling at about 25 miles per hour (a modest estimate) they must have travelled about 80 miles in that time, so that the flight was at least 110 miles long. Some of the birds were settled upon the water in 'rafts' of varying extent, feeding. A raft one mile long and one eighth mile wide, allowing 10 square feet to a bird, would contain at least 359,000 birds. The author estimates conservatively that the number of birds seen by him and his companion on that occasion was at least 750,000. The species concerned was the sooty shearwater, *Puffinus griseus*.

Habitat and Habits of *Trochus niloticus*

This paper by H. Srinivasa Rao recently published (*Rec. Indian Mus.*, 34, Pt. 1, 1937) deals with an important commercial mollusc. Its range is wide in the Indo-Pacific seas and it is common living among coral reefs and under rocky ledges. The author shows that there has been considerable depletion in the shell population due to continual fishing, the rate of collection per diver per hour having fallen from more than 20 in 1933 to 2–3 in 1935. It is a great wanderer within the limits of the reef surroundings, crawling up from about 7 fathoms on reaching maturity. The shallow waters are thus re-stocked. Its movements are very slow as it seeks food and shelter, the usual food being bottom deposits and fresh algæ. Two types of shell are sometimes regarded as specifically distinct, but they are here attributed to changes of shape probably due to differences of growth at various ages. Sexes are about equal. Females are sexually mature when the shells are about 9 cm. in diameter, males when they are about 6–7 cm. Breeding probably occurs throughout the year, but there are indications that during or immediately after the warm season there is an intensive spell. This species lives to be old and is known to attain ten years.

Swarming and Lunar Periodicity of a *Platynereis*

R. Gopala Aiyer and N. Kesava Panikkar describe interesting swarming habits in a species of *Platynereis*, probably new to science (*Proc. Indian Acad. Sci.*, 5, Sect. B, No. 6; 1937). The account of the heteronereid stage and the lunar periodicity in the swarming habits is submitted with the hope that it will lead to further observations on similar phenomena that may occur also in other localities on the Indian coast. The swarming habits were observed inside Madras harbour for a period of one year. All instances of swarming occurred between 7 and 10 p.m. on days of new moon and a day or two before or after. The time corresponds to the period of maximum high tide for that particular day. On every occasion the sea was calm and there was intense phosphorescence caused by *Noctiluca*. The syllids themselves do not produce light. An interval of three lunar months is observed between successive swarms, and swarming took place during the new moon in the months of March, June and September. No swarming was observed in December although special watch was kept on the day of new moon and the days before and after. The sea was very rough and there was no *Noctiluca*. The authors are of the opinion that the annual swarming has probably ceased with the September display, and occurred again in the March following.

Growth-controlling Substances in Plants

IN a series of preliminary experiments with these substances, Dr. H. L. Pearse has examined the reaction of leafless woody cuttings to treatment with root-forming substances (*Ann. Bot.*, N.S. 2, No. 5, 227; 1938). The experiments were performed on leafless cuttings of *Salix vitellina*, and the synthetic root-forming substance was indole-butyric acid in lanolin paste in one series and indole-butyric acid dissolved in water in the other. Some interesting results were also obtained from partial and complete ringing. It was found that treatment of the basal end of cuttings stimulated root-formation at that end. If, on the other hand, the apical end was treated, root-formation was accelerated throughout the length of the stem, though acceleration was at a maximum at the node nearest the apex and the number of roots decreased from apex to base. Ringing experiments showed that the indole-butyric acid was transported downward in the stem through tissue outside the xylem. It is suggested that the indole-butyric acid itself was the active agent concerned in root formation, and was used up or chemically changed in the process, since when the portion of the base which had been treated was removed, the effect of treatment was eliminated, but if more indole-butyric acid was added, then further response occurred.

Effects of Variations in Atmospheric Carbon Dioxide

ON February 16 a paper was read before the Meteorological Society which deals with a subject that has not occupied the attention of meteorologists very much hitherto, namely, the effect of variations in the amount of carbon dioxide in the atmosphere on the long wave radiation from the atmosphere to the earth, and the consequent effect on temperature. The particular variations with which the author, Mr. G. S. Callendar, is concerned, are those due to fuel combustion, and his subject amounts, therefore, to a study of the effect of fuel combustion on the mean temperature of the atmosphere of the earth, and so on climate. He calculates that the annual addition of carbon dioxide to the atmosphere from this source is [illegible]300 million tons, and by consideration of various other factors that control the amount of free carbon dioxide, such as the solution of the gas into the water of the oceans, arrives at 6 per cent as the calculated increase between 1900 and 1936, resulting from the fuel combustion. An examination of accurate determinations of the amount of carbon dioxide in the atmosphere, made by Brown and Escombe around 1900, and of recent determinations in the eastern United States, suggests that the actual increase and the calculated increase agree very well. The radiation absorption coefficients of carbon dioxide and water vapour are used to show the effect of the former upon the downward radiation of the atmosphere. The observed radiation is due mainly to infra-red absorption by varying amounts of water vapour and from the 3 parts in 10,000 of carbon dioxide normally present in the air. In temperate regions he calculates that with vapour pressure 10 millibars only 5 per cent of the radiation comes from the carbon dioxide, but that in polar regions the proportion is three times as great. A study of the effect of changes in the amount of carbon dioxide on the mean temperature leads to the conclusion that the observed and calculated artificial increase in recent years due to combustion is causing an increase of mean temperature at the rate of 0·003° C. per year. Temperature observations for the last fifty years from different parts of the world are examined and it is claimed that these show an increase at the rate of 0·005° C. a year.

Structure of Rubber

WITH the more extensive data from new X-ray diffraction patterns of stretched rubber an attempt has been made by H. A. Morss, jun. (*J. Amer. Chem. Soc.*, 60, 237; 1938) to find the true unit cell. No really satisfactory solution was reached but some points of interest are described. It appears that the carbon atoms of a molecular chain are not coplanar in stretched rubber. The reason appears to be the large repulsive forces which would have to exist in that configuration. In rotations on the single bonds during stretching and retraction the interatomic forces are probably repulsions in the dominating pairs, the prevailing H—H distances in the closest pairs suggesting repulsive rather than attractive forces. Repulsions give a plausible explanation of the form of the outer part of the stress-strain curve. A structural formula of rubber is proposed. The density of crystalline, stretched rubber as calculated from the unit cell is about 1·00 when the angle between the two independent sets of planes which reflect the two equatorial spots is changed from 90°, which first suggests itself, to 109·5°. This value agrees better with the experimental value 0·96 than the values calculated from other structures.

Production of Cosmic Ray Showers

THE investigation of cosmic ray shower-production by counters only gives an indirect and clumsy analysis of the size of the showers, and M. A. Starr (*Phys. Rev.*, 53, 6; 1938) has examined the production of showers in lead by taking a large number (about 20,000) photographs in a Wilson cloud chamber containing a lead plate. The chamber was released by a coincidence counter arrangement, and the rays are therefore to some extent selected, but it is considered that this selection does not seriously interfere with the statistical conclusions. The frequency of showers of different sizes was studied as a function of the plate thickness. The results are consistent with the cascade theory of showers of Bhabha and Heitler and of Carlson and Oppenheimer. According to these views, energetic electrons lose energy by γ-ray formation and the γ-rays produce electron pairs which again give rise to γ-rays. The average size of a shower increases with the thickness of the lead layer. It is found that about 8 per cent of the electrons striking a 7-mm. lead plate give rise to showers, and that about an equal number of showers are produced by γ-rays. This probability of shower production is much less than expected if all the incident particles observed are electrons obeying the theory, and it appears that more than half the particles are anomalous from this point of view. R. B. Brode and M. A. Starr (*Phys. Rev.*, 53, 3) discuss the ten nuclear disintegrations producing heavily ionizing tracks which were observed in the course of the work. Since these disintegrations coincided in time with the passages of a cosmic ray particle through the counters, they are believed to be due to cosmic rays. They are interpreted as the 'evaporation' of particles due to violent excitation of the nucleus and a sharing of the energy among the nuclear constituents as suggested by Bohr's nuclear theory.

Constitution of the Ionosphere and the Lorentz Polarization Correction

By H. G. Booker and L. V. Berkner

Department of Terrestrial Magnetism, Carnegie Institution of Washington

SOME years ago considerable discussion took place concerning the relation between the constitution of the ionosphere and its refractive index for radio waves. The question at issue was whether the force per unit charge exerted by the electric field of a radio wave upon an elementary charged particle in the ionosphere should be taken simply as the Maxwellian electric intensity E (the Sellmeyer theory), or whether there should be added a contribution $(4\pi/3)P$ (the Lorentz theory), P being the electric moment per unit volume produced by the radio wave in the neighbourhood of the charged particle under consideration. The discussion culminated in a paper by Darwin[1] which is the most exhaustive treatment of the subject so far published. This seemed to point to the conclusion that on theoretical grounds one should expect the Sellmeyer theory to hold good in the ionosphere at radio frequencies.

A clear-cut experiment for deciding between the two theories was first indicated by Ratcliffe[2] and afterwards described in detail by Goubau[3]. The experiment depends on the fact that, for radio waves, the ionosphere is rendered doubly-refracting by the influence of the earth's magnetic field. Free electrons in the ionosphere gyrate around the earth's magnetic field with a frequency of the order of a megacycle per second. For wave-frequencies less than the gyromagnetic frequency there is, under suitable conditions, a clear-cut distinction in the behaviour of the extraordinary wave according to the two theories. The distinction should become apparent when measuring, by the well-known method of vertical radio-sounding of the ionosphere, the variation of echo retardation with wave-frequency below the gyromagnetic frequency in certain regions of the earth. Where the magnetic dip is greater than $\sin^{-1}(1/\sqrt{3}) = 35°$, but less than the value at which vertical propagation in the ionosphere at the wave-frequencies under consideration passes from quasi-transverse to quasi-longitudinal type, the distinction between the two theories is the following. According to the Sellmeyer theory, the virtual height of the extraordinary wave increases to infinity as the wave-frequency increases to the gyromagnetic frequency. However, on account of strong absorption of the extraordinary wave in the immediate neighbourhood of the gyromagnetic frequency, it would be quite impossible to trace the extraordinary wave to an enormous virtual height at a wave-frequency just below the gyromagnetic frequency. On the other hand, according to the Lorentz theory, the virtual height of the extraordinary wave increases to infinity as the wave-frequency increases to a value which we shall call the Lorentz frequency and which is definitely below the gyromagnetic frequency. Moreover, the absorption of the extraordinary wave just below the Lorentz frequency according to the Lorentz theory is less than it is just below the gyromagnetic frequency according to the Sellmeyer theory. In consequence there is a greater possibility of tracing the extraordinary wave to a great virtual height if the Lorentz theory is valid than if the Sellmeyer theory is valid.

At Kensington, Maryland, U.S.A., where the magnetic dip is between 71° and 72°, the Lorentz frequency, neglecting the effect of heavy ions, is about 17 per cent less than the gyromagnetic frequency. Moreover, the reflection coefficient of the extraordinary wave just below the gyromagnetic frequency according to the Sellmeyer theory is about four orders of magnitude less than it is just below the Lorentz frequency according to the Lorentz theory.

The accompanying figure reproduces one of a large number of records which have been obtained over the past year at the Kensington Experimental Station, using the automatic multifrequency equipment developed in this Department. Towards the lower end of the frequency-range these records show echoes the virtual heights of which increase with increase of wave-frequency and tend to infinity as the wave-frequency increases to 1·38 mc./sec. At a frequency slightly below 1·38 mc./sec. it is actually possible to recognize the individuality of successive echoes the wave-frequencies of which differ by known amounts, and to deduce that the virtual height is here increasing with increase of wave-frequency at about a hundred kilometres per kilocycle per second. We interpre these echoes as due to reflection of the extraordinar wave from the F-region of the ionosphere at wav frequencies below the gyromagnetic frequency. T value of the gyromagnetic frequency at ground-level at Kensington is 1·61 mc./sec., and if it decreases with increase of height according to the inverse cube of the distance from the centre of the earth (as it should to a close approximation) it has the value 1·54 mc./sec. at a height of 100 kilometres and 1·44 mc./sec. at 250 kilometres.

One of the striking features of the record here reproduced is that the echo in question can be traced to the enormous virtual height of 1,600 kilometres before it finally fades out. This simple fact makes it obvious from the outset that it is impossible to explain these results in terms of the Sellmeyer theory without drastically reducing, in complete contradiction to accumulated experience, our idea of the order of magnitude of the damping experience by radio waves in the ionosphere.

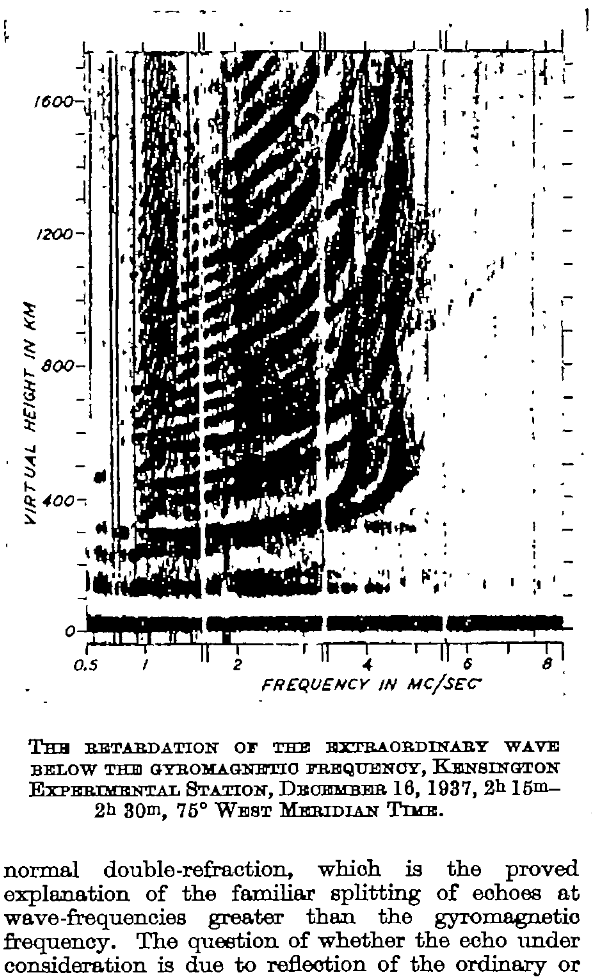
It is important to realize that the large retardation experienced by these echoes is not taking place near the point of reflection. According to either the Sellmeyer or the Lorentz theory, most of the retardation and absorption of the extraordinary wave at these frequencies takes place where the electron density is something like a quarter of that required to reflect the wave. Since the frequencies in question cannot be much above the E-region penetration-frequency for the extraordinary wave, and since there is reason to believe that considerable ionization exists between the E- and F-regions, one might expect on theoretical grounds that most of the retardation and absorption of these echoes would occur in the lower part of the E-region where the ionization density first becomes appreciable. This is confirmed experimentally by the multiple echoes which appear on most of the records. Prominent among these multiples are echoes which, in addition to having travelled up to the F-region and back again, have been reflected back and forth between the E- and F-regions one or more times, suffering partial reflection from the top of the E-region in a manner which is quite common but not fully understood. The consequent additional retardation suffered by these multiple echoes is found to be almost *independent of wave-frequency*. This confirms the expectations that the large retardation experienced by the echoes at wave-frequencies just below 1·38 mc./sec. takes place in the lower part of the E-region. Now we can prove from observations of the penetration-frequencies of the E-region that the value of the gyromagnetic frequency at the level where the waves penetrate the E-region is certainly greater than 1·50 mc./sec.

To interpret these observations in terms of the Sellmeyer theory, it would therefore be necessary to assume that the gyromagnetic frequency, which is proportional to the magnitude of the earth's magnetic field, varies with height above the surface of the earth in the following manner: (1) A decrease from 1·61 mc./sec. at ground-level to 1·38 mc./sec. in the lower part of the E-region, corresponding to an inverse tenth or eleventh power of the distance from the centre of the earth; (2) a sharp increase to a value greater than 1·50 mc./sec. at the level where the waves penetrate the E-region; (3) at greater heights the gyromagnetic frequency could decrease as the inverse cube of the distance from the centre of the earth in agreement with the theory of the earth's magnetic field. In addition it would be necessary to reduce the accepted estimate of the collisional frequency in the lower part of the E-region by more than an order of magnitude and at the same time to explain why the attenuation of radio waves in general is as great as it is. The interpretation of these observations in terms of the Sellmeyer theory would therefore seem to be out of the question.

Qualitatively there seems to be no objection to interpreting the results in terms of the Lorentz theory. To obtain a quantitative interpretation it is necessary to realize that good theoretical reasons exist for believing that considerable numbers of molecular ions are present in the lower part of the E-region and that these can materially affect the value of the Lorentz frequency. In interpreting our results in terms of the Lorentz theory we therefore choose the molecular ion-concentration to have the value which brings the Lorentz frequency to 1·38 mc./sec. The ratio of molecular ion-density to electron-density in the lower part of the E-region turns out to be about ten thousand. Observations of the penetration-frequencies of the E-region show that at the level where the waves penetrate the E-region this ratio has a value of the order of one thousand. Heavy ion-concentrations of these orders of magnitude do not seem unreasonable and are required in order to explain satisfactorily the diurnal variation of terrestrial magnetism.

It is hoped to publish in the near future a detailed discussion of the results and conclusions sketched above.

While this work was being prepared for publication, an account of similar, though apparently less complete, observations was published by Martyn and Munro[4]. But these authors' interpretation of the observations is entirely different from our own, and their conclusion diametrically opposite. The echo which we interpret as due to normal reflection of the extraordinary wave, they interpret as due to an abnormal reflection of the ordinary wave. We are at a loss to understand why Martyn and Munro completely ignore the possibility that splitting of echoes at wave-frequencies less than the gyromagnetic frequency may be due to normal double-refraction, which is the proved explanation of the familiar splitting of echoes at wave-frequencies greater than the gyromagnetic frequency. The question of whether the echo under consideration is due to reflection of the ordinary or extraordinary wave should be settled by observation of its elliptical polarization. It would appear that this has already been done by Farmer and Ratcliffe[5], who found the echo to have the elliptical polarization corresponding to the extraordinary wave in agreement with our interpretation, but who were unable to follow it to wave-frequencies sufficiently high to decide between the Sellmeyer and Lorentz theories.



THE RETARDATION OF THE EXTRAORDINARY WAVE BELOW THE GYROMAGNETIC FREQUENCY, KENSINGTON EXPERIMENTAL STATION, DECEMBER 16, 1937, $2^h\,15^m$–$2^h\,30^m$, 75° WEST MERIDIAN TIME.

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[1] *Proc. Roy. Soc.*, A, 146, 17–46 (1934).

[2] *Wireless Engineer*, 10, 354–363 (1933)

[3] *Hochfrequenz.*, 44, 138–139 (1934).

[4] NATURE, 141, 159–161 (1938).

[5] NATURE, 135, 831–832 (1935).

Recent Developments of Plant Virus Research

A MEETING of the Royal Society held on March 17 was devoted to discussion of "Recent Developments of Plant Virus Research". The proceedings were opened by Dr. R. N. Salaman, who indicated the lines along which research is progressing. He then dealt in detail with problems arising from the existence of distinct strains within a plant virus, with special reference to potato virus X. Six distinct strains of this virus have been isolated at Cambridge. Wide differences in virulence exist between them, but their relationship is shown by the identity of physical characters and especially by the fact that presence of any one strain in a host prevents reinfection with any other of the six strains. This protective effect implies the existence of a radical common to all X virus strains and distinct from any which may determine virulence. From the differences between the reactions of some strains on potato and tobacco and from the effect of mixing strains with tobacco mosaic he deduced the presence of three or four more radicals. Attention was directed to the possibility of prophylactic inoculation for protection of field crops.

Dr. K. M. Smith discussed "The Ultrafiltration of Plant Viruses". He summarized work on the determination of particle size and stressed the difficulty of interpreting data obtained by filtration of purified virus proteins through graded collodion membranes. Certain plant viruses can only be made to pass membranes of pore size exceeding 400$\mu\mu$, a result attributed to low virus concentration and loss by adsorption. Concentration of viruses leads to reduced filterability. Thus *Lycopersicum* virus 4 and *Nicotiana* virus II in fresh sap have estimated particle diameters of 18–20$\mu\mu$, whilst in purified solutions the values obtained are 80–85$\mu\mu$. With *Nicotiana* virus I the corresponding figures are 22 and 120$\mu\mu$ respectively, results partly explicable on the assumption that in purified and concentrated solutions aggregation of particles takes place. By use of a cataphoresis apparatus the last-named virus can be drawn through a membrane of 13$\mu\mu$ pore diameter. This indicates the existence of ultimate virus units having diameter about 4$\mu\mu$.

Mr. F. C. Bawden described work on purification of crystalline and liquid crystalline virus proteins. From plants infected with tobacco mosaic a nucleoprotein has been isolated, solutions of which have a satiny sheen. When such a solution is slowly concentrated, it becomes viscous, and when shaken the resultant gel breaks up into microscopic needles. A strong solution allowed to stand separates into two liquid layers; the lower and more concentrated is completely birefringent whilst the upper exhibits anisotropy of flow. The difference between the layers has thus been attributed to more perfect orientation of suspended rod-shaped particles in the lower solution. In the host cell the 'X' bodies are not birefringent, but the striate material peculiar to this virus exhibits birefringence along the transverse axis and suggests formation of true virus crystals in the plant, although infected host sap represents only a 0·2–0·3 per cent concentration of virus protein. Great differences may be inferred between the state of virus particles in the host and in purified preparations; the latter are much less infective and show greater anisotropy of flow than a clarified sap of similar concentration. The virus of tomato bushy stunt is also a nucleoprotein, but its purified preparation shows no anisotropy of flow and crystallizes in perfect rhombic dodecahedra.

Prof. J. D. Bernal described the conclusions drawn from X-ray study of the structure of the virus protein molecule. No difference in intramolecular structure can be detected between liquid crystalline proteins isolated from different strains of tobacco mosaic. All have the regular internal crystalline structure characteristic of such proteins as the globulins, and their molecules apparently consist of a number of primary units of dimensions $6 \times 6 \times 6{\cdot}9\mu\mu$. In solutions and gels the particles themselves are also regularly related to each other. The distance between them depends on the concentration of the suspension, but even in a 20 per cent solution an orderly arrangement is maintained. The minimum distance recorded, that in a dried gel, was 132 angstroms, which indicates one dimension of the particle. The corresponding figure for cucumber mosaics 3 and 4 is 135. In plant sap, on the contrary, it was suggested that the virus units of tobacco mosaic are approximately equidimensional, with molecular weight of the order of 200,000 and a size of 120 angstroms.

Dr. MacFarlane dealt with the physical properties of vaccinia, shown by ultracentrifuging to consist of particles of unequal size. Methods were described for determining the density of vaccinia in the undried state, and it was suggested that the vaccinia particle consists of a protein molecule surrounded by an atmosphere of closely bound and orientated water ions. This atmosphere is gradually removed when vaccine is suspended in sucrose solution, while in flocculated virus no water remains. Such a structure implies the impossibility of metabolic reactions on the part of the protein nucleus.

Dr. Findlay summarized the evidence for the existence of strains in animal viruses and pointed out that such strains do not necessarily counter-immunize. Special stress was laid on variation induced by cultivation in unfavourable host tissue, but such altered strains are liable to reversion. Most apparent cases of alteration in properties are probably due to selection from a previously heterogeneous population of strains.

Mrs. Watson discussed the relation of some plant viruses to *Myzus persicæ*. Starvation of the aphis before feeding on the infected plant results in great increase in infectivity, but this effect is lost if the duration of feeding exceeds an optimum period. In the case of *Hyoscyamus* virus 3 and potato virus Y, this period is two minutes; in the case of cucumber mosaic it is fifteen minutes. No direct relationship can be demonstrated between transmissibility by *M. persicæ* and concentration of virus in the plant as estimated by the starch local lesion test.

A general discussion followed, during which Prof. P. A. Murphy stressed the importance of multiplying completely virus-free potato stocks on a commercial scale. Different environments have distinctive virus populations and hence dangers arise from the use of 'masked' plant virus strains as vaccines. Dr. Elford commented on the advisability of reducing adsorption in ultrafiltration work and suggested the use of broth as a medium for re-suspension of purified plant viruses.

Irrigation of Dry Hill Sal Areas in India

THIS subject is discussed by Mr. W. P. M. Warren in the *Indian Forester* of April of last year. Those who have had an acquaintance with the considerable areas of poor open decrepit forest which cover the hills in what was formerly known as Chota Nagpur in the old Bengal Province will be interested to learn of the remarkable experimental work being carried out in a part of this area at Bamiaburu, some twenty miles distant from Chakardharpur on the Bengal-Nagpur Railway. The work so far undertaken has led to results of considerable importance, when it is mentioned that some five sixths of the Bihar forests consist of this worthless type of forest. Of greater value, however, is their apparent opportunity for experimental work on a wider basis in parts of the world where the activities of man are resulting in appalling floods and bad soil erosion.

Briefly, a scheme was commenced in 1933 at Bamiaburu with the object of arresting the run-off water from hillsides by making a system of contour channels. By this means the water percolates down through the soil instead of running to waste. This delayed run-off on an extensive scale would possibly prove a solution for flood problems, by permitting the plain's water, which in any event would be less in quantity, to get away first. As a result of this holding up of the water by the contour channels, remarkable growth is already becoming evident in areas where formerly hollow stagheaded drought-stricken trees prevailed; blanks are filling up with regeneration and the density of stocking is increasing. The cost of the work is low, Rs. 100 per mile only, if dry rubble bunds (walls) for crossing nullahs are made instead of something more expensive. Observations taken during the last year or two have shown that the night temperature in April in the area at present under treatment (height 1,250 ft.) under steady meteorological conditions was equivalent to that experienced at 3,000 ft. in these parts. Humidity and rainfall in May (1936), under disturbed atmospheric conditions were higher than at any other recording station nearby, though its situation and topography were less favourable than at one station. Clouds in the latter half of this month spread each evening over the areas, with the often purely local precipitation of rain. Additional light showers during the day fell only in the area itself, and not outside, and so were not recorded. Mr. Warren does not pretend to be a meteorological expert. No recording station with a similar situation to Bamiaburu exists in the neighbouring areas, and he had not the advantage himself of proper equipment. He therefore only summarizes actual experiences and records obtained. It is too early to claim too much from this remarkable experiment. But to those formerly acquainted with this, in April and May, torrid region, the results so far attained appear to open great possibilities.

That this contour-channel method is not a new idea, in India at least, is shown in an article by Dr. R. M. Gorrie, in the May issue of the *Indian Forester*, on that evergreen theme, the erosion in the Pabbi Hills in the Gujrat District in the Punjab. This problem is more than half a century old, the country having been taken over by the British in 1857, some attempts at regulating the grazing on this arid and already heavily eroded mass of foothills rising out of the plain being made about 1877. At this period the erosion was considered in connexion with the North Western Railway line. In the early 1880's reclamation and protection work were taken in hand by the late J. H. Lace. One of the methods introduced by Lace was trenching dug along the contours of steep slopes to catch and hold water for the use of tree seedlings on the berm.

Lace's work was successful, but Government soon let it drop, and the subsequent history of the Pabbi is depressing reading. What has forced the Pabbi erosion question to a head in modern times is the building of the Upper Jhelum Canal. This work is being affected to a serious extent by the enormous masses of silt brought down in the sudden floods, and considerable sums of money have had to be spent on protective works to the canal system from this cause alone.

Scientific Tests of a Vaudeville Telepathist

BULLETIN 3 of the University of London Council for Psychical Investigation consists of a detailed study by S. G. Soal of the hyper-acuity of the senses that is made use of by Josef Kraus ("Marion"), either consciously or unconsciously, in producing his demonstrations of telepathy and clairvoyance. The interest of this report is enhanced by the fact that it is the first scientific research into this subject, and it need scarcely be pointed out that the precautions that have to be taken when human beings are the material of the experiment far exceed those necessary in other branches of science. As an exposition of these precautionary measures alone, the Bulletin is quite outstanding and should be carefully studied by everyone interested in psychical research. Incidentally, the facts disclosed in this research throw very grave doubt on the supposed proofs of telepathy and clairvoyance that have recently received considerable publicity, and in particular those of Dr. J. B. Rhine in the United States.

In Section 1, a statistical study of the results of experiment shows that Marion can rapidly locate small objects that have been hidden by a small audience who know the hiding-place and whose involuntary movements he is able to observe. Similarly, he can determine an imaginary hiding-place concentrated on by the audience when no actual object is hidden. But he cannot improve on chance results if the audience is screened from his view, or if no one in the room is consciously aware of the hiding-place. This indicates that he gets visual indications of small unconscious movements by one or more persons in the audience.

In another series of experiments, Marion exhibited a power superior to that of Cumberlandism or muscle-reading by finding hidden objects when followed by a single person who knew the hiding-place. Progressive covering up of this agent by a wooden box showed that Marion could still succeed even when he could see no more than the agent's feet. If the agent was totally covered and wheeled round the room, failure ensued. In this case slight changes in the movements of walking appear to be the principal *indicia*. This result clearly indicates that in any telepathic experiment the agent should not be visible to the percipient.

In Section 2, Marion's power of recognizing cards which he had previously handled, when mixed in a new pack, is studied, and it is shown that this is probably due to tactual discrimination of a high order. His departure abroad prevented experiments to see if he could emulate the blind osteopath, Captain Lowry, by distinguishing the pips on a playing-card by sense of touch alone.

Further statistical and other tests in telepathy and clairvoyance are described in Section 3; but no evidence was provided of any faculty for reading the contents of sealed envelopes or of divining numbers thought of by members of an audience. Marion's claims as regards graphology and psychometry also seem to be without foundation.

Transatlantic Steam Navigation a Century Ago

JUST when the S.S. *Sirius* and the S.S. *Great Western* were being advertised to sail on their first passages to New York, and on the day, March 31, 1838, the *Great Western* left the Thames for the Severn, preparatory to starting on her voyage on April 8, the *Athenæum* published an article running to four pages under the title "Atlantic Steam Navigation". This was one of several articles in the same journal all of which were written with a good knowledge of the subject and in an unprejudiced manner. From the article which appeared in the issue of March 31, the following passages are taken:

"There is really no mistake then in this long talked of project of navigating the Atlantic Ocean by steam. There is no doubt, that is, of the existence of the intention to make the attempt, and to give the experiment, as such, a fair trial. Nor is the intention entertained (like many innovations sometimes more ingenious than will bear much examination) by an irresponsible party, or by one party alone, as we shall presently show. The whole commercial community, at least of our own country, and we may add of the United States, are alive to its interest. In Liverpool, New York and the 'Great Metropolis'—the three depots of the mercantile navigation of Christendom . . . the work goes bravely on. The *Sirius* is absolutely getting under weigh, while we write this paragraph, for America New York, via Cork! The buzz of excitement yesterday reached even the secluded walls of our own study. We rushed down to Blackwall pell-mell, in an omnibus, like all the rest to see not the *Sirius* but the *Great Western*, which the papers have told us so much about for a month past. . . . Groups of nobility and gentry, with his Grace of Wellington at their head, figured in the cabin album; and we met as we came back, the Lord Mayor with his state carriage and four footmen rolling in gold, dashing down to Blackwall to get a last glimpse; all in pursuit, in a word, of the great animals of the day—the steamers now starting for the other side of the Atlantic.

"There is no mistake, then, we repeat, as to the trial of the experiment."

The writer of the article then went on to deal with the *Sirius*, the *Great Western*, the companies, the construction of the *British Queen* at Limehouse, the charges to be made for passengers and letters, the attitude of the Liverpool shipowners and other matters. "Our space," he concluded, "is now small for discussing anew the policy or subsequent prospects of this scheme. We consider it, however, in that view, a subject of very considerable importance, as well as of the most curious and teeming interest. If sustained, there can be no doubt of its vast advantage in *speed*. . . . For the mails, for the immense and vastly increasing correspondence between the two countries, for all personal intercommunication of mercantile men . . . this is a vital and conclusive point. We must count also on an increase in travelling, if not of trade. . . .

"We think the sum of it, for the present, may be taken thus:—the practicability of steam will be established at once. Its speed and its certainty will induce interests, enough for its maintenance, to a greater or lesser extent to support it. All correspondence will be conveyed by it; all mercantile travel and some goods. Most passengers may be shy of it for a time—many for a long time (as some are of railroads still); accidents will happen of course; still the scheme will go on to maturity. Of its influence on other and far greater interests than yet alluded to, we cannot now speak. This is a scheme not to be hastily treated. It is one, too, which may be deferred awhile. All eyes now are turned on the "*commencement* of the end". We may yet discuss with improved data, the *end* of such a beginning."

The *Great Western*, the first steam vessel designed for the Atlantic passage, it may be added, was 212 ft. between perpendiculars, 35 ft. wide inside the paddle boxes and on a draught of 16 ft. 8 in. displaced 2,300 tons. Built of wood, she was strengthened in an elaborate manner by diagonal trussing of wood and iron and was copper sheathed. She had four boilers designed to work at 5 lb. pressure and her engines developed about 750 horse-power. Her machinery weighed nearly 400 tons and she stowed about 600 tons of coal. She left Blackwall early on March 31, 1838, and when she was between Gravesend and Southend a fire broke out around the base of the funnel which threatened to spread to the ship. The fire, however, was got under and the ship eventually left the Severn on her maiden voyage on April 8.

University Events

Cambridge.—At Trinity College, Prof. W. L. Bragg, Cavendish professor of experimental physics and former director of the National Physical Laboratory, has been elected into a professoral fellowship.

At King's College, J. W. S. Pringle and K. H. Harrison have been elected into fellowships. Mr. Pringle was educated at Winchester College, was placed in the first class of both parts of the Natural Sciences Tripos, was awarded the Amy Mary Preston Read scholarship in 1937 and appointed a University demonstrator in zoology. Mr. Harrison was educated at Bootham School, placed in the first class in both parts of the Natural Sciences Tripos and awarded the Benn W. Levy Research Studentship in biochemistry in 1936.

Leeds.—Mr. W. E. Adams has been appointed lecturer in histology and will take up his duties at the beginning of next session.

Oxford.—The Rolleston Memorial Prize of the value of about £100 is awarded every two years for original research in animal and vegetable morphology, physiology and pathology, or anthropology. Memoirs already published may be submitted and graduates of Oxford or Cambridge or research students are eligible. Further information can be obtained from the Registrar of the University, Oxford, to whom the memoirs should be sent before March 31.

The next award of the Radcliffe Prize, which is of the value of £50, will be made in March 1939. It is awarded for research in any branch of medical science and is open to all graduates of the University who are proceeding to a medical degree at Oxford. Further information can be obtained from the Secretary of the Faculties, University Registry, Oxford.

Societies and Academies

Paris

Academy of Sciences, January 24 (*C.R.*, 206, 221–288).

Jean Cabannes and Jean Dufay: The yellow radiation of the night sky. Utilizing numerous photographs made at Montpellier, the wave-length of the yellow line is found to be 5894 ± 1 A. The possibility of this line being produced by the emission of sodium atoms in the upper atmosphere is considered.

Charles Eugène Guye: Rectification of the note of January 4 on the possibility of verifying experimentally the relation $\nu = \nu_0 \sqrt{1-\beta^2}$ of limited relativity.

Raphaël Salem: The convergence *presque partout* of certain trigonometrical series.

Paul Lévy: The variation of the maximum of a function.

Lucien Hibbert: The solution of algebraical equations of the form $z^n = z - a$.

Carlos Biggeri: Some theorems on the peripheral singularities of Taylor's series.

Albert Métral and François Raymond: A method of measuring the resistance caused by the air on a railway train.

Adolphe Festraets: The Stroobant (star) stream.

Bernard Kwal: The indetermination of electromagnetic potentials.

Ouang Te-Tchao: The spectrum of mobilities of the large ions.

Noel Felici: The equilibrium of supra-conductors.

Robert Pinoir: A new method of stabilization of the anodic current of electronic valves with respect to variations of the plate potential.

Michel Cymboliste: The relations between the state of the surface of electrolytic chromium, its structure and its mechanical properties.

F. Redslob and H. Forestier: Study of the reactions of the formation of the ferrites of tin and cadmium.

Georges Costeanu and Paul Renaud: The actions of water, hydrogen sulphide and iodine on sensitive surfaces.

André Chretien and Gustave Oechsel: The use of acetyl chloride as a chlorination agent in inorganic chemistry. Acetyl chloride reacts with various metallic oxides (UO_3, V_2O_5, MnO_2). The apparatus used for the isolation and purification of the products is described and illustrated.

Mlle. Yvonne Garreau: The action of thiochronic acid and of 2·5-dichlorhydroquinone-3·6-disulphonic acid on the primary amines. Constitution of the latter acid and of euthiochronic acid.

Georges Laude: The influence of some factors on the formation of ammonia by boiling proteins with alkaline solutions of potash.

Albert Michel-Lévy and Jean Wyart: The utilization of the high temperatures and high pressures realized in the detonation of explosives for the artificial reproduction of minerals: zincite and willemite. Starting with a precipitate of amorphous silica in a brass container, the detonation of an explosive gives crystallized willemite.

Marcel Chichery: The stratigraphy of the Dinantian formations of the Ardoisière basin, near Vichy (Allier).

Georges Choubert: The Dogger of the Hauts-Plateaux and of the middle Moulouya.

Hubert Garrigue: A study of the variations of temperature of the free air at the edge of an aeroplane.

Roger Faillettaz: Recording atmospherics and storm predictions.

Maurice Burgaud: Magnetic observations in China. Tabulated results from 38 stations in China, reduced to January 1, 1937.

Frédéric Marie Bergounioux: The discovery of a fossil tortoise in the Permian of Saint-Christophe (Aveyron).

André Sarazin: The nuclear evolution of the basidia and of the basidiospores in *Agaricus campestris*.

René Souèges: The embryogeny of the Campanulaceæ. The development of the embryo in *Jasione montana*.

Raymond Cahen and E. Moisset de Espanès: The cardio-vascular effects of the fluid extract of *Gelsemium sempervirens*.

Louis Gallien: The action of dihydrofolliculine benzoate in the differentiation of sex in *Rana temporaria*.

Albert Vandel: The action of X-rays on the terrestrial Isopod *Trichoniscus (Spiloniscus) provisorius*.

Dublin

Royal Dublin Society, January 25.

V. C. Barry: The preparation, properties, and mode of occurrence of laminarin.

J. Carroll: Mineral oils as insecticides. An outline of the extent to which kerosene has been used in the past and of recent research on the use as insecticides of other fractions and grades of mineral oil. A full account is given of the utilization of lubricating oil emulsions, miscible oils, white oil emulsions, and combined tar-distillate and mineral oil sprays. Combination mineral oil and fungicide sprays are discussed, with suggestions as to promising lines for further research.

O. Roberts and J. Doyle: The *p*H of conifer leaves in relation to systematy. Individual variations in *p*H are small. Seasonal variations, though also small, seem definitely related to seasonal metabolic changes. From the examination of more than ninety species it appears that there is a strong tendency in conifers for natural affinity to be expressed in similarities of metabolism, which are shown by correspondence, often very definite, of the *p*H range of the related groups.

Amsterdam

Royal Academy (*Proc.*, 41, No. 1, Jan. 1938).

H. Y. Jordan and J. Guittart: Regulation of the breathing of *Astacus fluviatilis*. The river crawfish reacts by hyperventilation to lack of oxygen as proprioceptive stimulus.

H. A. Kramers: Use of 'grand ensembles' in statistics. Remarks on the application of Gibbs's methods in classical and quantum statistics.

J. G. van der Corput: Two, three or four primes (2).

P. Erdös: Additive properties of squares of primes.

C. S. Meyer: An integral representation of the Whittaker function.

J. F. Koksma: Metric considerations on the approximation of real numbers.

G. C. Hirsch and J. W. Sluiter: Change in the structure and shape of the Golgi bodies in the primary yolk of the hen's egg and the 'system theory' of the Golgi bodies.

P. C. Flu: Investigation into the phage content of phage-containing globulin repeatedly precipitated by means of ammonium sulphate.

P. J. Haringhuizen and D. A. Was: A research on thin layers of tin and other metals. (4) Further investigation on the corrosion by oils. Experiments on the corrosion of iron and cadmium by lubricating oils, and of tin, iron and copper by olive oil and salad oil.

Cracow

Polish Academy of Science and Letters, January 10.

W. Jacyna, L. Malis and A. Obnorsky: Critical remarks on the thermodynamic scale below 1° K. The method used by Kürti, Lainé and Simon is considered incorrect. A thermomagnetic equation of sufficient exactness is indispensable.

T. Banachiewicz: Control relations for the multiplication of Cracovians.

J. Zawadzki and Mlle. A. Ulinska: The dissociation of zinc carbonate and the action of carbon dioxide upon zinc oxide. Contribution to the mechanism of reactions of the type $A_{sol} = B_{sol} + C_{gas}$.

J. Tokarski: The petrographic analysis of the tufas of Berestowiec.

J. St. Mikulski: Experimental researches on the thermal ecology of eggs in the course of development of some tail-less Amphibians (*Rana, Bufo, Pelobates*).

Mlle. J. Ackermann: Experimental histochemical researches on the metabolism of lecithin in the animal organism. The influence of the ingestion of lecithin on the lipid content in the liver.

S. Skowron and Z. Wicinski: Factors determining the duration of the yellow bodies.

Moscow

Academy of Sciences (*C.R.*, 17, No. 8, 1937).

P. P. Dobronravin: A possible interpretation of the new system of the TiO bands in the infra-red.

F. M. Šemiakin and P. F. Mikhalev: Probable mechanism of the formation of periodic ice streaks in the course of soil freezing, with reference to the problem of permanently frozen subsoil.

B. Deriagin: A device for the investigation of the sensitivity of eye to the ultra-short illumination.

N. S. Kurnakov, I. B. Feigelson and A. G. Bergman: Cyclochronograms of salt lakes. Lake Elton (1932–1936).

E. V. Zmačinskij: Reaction for the differentiation of fruit sugar from grape sugar.

M. P. Volarovič and L. I. Korčemkin: Connexion between the viscosity of molten rocks and the acidity coefficients according to F. J. Loewinson-Lessing.

M. P. Volarovič and A. A. Leontjeva: Investigations on the viscosity of obsidians, with reference to the problem of genesis of pumice stone.

D. Kostoff: Size of *Nicotiana rustica* L. × *Nicotiana tabacum* L. hybrid embryos and hybrids in respect to their parents.

G. H. Molotkovskij: A porometer for investigations under natural conditions.

G. M. Psarev: Influence of the alternation of day and night on the nature of the variation in the duration of the various phases of development in soya.

M. I. Menšikov: New data on the distribution of fishes in the basin of the Irtysh.

A. A. Voitkevič: Morphogenetic activity of various parts of hypophysis. (10) The mechanism of the action of the basophile elements of the anterior hypophysis lobes on the feathers of birds.

C.R., 17, No. 9, 1937.

A. Gelfond: A generalization of the inequality of Minkovski.

S. Sobolev: A class of integro-differential equations with several independent variables.

N. Achyeser: The best approximation in a class of constant periodic functions.

A. Markoff: Existence of an invariant integral.

S. I. Wawilow: Nature of the elementary sources of light and the interference phenomena.

A. I. Alichanian and A. S. Zavelskij: (1) The low-energy region of the β-spectrum of radium E. (2) The low-energy region of α-spectra of thorium C'' and thorium B.

I. Koukles and N. Piskounov : Tautochromic vibrations in conservative and in non-conservative systems.

M. M. Katznelson and D. A. Brodsky : Hexahydro-benzil-barbituric acids.

K. I. Makov : Cimmerian deposits in the Skadovsk district, Ukrainian S.S.R.

N. N. Konstantinov : Some interspecific crossings in the genus *Gossypium*.

V. A. Hižniak : Wheat-quitch amphidiploids.

F. Ukradyga and A. Oleksijuk : Nutritive media for sugar beet in sand and water cultures.

V. G. Aleksandrov and O. G. Aleksandrova : Mosaic of wheat endosperm.

N. S. Petinov and P. S. Belikov : Continuous supply of plants with water as an indispensable condition of high yields.

B. I. Balinskij : Production of supernumerary balancers in deficiency experiments in *Triton* embryos.

Washington, D.C.

National Academy of Sciences (*Proc.*, 24, 1–52, Jan. 15).

S. Gaposchkin : Asymmetry of light curves in the 'great sequence' as a function of frequency of period.

B. J. Bok and E. M. Lindsay : Stellar distribution in the vicinity of a southern galactic window.

E. H. Myers : Present state of our knowledge concerning the life-cycle of the Foraminifera. For many of these organisms, now extensively used in problems of stratigraphical geology and as guide fossils in petroleum geology, the life-cycle consists of an orderly succession of sexual and asexual phases, leading to dimorphism of the test or shell.

G. A. Miller : Groups having a maximum number set of independent generators.

M. Richardson : Special homology groups.

H. S. Uhler : Log π and other basic constants. The fundamental formula underlying the work is a formula for π given by Ramanujan. By its use, with machine calculation, values are given for $\frac{1}{2}\log_{10} 2\pi$, $\log_e \pi$, $\log_{10} \pi$, $\log_{10} 2$, $\log_{10} 3$, $\log_{10} 5$, $\log_{10} 7$, $\log_e 17$, $\log_1 17$, $\log_e 71$, $\log_{10} 71$, $\log_e 113$, $\log_{10} 113$, $1/\pi$ and π^2, most of them to more than 200 places of decimals.

A. Fialkow : Einstein spaces in a space of constant curvature.

E. Kasner and J. De Cicco : Classification of element transformations by means of isogonal and equi-tangential series.

J. W. Calkin : Abstract self-adjoint boundary conditions.

J. van Overbeek : A simplified method for auxin extraction. The auxin was extracted from uncrushed material with ether alone, and its concentration is expressed in terms of hetero-auxin (indole-3-acetic acid).

E. B. Fred, P. W. Wilson and O. Wyss : Light intensity and the nitrogen hunger period in the Manchu soybean. Plants exposed at an early stage to intense sunlight are unable to fix atmospheric nitrogen, due apparently to high carbohydrate-nitrogen ratio. By shading a plant for a few days or by addition of combined nitrogen (calcium nitrate), it responded quickly, the leaves becoming green and nitrogen fixation established, due apparently to the change effected in the carbohydrate-nitrogen ratio.

Forthcoming Events

Monday, March 28

Royal Geographical Society, at 5.30.—Film of "Australian Aboriginal Tribes", lent by the British Museum.

Royal Society of Arts, at 8.—Dr. M. A. H. Tincker : "The Growth of Plants in Relation to Cultivation" (Cantor Lectures. Succeeding lectures on April 4 and 11).

Thursday, March 31

British Society for International Bibliography (at the Science Museum), at 5.15.—B. V. J. Brajnikoff : "Abstracting Russian Literature".

Friday, April 1.

Royal Institution, at 9.—Sir Frederick Keeble, F.R.S. : "Humphry Davy, Farmer."

Chemical Society, March 31–April 1.—Annual General Meeting to be held in Manchester.

April 1.—Prof. G. Barger, F.R.S. : Pictet Memorial Lecture.

British Psychological Society, March 31–April 4.—Extended General Meeting to be held in the University of St. Andrews.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned :

Head of the Chemistry Department of the Coventry Technical College—The Director of Education, Council House, Coventry (March 26).

Junior Maintenance Engineers at the B.B.C.—The Engineering Establishment Officer, B.B.C., Broadcasting House, London, W.1 (March 29).

Plant Pathologist in the Department of Agriculture for Scotland —The Secretary (Establishment Branch), 29 St. Andrew Square, Edinburgh, 2 (March 31).

Chemist, Physicists, Bacteriologist and Junior Chemist to the Wool Industries Research Association, Torridon, Leeds, 6—The Secretary (March 31).

Scientific Officers and Junior Scientific Officers in the Department of Scientific Research and Experiment, Admiralty—The Secretary of the Admiralty (C.E. Branch) (April 2).

Assistant (Grade III—chemistry) in the Department of Scientific Research and Experiment, Admiralty—The Secretary of the Admiralty (C.E. Branch) (April 2).

Assistants (Grades I and II—mathematics) in the Department of Scientific Research and Experiment, Admiralty—The Secretary of the Admiralty (C.E. Branch) (April 2).

Physicist in the Radon Department, St. Bartholomew's Hospital, E.C.1—The Acting Clerk to the Governors (April 4).

Junior Scientific Officer in the Wood Chemistry Section of the Forest Products Research Laboratory, Princes Risborough, Aylesbury, Bucks—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (April 9).

Lecturer in Mechanical and Marine Engineering in the City Technical College, Liverpool—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (April 11).

Professor of Chemistry in the University of Sheffield—The Registrar (April 23).

Demonstrator in Mathematics in the Imperial College of Science, Prince Consort Road, South Kensington, S.W.7—The Secretary (April 26).

Assistant Lecturer in Social Psychology in the London School of Economics—The Secretary, Houghton Street, Aldwych, W.C.2 (April 30).

Leverhulme Foundation Fellow and Lecturer in Physics in the University of Liverpool—The Registrar (May 1).

Professor of Chemistry in the Indian Institute of Science, Bangalore—The Registrar (June 1).

Chief Mechanical Engineer and Temporary Chemists in the Royal Naval Cordite Factory, Holton Heath, Dorset—The Secretary of the Admiralty (C.E. Branch, II), London, S.W.1.

Lecturer in Mechanical Engineering in the Borough Polytechnic, Borough Road, S.E.1—The Principal.

Lecturer in Air-Conditioning in the Borough Polytechnic Borough Road, S E.1—The Principal.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Carnegie Trust for the Universities of Scotland. Thirty-sixth Annual Report (for the Year 1936–37) submitted by the Executive Committee to the Trustees on 16th February 1938. Pp. iv+90. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [212

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1936. Part 2. Pp. iv+83. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [212

University of Oxford: Bureau of Animal Population. Annual Report, 1936–37. Pp. 38. (Oxford: Bureau of Animal Population.) [222

British Chemical Plant, 1938. Official Directory Pp. 170. (London: British Chemical Plant Manufacturers' Association.) Free. [222

An Index to Acts of Parliament and Statutory Rules and Orders affecting the Chemical Industry. Supplement No. 1 to second edition. (Published for the Association of British Chemical Manufacturers.) Pp. 8. (Cambridge: W. Heffer and Sons, Ltd.) 6*d*. [232

British Broadcasting Corporation Eleventh Annual Report, 1937. (Cmd. 5668.) Pp. 32. (London: H.M. Stationery Office) 6*d*. net. [252

Philosophical Transactions of the Royal Society of London Series A: Mathematical and Physical Sciences. No. 771, Vol 237: The Royal Society Expedition to Montserrat, B W.I.; Final Report. By C. F. Powell. Pp. 34+5 plates. 7*s*. 6*d*. No. 772, Vol. 237: The Shadow of a Straight Edge. By E. T. Hanson. Pp. 35–66. 4*s*. No. 773, Vol 237: The Computation of Fermi-Dirac Functions. By J. McDougall and Edmund C. Stoner. Pp. 67–104. 5*s*. (London: Cambridge University Press.) [282

Scientific Horticulture (formerly the H E.A. Year Book): the Journal of the Horticultural Education Association. Vol. 6, 1938. Pp. 260+xxxii+20 plates. (Wye: South-Eastern Agricultural College.) 4*s*. net. [13

University of London: University College. Annual Report. February 1937–February 1938. Pp. 178. (London· Taylor and Francis.) [23

Exploration. Edited by Mabel M. Barker. Pp. 12 (interleaved). (London: The Le Play Society.) 4d. [23

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1787 (2821)· Tests on a Single Section of R. 100 at Cardington. By T. S. D. Collins and L. Chitty. Pp. 86+2 plates 12*s*. net. No. 1788 (2845): Estimation of Increase in Lift due to Slipstream. By R. Smelt and H. Davies Pp. 20. 3*s*. net No. 1794 (2908): Lateral Stability of a Single-Engined High Wing Monoplane with Airscrew Running—Yawing Moments due to Sideslip and Rudder Power. By G. A. McMillan, L. W. Bryant and A. G. Gadd. Pp. 41+2 plates. 6*s*. net. No. 1795 (2655)· Forced Oscillations of Aeroplanes, with Special Reference to von Schlippe's Method of Predicting Critical Speeds for Flutter. By Dr. R A. Frazer and W. P. Jones. Pp. 26. 3*s*. 6*d*. net. (London. H M Stationery Office.) [48

Other Countries

India Meteorological Department. Scientific Notes, Vol. 7, No. 74: The Rainfall in the Indian Peninsula associated with Cyclonic Storms from the Bay of Bengal during the Post-Monsoon and Early Winter Seasons By K. P. Ramakrishnan. Pp. 65–74+8 plates. (Delhi: Manager of Publications.) 1.10 rupees, 2*s*. 9*d*. [222

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 159: Influence of Number of Blades on the Performance of Centrifugal Supercharger. By Itirô Watanabe, Hirosi Sibata, Yasuo Nakagawa and Dôsei Toyozawa. Pp. 145–168+25 plates. (Tôkyô: Kôgyô Tosho Kabushika Kaisha.) 1.65 yen. [252

Norges Svalbard- og Ishavs-Undersøkelser. Meddelelse Nr. 40: Über einige Hieracium-Arten aus Gronland. Von S. O. F. Omang. Pp. 12+3 plates. Meddelelse Nr. 41: Norges Svalbard- og Ishavs-Undersøkelsers Ekspedisjoner til Øst-Grønland sommeren 1937. Av John Giaever. Pp. 8 (Oslo. Jacob Dybwad.) [252

Norges Svalbard- og Ishavs-Undersøkelser. Skrifter om Svalbard og Ishavet. Nr. 71: Zoological Results of the Norwegian Scientific Expeditions to East Greenland, 6. i. Makrolepidopteren aus Nordostgrönland, von Nils Knaben; ii. Mikrolepidopteren aus Nordostgrönland, von Emil Barca. Pp. 37+3 plates. 3.50 kr. Nr. 72: Die Downtonischen und Devonischen Vertebraten von Spitzbergen. 6: Lunaspis-arten aus dem Devon Spitzbergens Von A. Heintz. Pp. 23+1 plate. 2.00 kr. Nr. 73: Report on the Activities of Norges Svalbard- og Ishavs-Undersøkelser 1927–1936. Pp. 125. 10 00 kr. Nr. 74: Some Investigations into the Physiology and Nosology of Eskimos from Angmassalik in Greenland; a Preliminary Statement. By Arne Høygaard. Pp. 14. 1.50 kr. Nr. 75: On the Vascular Plants of Eastern Svalbard, chiefly based on Material brought home from the *Heimland* Expedition 1936. By Eilif Dahl. Pp. 50. 3.50 kr (Oslo: Jacob Dybwad.) [252

Norges Svalbard- og Ishavs-Undersøkelser. Geleitworte zu den Blättern Claveringoya, Jordan Hill und Geographical Society-Øya der Karte von Nordostgronland. Von Prof. Dr. Otto Lacmann. Pp. 57+3 maps. (Oslo: Jacob Dybwad.) [252

Sveriges Geologiska Undersokning. Ser. Aa, No 179: Beskrivning til kartbladet Forshaga. Av R Sandegren och N. H Magnusson. Pp. 117. 4.00 kr. Ser. Aa, No. 181: Beskrivning til kartbladet Smedjebacken. Av G. Lundquist och S. Hjelmquist. Pp. 129. 4.00 kr. (Stockholm· P. A. Norstedt and Soner.) [282

Carlsberg Foundation's Oceanographical Expedition round the World 1928–30 and previous "Dana"-Expeditions. Dana-Report No. 12: Hydrographical Observations made during the "Dana"-Expedition 1928–30. Pp. 46. 6.50 kr.; 6*s*. Dana-Report No. 13: Revision der *Centriscidæ* (*Acanthropterygii centrisciformes*). Von Erna Mohr. Pp. 70+2 plates. 9 00 kr.; 8*s*. (Copenhagen, C A. Reitzels Forlag; London· Oxford University Press.) [282

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 194: Design of an Impact Tester to measure Resistance and Extension. By Dr. W. Lawrence Balls. Pp. 19+12 plates. (Cairo. Government Press.) P.T. 3. [282

Summary Proceedings of the Thirty-fifth Meeting of the Indian Central Cotton Committee, Bombay, held on the 9th and 10th August 1937. Pp. 82. (Bombay: Indian Central Cotton Committee.) 1 rupee. [282

Fifty-fourth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1936–1937. Pp. 10. (Washington, D.C.: Government Printing Office.) [282

U S Department of the Interior: Office of Education. Bulletin, 1937, No. 9. College Salaries, 1936. By Walter J. Greenleaf. Pp. v+33. (Washington, D C.: Government Printing Office.) 10 cents. [282

Symposium on Hormones: Sigma Xi Lectures for 1936–37, Ohio State University. (Reprinted from the "Ohio Journal of Science", Vol. 37, No. 6, November 1937.) Pp. 315–463. (Columbus, Ohio. Society of the Sigma Xi.) 1 dollar. [282

India Meteorological Department. Scientific Notes, Vol 7, No. 76: Average Intensity of Rainfall on a Rainy Day in India. By V. Doraiswamy Iyer and Kasturinath Sobti. Pp. 103–108+7 plates. (Delhi: Manager of Publications.) 12 annas; 1*s*. 3*d*. [282

Ministerio da Educacão e Saude Publica. Observatorio Nacional do Rio de Janeiro. Taboas das Marés para o anno de 1938 nos Portos do Rio de Janeiro, Belém, S. Luiz, Amarração, Camocim, Fortaleza, Natal, Cabedello, Tambahú, Recife, Aracajú, Bahia, Ilhéos, Victoria, Santos, Paranaguá e Itajahy. Pp. 208. Annuario publicado pelo Observatorio Nacional do Rio de Janeiro para o anno de 1938. (Anno 54.) Pp. xiii+488. (Rio de Janeiro: Observatorio Nacional.) [13

Field Museum of Natural History. Publication 405 (Botanical Series, Vol. 17, No. 4) A Contribution to the Flora of Honduras. By Prof. T. G. Yuncker. Pp. 285–408+18 plates. (Chicago: Field Museum of Natural History.) 1 dollar [13

Mémoires du Musée Royal d'Histoire Naturelle de Belgique Deuxième Série, Fasc. 9. Résultats scientifiques des croisières du Navire-École Belge *Mercator*. Vol. 1 Pp. 156+23 plates. Deuxième Série, Fasc. 12: Hydropolypes et Scyphopolypes recueillis par C. Dawydoff sur les Côtes de l'Indochine française. Par Dr. Eugène Leloup. Pp. 73+6 plates. Mémoire No. 81: Les Lamellibranches du dévonien inférieur de l'Ardenne. Par Eug. Maillieux. Pp. 274+14 plates. Hors Série. Résultats scientifiques du Voyage aux Indes orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold be Belgique. Vol. 2, Fasc. 18. Gastéropodes marins. Par Ph. Dautzenberg. 3: Famille Conidae. Pp 284+3 plates. (Bruxelles. Musée Royal d'Histoire Naturelle de Belgique) [13

Annuaire de l'Académie Royale de Belgique, 1938. Pp. 148+290+7 plates. (Bruxelles: Académie Royale de Belgique.) [23

U.S. Department of the Interior: Geological Survey. Bulletin 880-C: Kodiak and adjacent Islands, Alaska. By Stephen R. Capps. (Mineral Resources of Alaska, 1935.) Pp. iv+111–184+plates 2–10 50 cents. Bulletin 892: Bibliography of North American Geology for 1935 and 1936. By Emma Mertins Thom. Pp. ii+504. 50 cents. Professional Paper 142-F: The Mulluscan Fauna of the Alum Bluff Group of Florida. By Julia Gardner Part 6: Pteropoda, Opisthobranchia and Ctenobranchia (in part). Pp. iii+251–435+plates 37–48. 45 cents. Professional Paper 186-N: Relation of Salinity to the Calcium Carbonate Content of Marine Sediments. By Parker D. Trask. (Shorter Contributions to General Geology, 1936.) Pp. iv+273–299+plate 71. 20 cents. Water-Supply Paper 773: Contributions to the Hydrology of the United States, 1926. Pp. v+269–278. Water-Supply Paper 816: Major Texas Floods of 1936. By Tate Dalrymple and others. Pp. v+146. 25 cents. (Washington, D C.: Government Printing Office.) [43

U.S Department of the Interior· Office of Education. Bulletin, 1937, No. 36: Guidance Bibliography, 1935: an Annotated List of Books, Pamphlets and Periodical References on Guidance appearing during the Calendar Year 1935. Compiled by Marion H. Witmer and Maris H. Proffitt. Pp. v+65. (Washington, D.C.: Government Printing Office) 10 cents. [43

Bashford Dean Memorial Volume. Archaic Fishes. Edited by Eugene Willis Gudger. Article 6: The Anatomy of the Frilled Shark *Chlamydoselachus anguineus* Garman. By Prof. Bertram G. Smith. Pp. 331–505+7 plates. (New York: American Museum of Natural History.) [48

Greek Wolf-Lore: a Dissertation in Greek presented to the Faculty of the Graduate School of the University of Pennsylvania in partial fulfilment of the requirements for the Degree of Philosophy. By Richard Preston Eckels. Pp. 88. (Philadelphia: University of Pennsylvania.) [43

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 3, No. 5 On the Unified Theory of Meromorphic Functions By Kwok Ping Lee. Pp. 253–286. 0.70 yen. Vol. 3, No 6: The Chemical Investigation of the Ancient Metallic Culture in the Orient. By Tsurumatsu Dôno. Pp. 287–328+19 plates. 2.20 yen. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 4, Part 4: The Cambro-Ordovician Shelly Faunas of South America. By Teiichi Kobayashi. Pp. 369–522+8 plates. 3.00 yen (Tokyo: Maruzen Co., Ltd) [73

Catalogues, etc.

Philosophy: including rare and interesting Manuscripts of Aristotle, Walter Burley, Petrarch, Boethius· De Trinitate, Nicolaus de Cusa and his mystical Neo-Platonist Contemporaries. (Catalogue 47.) Pp. 90. (London· E. P. Goldschmidt and Co, Ltd.)

Catalogue of Books and Journals relating to Mathematics and Physics, including Aeronautics, Astronomy, Meteorology, Engineering and Wireless Telegraphy. No. 522. Pp. 66. (Cambridge: W. Heffer and Sons, Ltd.)

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Civil Aviation in Great Britain

THROUGHOUT the post-War period, the development of civil aviation in Great Britain as in other countries has been warped by military demands. The report on the Economics of Air Transport in Europe submitted by M. Henri Bouché to the Air Transport Co-operation Committee of the League of Nations in 1935 revealed not only the uneconomic position of civil aviation in Europe generally, but also the way in which national prejudices or military arguments have deprived civil aviation of the freedom which would enable it to reap the advantages inherent in its potentially greater speed as compared with surface transport. In observations on the recently issued report of the Committee of Inquiry into Civil Aviation, which was under the chairmanship of Lord Cadman, the Government has admitted that the unprecedented effort of the Air Ministry and the aircraft industry of the last two years in the military sphere have accentuated the neglect of civil attention, although it is now thought to be possible to give further assistance to civil aviation and to improve its organization.

The present report (Cmd. 5685. London : H M. Stationery Office, 1938. 1*s*. 6*d*. net) is the outcome of a storm of Parliamentary criticism of British civil aviation in November last, which indeed led to the reconstruction of the membership of the original committee, and the contents of the report confirm the soundness and pertinence of much of that Parliamentary criticism. No one who reads the report or who followed the subsequent debate in the House of Commons can be in doubt as to the room or need for further and strenuous efforts in the field of civil aviation and world air transport, and the report should stimulate both interest and constructive criticism in this field. The need for the continuous pressure of informed opinion is sufficiently illustrated by the reference in the report to the failure to give full effect to the recommendations of the Maybury Committee on the development of civil aviation in the United Kingdom, although their acceptance by the Government was announced more than a year ago.

It should not, of course, be overlooked that the Government policy of concentrating on the development of Empire routes, which constitute 90 per cent of the total mileage operated by Imperial Airways Ltd., has to a large extent been fully justified, and that such services have advanced much further towards financial autonomy than the great majority of Continental routes, which, as was shown by M. Henri Bouché and is pointed out again in this report, are much more heavily subsidized. So, too, the report finds no evidence that Imperial Airways' services are less safe than those of any foreign company or that traffic considerations are allowed to outweigh prudence.

The report emphasizes the necessity of closely associating and co-ordinating four elements in civil air transport if successful development is to be assured. There is first the machinery of Government, covering such matters as the initiation of policy, consideration of the international implications of civil aviation, stimulating the development of aircraft, and controls required in the interests of safety. Then there is the aircraft operator, who will give practical effect to Government policy by developing air transport with energy and foresight. Thirdly, there is the aircraft constructor, and lastly the provision of essential ground organization.

The Committee recognizes that the military aspect of aviation cannot fundamentally be separated from the civil aspect, and emphasizes the necessity for much more virility in the initiation of policy and foresight in planning. The stimulation of research and design and the production of civil aircraft, as well as the encouragement of suitable organization of the aircraft industry, devolve upon the Secretary of State. Continuity in directing the policy of aircraft research, development and production is essential, and the Committee trenchantly criticizes the present system of expecting a military officer without previous knowledge and experience of such matters and holding office for a limited term to deal effectively with the situation.

The recommendation for the creation of a post of Permanent Under-Secretary of State for Air to assume control of this Department has already been accepted by the Government, as have further recommendations for the appointment of a Deputy Director of Civil Aviation and a Director of Civil Research and Production, and for strengthening the technical staff concerned with research and development. The Government, however, has not accepted the recommendation of the Committee that the functions of the Member for Research and Development on the Air Council, and also that part of the Department administered by the Air Member for Supply and Organization which deals with the production of aircraft, should be transferred to the Permanent Under-Secretary of State, as it is considered that such changes would seriously interrupt the work of the Service side of the Air Ministry.

In its observations on this question, the Government points out that the Department of Research and Development is already an extensive organization, largely civilian and permanent, the Director of Scientific Research being a permanent officer and a scientific worker of high repute. The Department is in close touch with other Government research establishments, with universities and with private firms, and its research and experimental establishments provide testing stations and a central laboratory for theoretical research. The Government contention that research and development on the Service side are in fact continuous and progressive, and that much of this work is of immediate value and available to makers of civil aircraft, is, however, not disputed by the Committee. Its contention is that, in the past, most of the research undertaken by the Air Ministry has had a military bias, and the reorganization recommended is intended to ensure that civil research work is given due prominence in future.

The tenor of the Government observations on the subject of research is accordingly less reassuring than might be desired, and the Prime Minister's silence on the subject in the debate is in itself disturbing. It is suggested, in fact, that instead of defence requirements drawing on the general body of scientific knowledge and applying it to the particular problems of defence, supplementing it by further investigation as required, in the field of aviation this policy is to be reversed and the trend of development dictated by Service requirements. This very policy has restricted and warped the whole development of civil aviation since the War, and it is optimistic to expect much improvement until the resources available for research and development in aviation are administered by those possessing not only the essential technical and administrative qualities, but are also trained to view the subject as a whole and not primarily in respect of Service requirements.

This is indeed the main point in the Committee's contention that the direction of aircraft research, development and production should be transferred from a military to a civil officer, not necessarily a technician, but possessing high ability, energy and proved capacity for organization. It is further supported by the reference to specific problems of research, such as the icing problem, with which two appendixes to the report deal in some detail. The prevention of ice formation is indeed a composite problem affecting the engines, airscrews, instruments, wireless equipment and the air frame itself, and the report insists that research into this problem should be prosecuted with the utmost vigour.

Other research problems to which the report directs special attention include such matters as pressure cabins, automatic blind landing equipment, anti-static electricity devices and the application of wireless to aviation purposes, in all of which evidence was submitted that Great Britain is not keeping pace with the United States of America, while special attention to lines of research which would make flying safer is also urged. It is indeed pointed out that unless a limit is soon put to the size of aerodromes, considerations of cost may prove a serious handicap to further progress, and on this ground alone a reduction in the landing speed of air liners without impairing performance in other respects is desirable.

Scientific workers can scarcely fail to be keenly interested in these technical problems as well as in the recommendations relating to policy and reorganization intended to give civil aviation some of the freedom of development of which it has been deprived largely by defence considerations. They will, however, be equally interested in the comments of the report on staff questions. Here the report is perhaps unduly reticent, and its criticism is implied rather than openly expressed. That it should be necessary for a report of this type to make the recommendation that personal contact between employer and employee in air transport should be supplemented by collective representation is a serious reflection on the management concerned, and its significance cannot be appreciated without regard to the great advance in dealing with staff matters characterizing large-scale progressive industry in recent years. The fact that the Committee should find it necessary to recommend that dividends should be restricted to the limits usually associated with public utility companies—a principle with which the Prime Minister announced his sympathy—further indicates how far the managements of Imperial Airways or British Airways Ltd. has lagged behind the best practice and principles of modern management.

There can be no two opinions that the inquiry instituted has been thoroughly justified, and if the recommendations of the report are implemented there is reason to believe that civil aviation in Great Britain may be liberated from some of its shackles. None the less, it is clear from the Government observations that defence considerations remain the dominant factor, and it should not be forgotten that civil aviation can only gain its true freedom in the international sphere. Fundamentally, moreover, the report is a telling indictment of the management of the industry, and adds yet one more warning to others in the past of the dangers to the community of allowing control to remain in the hands of those who are incompetent to take long-range and progressive views, or to assess accurately and sympathetically the technical and human as well as the financial issues involved. In these days, when the resources at the disposal of scientific management are so vast and accessible, there is less excuse than ever for maladministration and failure to ensure that those in control possess the administrative capacity for their task is more likely than any other factor to involve the downfall of social or industrial institutions to-day.

Petroleum Technology

The Science of Petroleum:
a Comprehensive Treatise of the Principles and Practice of the Production, Refining, Transport and Distribution of Mineral Oil. Editors: Dr. A. E. Dunstan, Prof. A. W. Nash, Dr. Benjamin T. Brooks, Sir Henry Tizard. Vol. 1. Pp. xxvi + 836. Vol. 2. Pp. xvi + 837–1670. Vol. 3. Pp. xvi + 1671–2386. Vol. 4. Pp. xvi + 2387–3192. (London: New York and Toronto: Oxford University Press, 1938.) 4 vols., £15 15*s.* 0*d.* net.

EVEN in an age of industrial achievement the economic efficiency of the petroleum industry is outstanding. In particular, its products have been progressively and rapidly adjusted to the ever-changing requirements of a world largely based for its mechanized civilization upon the internal combustion engine. What is still more striking is that many of these adjustments have been made in advance of the engine-builder's demand for them. The designer has been encouraged in effect to produce more and more efficient units because of the special fuels and lubricants waiting to his hand. He now sets no limits to his requirements in this direction, for he knows from experience that the oil industry will serve him to the fullest extent of its resources even if it means scrapping (as often happens) the highly successful plant and process of the previous day.

This spirit of deliberate self-modernization is evident throughout the oil world. It is significant that the biggest technical advances and productive successes in the search for petroleum by geophysical means have been made at a time when visible reserves of oil are greater than ever in the past and when production in many quarters has had to be artificially restrained. It is equally worthy of mark at the other end of the scale that chief encouragement of the synthetic production of oil has come from the large petroleum undertakings, and not from the coal or similar interests, which might be expected most directly to benefit.

The great research stations of the petroleum industry and its modern refineries; its geophysical surveying, high-pressure drilling and thousand-mile pipe lines; its tanker fleets, its distribution organization and its resolute development of a new synthetic chemistry, all reflect a standard of technical and administrative attainment which it is difficult to parallel. There is, too, an atmosphere of audacity about some of its doings which compels recognition of the industry's aliveness and youthfulness. That is probably the answer to many things in the petroleum industry. It is young, it is successful. It has money, it has vision. Through these it has been able to attract to itself men of high capacity and to reward them. As a result the last two decades have seen within the industry's wide range of interests a complete departure from all empirical methods and a dependence upon organized development and control which can only be apprehended with difficulty even by those directly concerned with oil in one way or another.

It follows that the scientific basis of the exploitation of petroleum must be very wide. How wide can be partly judged by a statistical description of the work under review.

This work consists of four quarto volumes weighing approximately two stone and containing more than 3,000 pages. It has been produced by the co-operative efforts of four editors, twenty-four associate editors, 316 contributors and many secretaries, index-compilers and general assistants. It is divided into five parts and 44 sections. Each section contains a sufficient number of papers from specialist contributors to cover all aspects of a particular subject without loss of the individuality arising from separate authorship. The subjects range from nomenclature to shale oil. They cover the origin of petroleum, its distribution, exploration, winning and transportation; physical and chemical data and testing; refinery processing of all kinds; cracking, re-forming and hydrogenation; manufacturing materials, instrumentation and use of commodities; direct products and their utilization; synthetic derivatives and bitumen.

The intrepidity involved in undertaking this work can only be matched by the tenacity of purpose which has brought it to successful issue. Dr. Dunstan, Prof. Nash, Dr. Brooks and Sir Henry Tizard are severally to be congratulated on the completion of a task which they must at times have felt to be endless. To them and to the publishers are due the sincere thanks of all interested in the "principles and practice of the production and refining of mineral oil". They have done what they set out to do and have produced a "Comprehensive Treatise". The work is not merely a landmark in the history of the literature of petroleum—it is a record of knowledge and achievement which must inevitably form the basis of all future writings on similar lines, whether they be digest or dissertation. Moreover, by being collated in the form of groups of individual papers, its own supplementation should be fairly straightforward. It is obvious that arrangements for keeping the treatise up to date will have to be made right away.

The list of contributors discloses the fact that as to four fifths of the work they are drawn about equally from Great Britain and the United States. This is flattering to the British position in the oil world, and is accounted for by the preponderatingly British editorship. Although there are missing in consequence a number of well-known specialists whose participation might have been anticipated, critical perusal of certain articles they might have written fails to disclose that anything has been lost in calibre thereby.

Vol. 1 is concerned with geology and production—350 pages of the former and 500 of the latter. As with the remainder of the treatise, it is just not possible within the scope of a review to indicate the breadth of the special subjects covered. It is only by comparison with corresponding matter written years ago that the remarkable advances in procedure and ideas can be gauged. They are perhaps most spectacular in the case of the methods available for geological mapping, but are equally true as regards production. The repressuring of fields, the use of gas-lift, the control of oil-field water, and conservation methods generally are all directed towards the elimination of waste and general improvement in the utilization of resources. It is significant of modern dependence upon scientific method that some of the most mathematical articles in the whole compendium are to be found in just those sections which in the past would have been regarded as the exclusive domain of the practical driller.

Since the success of an industry must depend largely on the standard of its products, it is natural, however, that "The Science of Petroleum" should be concerned outstandingly with chemistry and chemical engineering. These aspects are copiously covered in vols. 3, 4 and 5, dealing with composition, testing, refining and utilization. The sections dealing with cracking, hydrogenation and re-forming are all well done, but are likely to be those which will need revising first. It is in this direction of the tearing apart of the hydrocarbon molecules of petroleum and their rebuilding into even more effective commercial combinations that most progress is being made. What was an almost wholly analytical industry is now largely synthetic in character, quite apart from its modern concern with the production of special chemicals.

Every man interested in oil will wish to possess these volumes. That should apply from driller to depot manager and include the worker with synthetic, as well as natural, petroleum. Incidentally, he will greatly admire their appearance on his shelves, and, whilst reading them, the truly wonderful technique of their production. S. J. M. Auld.

Mental Defect

A Clinical and Genetic Study of 1280 Cases of Mental Defect

By Dr. L. S. Penrose. Pp. 159 + xiv. (Medical Research Council. Special Report Series, No. 229). (London: H.M. Stationery Office, 1938) 2*s*. 6*d*. net.

THE eugenic movement has laid great stress on the burden imposed on the community by the existence in the population of about 1 per cent of mental defectives; and extravagant statements have been made both for and against the possibility of reducing the incidence of mental defect by eugenic measures. Thus it has been stated, on one hand, that mental defect could largely be eliminated by the sterilization of defectives, and, on the other, that it could largely be controlled by prenatal hygiene or improved obstetrics.

Dr. Penrose's report will not please the extremists of either school. It is an extraordinarily painstaking record of facts. No fewer than 1280 patients in an institution, and 56,198 of their relatives, were investigated. With such large material it is possible to classify defectives not only by the grade of mental defect, but also in 76 per cent of cases by their clinical type.

7·3 per cent were due to congenital syphilis or to cerebral trauma or inflammation. Perhaps another 3 per cent (including cases of hemiplegia and disseminated sclerosis) might be put down entirely to environmental effects. In the remainder, genetical causes play at least a considerable part in determining the abnormality.

4·9 per cent of cases were due to mongolism, where genetical and environmental factors interact. For while the condition was ten times as common amongst their relatives as amongst those of other patients, the mean age of their mothers was 38·2 years, as compared with 29·4 years for other patients. 1·0 per cent of cases were due to three well-recognized dominant genes causing epiloia, neurofibromatosis, and Huntington's chorea. There is a very strong case for preventing the breeding of persons afflicted with these diseases, whether mentally defective or not. As, however, new cases constantly occur by mutation, and Huntington's chorea may only show up late in life, this would not abolish the diseases in question, though it might reduce their incidence by more than half.

7–10 per cent of all cases were probably due to fairly clear-cut recessive genes. One of the most striking results of Dr. Penrose's investigation is to make it highly probable that congenital cerebral diplegia, which accounts for 5·1 per cent of all cases, is a recessive character. The segregation into normals and abnormals was unusually clear cut, and there was consanguinity in 9 per cent of cases. Other recessives include phenylketonuria, a metabolic abnormality which always causes mental defect; cerebromacular degeneration; retinitis pigmentosa; deaf mutism in some families; and probably cretinism. The frequency of consanguinity in other cases suggests the presence of recessive genes.

But the majority of cases were not so simply determined. There was a good deal of certifiable defect, and still more dullness, among the parents and other relatives. This was particularly so in the case of simpletons (feeble-minded). This is what we should expect if the milder grades of mental defect were determined mainly by the interaction of a number of partly dominant genes, and to a small extent by the environment.

What practical steps are suggested by the report? 7–9 per cent of the defectives had one parent sufficiently defective to be certified or certifiable. It follows that had all defectives of certifiable grade a generation ago been segregated or sterilized, 7–9 per cent of these patients would never have been born. This number must possibly be reduced for the whole population, as defective children of defectives are perhaps more likely to be institutionalized than defective children of normals.

Again, 3·5 per cent of all patients had consanguineous parents. Had first-cousin marriages and the illegal unions of closer relatives been prevented, 2·4 per cent of the defectives would not have been born. Finally, 4·7 per cent of the patients had thyroid disorder, of which an early treatment would in many cases have cleared up the disease; 3·9 per cent had congenital syphilis, which is preventable. Others were victims of birth injury, meningitis, and encephalitis, which are at least partially preventable. The cases of pituitary and other endocrine disorder are likely to be brought within the scope of therapeutics fairly soon, if they are not yet so. Since diabetes can be dealt with by insulin, a hormone controlling the oxidation of phenol-pyruvic acid may yet be found.

It would seem, then, that negative eugenics and therapeutics are about equally hopeful as preventive measures, whilst the prevention of inbreeding, though not negligible, is definitely less promising. But all three measures would not, in the present state of our knowledge, prevent 20 per cent of cases.

We need more knowledge, and this report certainly lays the foundations for future research. I have no doubt that it is the most important contribution to human genetics which has been made for many years in any part of the world, and the Medical Research Council, the Darwin Trust, and the Royal Eastern Counties Institution, are to be unreservedly congratulated on it. The diagnosis and family history of every single case is given in an appendix which will be of the very utmost value. However, certain parts of the report require amplification, which they will doubtless receive elsewhere.

I trust that this report may be the beginning of a series which will be as valuable as those on nutrition and bacteriology, which are, of course, indispensable. J. B. S. HALDANE.

The Gorilla in its Home

In Quest of Gorillas

By Prof. William K. Gregory and Henry C. Raven. Pp. xvi + 241 + 110 plates. (New Bedford, Mass.: The Darwin Press, 1937.) 3.50 dollars.

IN the summer of 1929, a party of four scientific men, led by Henry C. Raven, of the American Museum of Natural History, left New York to visit the homelands of the gorilla in Africa. The doyen of the party was W. K. Gregory, the leading authority in all that relates to the structural history of anthropoids, living and extinct. The two other members were Prof. J. A. McGregor, known at home and abroad for his faithful reconstruction of extinct forms of humanity, and Dr. E. T Engle, anatomist, Columbia University. The expenses of the expedition were paid by that University.

Coming by way of Europe, the expedition visited Brussels and Paris, where, after much cross-examination, permission was obtained to shoot five gorillas "for scientific purposes", two in the mountainous country to the west of Lake Kivu and three in the French Cameroon.

On August 4, 1929, the expedition pitched its camp on the western fringe of the great forest to the west of Lake Kivu and nearly 7,000 feet above sea-level. Their camp occupied a corner of the lands of an experimental farm; nothing can illustrate better than this the rapidity with which equatorial Africa is being transformed. The local gorillas proved to be the most elusive of animals; their tracks were everywhere, their nests or beds—often freshly made—were plentiful; dung, recently dropped, knuckle impressions in the mud, and broken and stripped twigs and branches marked the trail left by a passing group. The rustle of branches or a black arm moving amongst them, a bark or a grunt, a momentary glance of a moving form in the thick undergrowth proclaimed the vicinity of a group, but it took Mr. Raven six weeks of stalking to secure the two specimens of the Kivu gorilla. Prof. McGregor was ever ready with his camera; even after six weeks of patient and skilled waiting, not even a snap—much less a film—had been obtained.

The first gorilla shot by Mr. Raven—a male—weighed 460 lb.; with its litter—the total weight which had to be carried across twelve miles of country cut by ravines and clothed with thick brush—was 600 lb. This fact will give some idea of the toil which men of science are willing to undertake in the pursuit of knowledge.

On September 19 the expedition struck camp in the Kivu mountains and set out for the French Cameroon, which was reached on November 14. Africa was crossed from east to west by motor-car, river steamer and railroad, the route taken being that blazed by Stanley. The expedition pitched its new camp on the western fringe of the great Congo Forest. The western gorilla, which Dr. Gregory regards as the parent form, the eastern or Kivu being but a variety of the western, was just as elusive and as hard to come by in West as in East Africa. Day after day Mr. Raven followed roving bands, often hearing them but rarely obtaining a passing glimpse. When one district had been searched in vain, another was commended as an infallible source of supply. After spending five weeks in the French Cameroon without success, the party broke up. Mr. Raven was left to pursue the quest alone, the other members of the expedition being obliged to return to New York to resume their vocational duties.

The first part of this book is written by Dr. Gregory; he is an instructive and entertaining writer, but the chapters which hold the reader are those wherein Mr. Raven tells what he saw and what he felt while hot on the gorilla trail. Mr. Raven has served a long apprenticeship to jungle life in many parts of the world. He soon realized that if he were to succeed in the quest for gorillas he must live as natives live—and sleep where the gorilla sleeps: which he did, with the usual result—a devastating illness, one which almost cost him his life. He spent more than a year in the French Cameroon and ultimately obtained the three covenanted specimens.

Incidentally, much is to be gleaned from the pages of this book, which throws light on the habits of the gorilla. In the thick jungle, the gorilla has the advantage of man; when he observes hunters' crawling in pursuit, the gorilla must wonder how a being, so ill-adapted as man, ever came into existence. In spite of his enormous strength, the gorilla is a peace lover. He never sets out deliberately on the war-path; all his 'scraps' are accidental, the result of some man, woman or beast intruding into his family circle without giving sufficient warning. But when he has to fight, as when the group he leads is in danger, he shows always the utmost courage, giving his life when necessary. It is this instinctive trait which is the undoing of the male gorilla; he falls a victim when he turns to defend his flock. The natives assert that gorillas talk at night; the most that Mr. Raven could hear were noisy movements in their stomachs and a hissing—apparently an expiratory movement of the lips.

The real danger to which the gorilla and chimpanzee are exposed is not the hunter but the planter, native and European. Gorillas are destructive feeders when they invade gardens and plantations. They are also counted good to eat by most natives of West Africa. The total number of gorillas cannot be large; I doubt if there are 10,000 of them, even when western and eastern are added together. Prof. Gregory thinks they may be increasing their numbers in certain districts.

A. K.

Significance of the History of Science

The History of Science and the New Humanism
By George Sarton. (Colver Lectures in Brown University, Elihu Root Lecture at the Carnegie Institution of Washington.) Pp. xx + 196. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1937.) 8*s*. 6*d*. net.

One welcomes especially any fresh utterance of Dr. Sarton on general lines, because he devotes himself too exclusively to the learned studies of which he is a master and speaks too seldom on the wider aspects and applications of those studies, on which he has so much to tell us. He is at the same time the most eloquent and convincing prophet of the value of the history of science as a discipline and the man best qualified on the history itself. It is a unique position and one envies the United States for possessing him.

In the volume under notice, Dr. Sarton publishes the substance of four comparatively popular lectures which he was invited to give by the Brown University and the Carnegie Institution of Washington. They are all full of inspiration and of good sense. Sarton does not overpress the claim for instruction in the history of science. He would even admit that it is not food for every palate. But he strongly and truly insists on its educational value as a central progressive and co-ordinating study, when taught by those who have an adequate preparation both in the sciences themselves and in general history, and applied by the learners in the same spirit. He makes the sound, though somewhat disquieting, remark that though there is no mental discipline so attractive and easy to receive, there is also none more difficult to impart. It is another case of the dominance of the specialist and the urgent need of more synthetically trained minds.

Of the four chapters, that on the relation of East and West and that entitled "The New Humanism" contain the freshest material and the most interesting detail. Dr. Sarton points out most seasonably that there should be no rivalry between West and East in the building up of science, for the creative movement was reciprocal. The East lit the first torch, which we know from recent discoveries in Babylonia and Egypt to have been a much brighter one than was at one time supposed. Then the Greeks took it up and made the blaze which has since illuminated the world. But before the work of the Greeks had been recovered and extended in the modern world, the light had gone back again to the East and was tended for centuries by the Arabs and Indians until the early Renaissance in Europe.

There are some specially interesting particulars here as to the function of the Jews in this matter. They were for long the linguistic intermediaries between East and West, though, after the middle of the thirteenth century, they lost this position of linguistic and national isolation and tended to become—educationally—one with the nationals of the Western countries where they lived. Thus, when we come to Spinoza, "we do not count him any more as a Jewish philosopher in the sense in which we counted Maimonides or Levi ben Gershon. He is one of the founders of modern philosophy, one of the noblest representatives of the human mind, not Eastern or Western, but the two unified".

Dr. Sarton's remarks on the right programme for a 'humanist' education will also be read with profit. He denounces an artificial international language, thinks that mathematics is the true international medium, but that everyone should have a usable knowledge of at least two of the great world-tongues. Ancient languages must, by the press of new knowledge, be left more and more to the specialist.

F. S. Marvin.

Tables Annuelles Internationales de Constantes et Données numériques :

International Annual Tables of Constants and Numerical Data. 9 : Electromotive Forces, by Prof. H. S. Harned ; Oxidation-Reduction Potentials, by G. Åkerlof. Vols. 11–12 (1931–1936), Section 60. Pp. iii+45. 25 francs. 13 : Faraday Effect, by M. Schérer ; Magnetic Birefringence, Electric Birefringence, by Prof. A. Cotton and J. Rabinovitch ; Photoelectricity, by G. A. Boutry. Vols. 11–12 (Years 1931–1936), Sections 38–41. Pp. iii+11+12+7+10. 20 francs. (Paris : Hermann et Cie. ; New York : McGraw-Hill Book Co., Inc., 1937.)

PARTS 9 and 13 of vols. 11–12 of "Tables Annuelles de Constants et Données Numériques" cover the period 1931–36. In Part 9, dealing with electromotive forces, H. S. Harned gives a convenient summary of data on concentration cells without liquid junctions, which will be very useful to workers in this field. Among the items of particular interest are Harned's own work on the thermodynamic dissociation constants of weak electrolytes, that of L. F. Nims on amino-acids, and several examples of ionic equilibria in heavy water. There is also a table of recently determined standard electrode potentials. This section should be used in conjunction with Part 3, in which the activity coefficients, free energies, etc., derived from the measurements, are given. G. Åkerlof gives a summary of oxidation-reduction potentials, including the considerable number of organic systems, some of biological interest, investigated during the period.

Part 13 deals with the Faraday effect (M. Schérer), magnetic and electric birefringence (A. Cotton and J. Rabinovitch) and photoelectricity (G. A. Boutry). The latter, which is probably of the greatest general interest, contains a table of recent determinations of the photo-emission thresholds and work functions of metals. Since the elucidation of the theory of the photo-electric effect by Fowler in 1931, it has been possible to evaluate the true work function corresponding to absolute zero, and a considerable number of such determinations have now been made, which are collected here. Other sections deal with the effects of thin films of alkali metals and of complex films on the photo-emission, and there is also a summary of the characteristics of commercial photo-electric cells.

Communication Engineering

By Prof. W. L. Everitt. Second edition. Pp. x+727. (New York and London : McGraw-Hill Book Co. Inc., 1937.) 30*s*.

AN excuse for yet another text-book on the electrical communication of information, that is, by electric wave-motion in space or along wires, is that it is a little better than its predecessors. This to a large extent is true of the present work, since the author's plan is attractive and the subject developed logically, as may be instanced by the general grouping of the chapters ; these are classification of impedance elements, linear bilateral impedances, unilateral and non-linear impedances, coupling between electrical circuits and free space, and coupling between electrical and mechanical circuits.

The reader must not be put off by these and many other strange literary expressions ; the subject is becoming so complicated that continual grouping of ideas is imperative. Nevertheless there is a number of prominent omissions, particularly as one is not warned of them ; phase compensation, for example, should be included for students to-day, for it is as important as the degenerative amplifier, the properties of which are clearly stated. The most useful network theorems are grouped at the beginning, which does not indicate their relative importance, but apart from this the text can be well recommended. L. E. C. H.

The Analysis of Engineering Structures

By Prof. A. J. S. Pippard and Prof. J. F. Baker. Pp. ix+554. (London : Edward Arnold and Co., 1936.) 30*s*. net.

THE final report of the Steel Structures Research Committee completed investigations of first-class importance that have had great influence on the treatment of steel building frames. Both authors of this book were members of that Committee, and they are to be congratulated on so ably incorporating this recent work in a students' text-book on structural analysis. One chapter gives a valuable summary of the main findings and design methods, but elsewhere, as in the chapter on structural connexions, full use is made of the detail investigations of the Committee.

The book as a whole deals comprehensively with the principles on which structural design is based, and the work is carefully classified, wide in scope and—even apart from the work of the Research Committee—up to date, a fact which is shown by the chapter on mechanical methods of stress analysis, although it suffers somewhat from an undue brevity. The book is a notable addition to English text-books on structural analysis and in several respects marks new standards.

The Truth about Vivisection

By Sir Leonard Rogers. Pp. x+182. (London : J. and A. Churchill, Ltd., 1937.) 5*s*.

THE anti-vivisection campaign is persistent, vigorous and clamorous, has ample funds (estimated at £40,000 a year) with which to promote its objects, and uses a variety of methods to do so. It is the aim of Sir Leonard Rogers in this admirable little book to present the reader with the whole truth of the matter. He discusses the working of the Act of 1876 controlling and limiting experiments upon animals, analyses the reports of the Royal Commissions on Vivisection, and describes the valuable results that have been obtained through experiments upon animals in the curative and preventive treatment of diseases, both human and animal. It is a book that everyone should study who desires to ascertain the truth about vivisection, and will be most useful to those who may have to combat anti-vivisection propaganda. R. T. H.

Pasteurization of Milk

By Prof. G. S. Wilson

TEN, or even five, years ago there was a very real cleavage of opinion among scientific workers in Great Britain on the value of pasteurization. In general, the physiologists and biochemists were afraid of the possible damage caused by heat to the nutrient substances in the milk, and were inclined to minimize the part played by milk in the spread of infective disease. Bacteriologists and public health workers, on the other hand, were becoming increasingly impressed with the danger of drinking raw milk, and, in the absence of any convincing evidence to show that the nutritive value of the milk was seriously damaged by mild heat treatment, they strongly favoured the extended use of pasteurization as a means of diminishing the amount of preventable disease.

To-day this cleavage of opinion is much less apparent—indeed, it would scarcely be an exaggeration to say that it no longer exists. The change has come about, as all similar changes in scientific opinion must do, as the result of increased knowledge. During the past few years, several studies have been made on rats, mice and particularly calves, which have agreed in showing that only a minimal amount of damage is caused to the nutritive value of milk by low-temperature pasteurization. In addition, the occurrence of repeated outbreaks of milk-borne disease, some of them accompanied by a relatively high mortality, has gone a long way to convince unprejudiced observers that tuberculosis is not by any means the only infection spread by milk to human beings. It is now recognized that cleanliness is not enough. The milk must also be safe—safe from the risk of spreading disease—if it is to be recommended more freely to supplement the inadequate or unbalanced dietary of certain sections of our population. In view of this increasing unanimity, it will probably be better to give a brief résumé of the evidence on which our present conclusions are based rather than to set out the pros and cons of pasteurization[1], and thus create the illusion of a difference of opinion that now no longer exists. For reasons of space, discussion will be confined to the nutritional and hygienic aspects of cows' milk pasteurized by the official holding process (145°–150° F. for 30 minutes, followed by cooling to 55° F. or below) and sold under licence. Not until these two aspects are fully understood is it profitable to consider the economic implications of compulsory pasteurization which play so large a part in practice in determining opposition to this measure.

The observations of numerous workers[2,3] agree in showing that pasteurization has the following effects. About 5 per cent of the lactalbumin is coagulated; the coagulation time by rennin is lengthened, but the casein clot formed consists of finer particles and is of a more open texture; there is a diminution in the soluble calcium and phosphate, estimated variously by different workers, but probably of the order of 5 per cent; there may be some loss of iodine through volatilization; there is some destruction, at present unmeasured but apparently small, of vitamin B_1; and there is some diminution in the vitamin C content, depending largely on the amount of previous exposure to light and on the presence of copper in the pasteurizing plant. Information on the effect of pasteurization on vitamin D is still deficient, but considering that vitamin D is even more resistant to heat and oxidation than vitamin A, it is improbable that any deleterious effect occurs. As against these positive changes may be set a number of negative findings. Thus it is found from feeding experiments on rats and calves that the biological value of the proteins is unaltered, that there is no detectable change in the availability of calcium or phosphorus, that there is no loss of vitamin A, and that the total energy value of the milk remains unaltered. Furthermore, recent carefully designed experiments on calves[4,5] in which alternate animals were fed for 8–12 weeks on raw and pasteurized milk from the same source, have failed to show any significant difference in growth between the two groups of animals. In each experiment the average percentage weight increase was slightly higher in the group of animals receiving the pasteurized supply, but the differences were such as might easily have occurred by chance variation alone.

In assessing these results in terms of human nutrition it must be remembered that, though cows' milk may be a perfect food for calves, it is not a perfect food for infants. It differs both qualitatively and quantitatively from human milk, and it is deficient in iron, copper, vitamin C, and often in vitamin D. The differences between raw and pasteurized cows' milk are very much less than those between cows' milk and human milk. Deductions, therefore, from animal experiments to man must be made with great caution. Unfortunately, there is a dearth of direct observations to determine the comparative nutritive value of raw and pasteurized milk for infants and children. The only experiment of any size that is on record[6] yielded results which failed to show any significant differences between the two classes of milk. Pending the publication of further observations of this type, we must conclude on the basis of all the available evidence that the nutritive changes produced by pasteurization appear to be comparatively slight, and are such as can readily be made good by suitable supplements to the dietary.

Turning now to the hygienic aspect of pasteurization, we have at our disposal well-documented evidence to show the danger of drinking ordinary raw milk and the protection afforded by adequate pasteurization against milk-borne disease. It is calculated[7] that in 1931 there were 2,600 deaths in Great Britain from tuberculosis of bovine origin and more than 6,000 fresh cases of the disease. Since then our knowledge of the part played by the bovine tubercle bacillus in causing pulmonary tuberculosis has considerably expanded, and there is no doubt that if this calculation were to be made afresh the figures would have to be increased rather than diminished. Undulant fever is a less important disease, but something like 400 cases yearly appear to arise in Great Britain, mainly from milk-borne infection[1]. Of epidemic diseases records[1] are available of the occurrence in Great Britain during the years 1912–35 of at least 103 milk-borne outbreaks of scarlet fever, septic sore throat, diphtheria, typhoid fever, paratyphoid fever, dysentery and gastro-enteritis affecting over 11,000 persons. These figures take no account of epidemic diarrhœa, in the causation of which milk almost certainly plays a considerable part. Our knowledge of sporadic milk-borne disease, apart from tuberculosis and undulant fever, is very deficient, since milk is rarely suspected as a vehicle of infection unless large numbers of cases occur in a short interval of time over a limited area, but as further information accumulates on this subject, it seems likely that the case against raw milk will have to be weighted still more heavily.

Pasteurization, adequately carried out in properly designed apparatus, and conveniently controlled in practice by the phosphatase test, destroys all pathogenic organisms in milk and renders it safe for human consumption. The laboratory and field evidence for these statements is too extensive to quote in detail. Reference may, however, be made to the now well-known observations of Price[8] in Toronto, which have all the force of an *ad hoc* experiment. Briefly, she found that among 300 tuberculous children bacteriologically examined, 15 per cent were infected with the bovine tubercle bacillus. All of these had come from parts of Ontario where pasteurization of milk was not carried out. In Toronto itself, where pasteurization has been compulsory since 1915, not a single case of bovine infection was found, in spite of the fact that 26 per cent of the incoming pooled supply of raw milk before pasteurization contained living tubercle bacilli. Nearer home we may add the recent experience at the Hannah Dairy Research Institute gained during one of the calf-feeding experiments alluded to above[5]. Of 36 calves fed for twelve weeks on raw milk, no fewer than 24 were found, when slaughtered, to be infected with the tubercle bacillus and to have macroscopic lesions of tuberculosis, whereas of 37 calves fed on milk from the same source after holder pasteurization, not a single one appeared to be infected. Apart from tuberculosis, the value of pasteurization in protecting against epidemic disease is well demonstrated by experience in the United States. Examination of the statistical returns shows that milk-borne disease has been practically eliminated from the large cities, where the great majority of the milk is pasteurized, and is now almost entirely confined to the rural districts and smaller towns, where most of the milk is consumed raw[9]. The effect of pasteurization in bringing to an end milk-borne epidemics that are already under way has been frequently and forcibly illustrated during the course of the past few years in Great Britain, notably in the extensive outbreak of typhoid fever at Bournemouth in 1936[10].

In view of this cumulative evidence it is not surprising that public health workers are asking for the control of milk-borne disease by compulsory pasteurization. From the hygienic point of view, this step is merely the equivalent to the treatment of water by filtration and chlorination. Recent experience has shown what widespread public disapprobation follows neglect to exercise adequate control over our water supply, and there seems no logical reason why the public conscience should not be similarly exercised over the safety of our milk supply.

It has been suggested that the right way to control milk-borne infection is to eradicate disease from our milking herds. While not depreciating for one moment the importance of this aim, it must be pointed out that pathogenic organisms may gain access to milk not only from the cow, but also from the human personnel, from the water supply, and possibly from rodents. Even if eradication of cattle disease within a generation or two were possible, it would still leave unsolved the problem of protecting the milk supply from these other sources of contamination.

Pasteurization, preferably accompanied by automatic bottling, alone affords an immediate, practicable, and effective method of ensuring the final safety of the milk as delivered to the consumer.

So far as the available evidence goes, there is no scientific argument against pasteurization. That the introduction of compulsory pasteurization might have widespread economic repercussions may be true, but it is not the purpose of this article to deal with a problem which comes into the domain of practical politics rather than of science. It is enough to show that, provided minor additions are made to the dietary of infants whose sole source of nourishment is pasteurized cows' milk—additions which are almost equally necessary on a dietary of raw cows' milk—there is no reason to fear that the growth and general development of our population would be in any way prejudiced by the extended use of pasteurized milk, while there is every reason to believe that the introduction of compulsory pasteurization, carried out under proper supervision, would lead to the practical abolition of milk-borne disease.

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Root-Pressure as a Factor in the Rise of Sap*

By Dr. Philip R. White, Rockefeller Institute for Medical Research, Princeton

THE history of our observations and theories—one can scarcely say our 'knowledge'—concerning the movement of sap in plants has been a rather tortuous one. Beginning with the 'vital' explanations of Hales[1] and Knight[2], in which the living cells were presumed to be the agents largely responsible for sap movement, our concepts have run the entire gamut to the 'mechanical' explanations of Dixon and Joly[3] and Askenazy[4] in which living cells were presumed to take no part in, or even to hinder, the movement of sap. The Dixon-Askenazy scheme is the one generally considered to-day to furnish the most satisfactory explanation of sap movement, while 'root-pressure', first observed by Hales in 1727, is looked upon as a transitory phenomenon, involving negligible forces (maximum value recorded, about 1·5 atm.), the occurrence of which in uninjured plants was subjected to doubt by Molisch[5], and hence probably unimportant.

For a number of years, I have been growing excised roots *in vitro*, isolated from all the influences which the rest of the plant normally exert upon the root[6,7]. It has thus been possible to establish with a considerable degree of precision the nature of these influences. It has been shown that the tops of plants provide the roots not only with carbohydrates but also with amino-acids[8] and with materials[9] either identical with or capable of being replaced by at least one vitamin, B_1. On the other hand, roots are not absolutely dependent on the tops for hormones, as was once supposed. Most of these studies have been carried out on roots of tomato which have been maintained in continuous culture for about five years (250 passages). Roots of a number of other plants have also been studied. Those of aster (*Callistephus hortensis* Cass.) have been grown for about 100 passages, those of *Nicotiana langsdorffii* Weinm. for about 75 passages, those of *Brassica nigra* Koch, *Trifolium repens* L., *Petunia violacea* Lindl., *Fagopyrum esculentum* Moench, *Daucus carota* L., and *Helianthus annuus* L. for about 50 passages and those of a dozen more species for lesser periods.

The capacity to grow as autonomous units seems to be a general property of roots, at least among the dicotyledons. Now, one of the striking and universal features of these root cultures is that they retain their morphological characteristics, their growth polarity and their vascular strands. These strands are normally developed, although the cultures are grown floating upon, or immersed in, the liquid nutrient. Since in such cultures no obvious function could be ascribed to such strands, their presence seemed anomalous. If, however, a continuous flow of liquid be assumed to take place through these roots, that is to say, if they continue to function in culture in the manner postulated by Hales, as pumps, then the presence of vascular strands would be understandable. The root cultures seemed to offer a possible means of answering the old question: "Is root-pressure a real function of normal roots, or is it merely a wound reaction? And if root-pressure is real, what is its true magnitude?"

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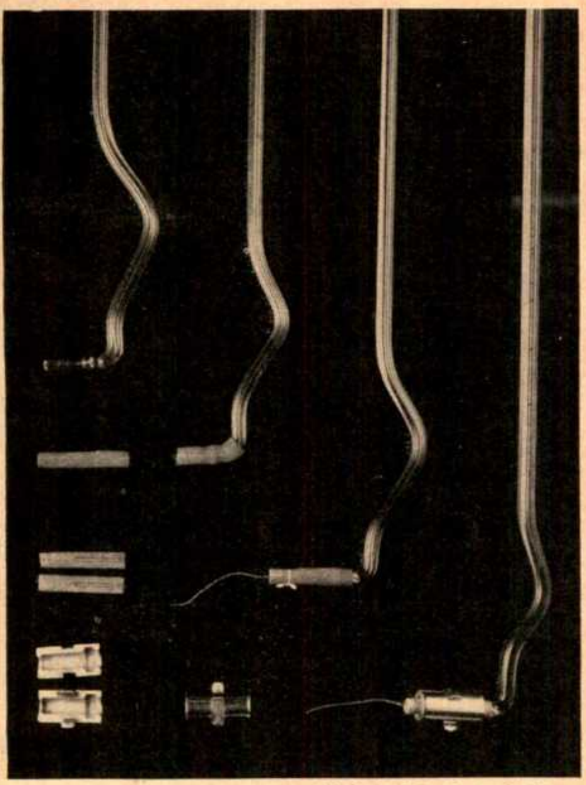
* Substance of a paper presented on December 28, 1937, before the Physiological Section of the Botanical Society of America at the annual meeting of the American Association for the Advancement of Science at Indianapolis, under the title "Root-pressure: An Unappreciated Force in Sap Movement".

To answer this question, manometers were developed to receive single growing roots, to collect any liquid which might be secreted from their bases, and to measure the force with which such liquid might be secreted. In its final form, the lower part of the manometer was constructed as shown in the accompanying figure. The upper end was attached to any of a variety of devices for measuring the amount of liquid secreted or the pressure developed.



[*Photograph by J. A. Carlile.*

MANOMETER ASSEMBLY CONSISTING OF SPECIALLY DESIGNED GLASS TUBE, RUBBER HOSE AND METAL CLAMP. BY MEANS OF THIS ASSEMBLY, A SINGLE GROWING ROOT CAN BE ATTACHED TO A RECORDING APPARATUS AND THE FORCE WITH WHICH WATER IS SECRETED FROM ITS BASE CAN BE MEASURED. $\times \frac{3}{8}$.

Qualitative results of tests made with such manometers were presented a year ago[10]. It was shown at that time that a continuous unidirectional flow of liquid does occur through such roots, that over a period of several days the quantities of liquid secreted may represent many times the volume of tissue increase due to growth of the culture in the same period, and that this secretion may take place against considerable pressure. Since then some measurements of the magnitude of the secretion force have been made. Although no absolute value has been obtained for the maximum secretion force, the results appear to warrant discussion at this time.

Simple straight manometers 500 mm. long and filled with either water or mercury gave identical curves, plotting height of column against time. No diminution in secretion rate with increase in column height was observable, even under mercury (maximum pressure 500 mm. mercury = 0·7 atm.). Using a levelling bulb, pressures up to 1,780 mm. mercury (2 atm.) were imposed, again without appreciably retarding secretion. When the manometers were attached to a compressed air tank and pressures up to six atmospheres (90 lb. per sq. in.) were applied, the secretion curves obtained were still indistinguishable from those obtained without imposed pressure. At pressures greater than 90 lb. per sq. in. the apparatus failed. Apparatus is now ready which, it is hoped, will permit the study of secretion under still higher pressures; but no measurements have yet been made with it. It is noteworthy that the roots have at no time failed to secrete continuously against all pressures to which it has been mechanically feasible to subject them. Failures have all been due to the apparatus—not to the roots.

The detailed secretion curves show a striking diurnal rhythm, secretion being practically at a standstill during the night, beginning at about 6 a.m., reaching a maximum rate about noon, and then falling off in quantity, though apparently not in force, during the afternoon. Since the secretion rate was unaffected by pressures up to 6 atm., it is clear that the true secretion pressure must greatly exceed this value. It is my opinion that it must reach at least 10 atm. and is probably much greater than that. This value is for single, isolated, normally metabolizing rootlets of tomato, a plant which rarely attains a height more than a tenth that to which such a force is capable of lifting water. It is thus evident that 'root-pressure' is a very real phenomenon, and is by no means the insignificant factor which text-books have led us to believe. Failure to appreciate it in the past century has probably been due to the necessity, before the development of the root-culture technique, of working with traumatized, moribund and hence abnormally metabolizing materials.

It is not suggested that mechanical factors, such as transpiration pull, cohesion, capillarity, imbibition, etc., do not play a considerable part in sap movement. Under conditions of high transpiration, they probably do account for the movement of large volumes of water through the plant. But under certain conditions such, for example, as those existing during the rainy season in many tropical forests, some or all of these mechanical processes must cease to function. Under such conditions, root-pressure, as demonstrated by these experiments, seems quite adequate to supply water to the tops of even the tallest trees.

No attempt will be made at present to explain how this force may be developed. We are interested, however, in determining if a diurnal rhythm of respiration rate exists corresponding to the observed rhythm of secretion, to extend the quantitative study of the phenomenon to roots of species other than tomato, including roots of some trees, and especially to extend the curve of secretion rate as influenced by imposed pressure far enough so that some estimate of the maximum secretion pressure can be obtained and compared with the osmotic values of the tissues involved. It is hoped thus to throw some light not only on the question of sap movement but also on the mechanism of secretion.

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Clay

FOR fifty years or more a number of people have been endeavouring to give a satisfactory answer to the question, "What is clay ?" Instead of a simple answer which meets all requirements, no adequate definition has been found. Geologists define as clay many substances which potters would reject. Chemists look for a definition based on chemical composition and fail to obtain satisfaction because many commercially useful 'clays' differ so greatly in composition that no satisfactory correlation seems possible. The highly plastic blue clay used by glove manufacturers seems to have little in common with the hard grey fireclays of the Coal Measures and even less with the china clays of Devon and Cornwall, or the kaolin of the text-books. Plasticity—which is supposed by many people to be the chief characteristic of all clays—is almost absent from some kaolins the composition of which causes them to be regarded as the purest of all clays and the 'typical clay-substance' of numerous authors and investigators. On the other hand, many substances become plastic when suitably treated, though their compositions are so different from any kind of clay that the inclusion of plasticity as an essential part of any definition has often led to confusion.

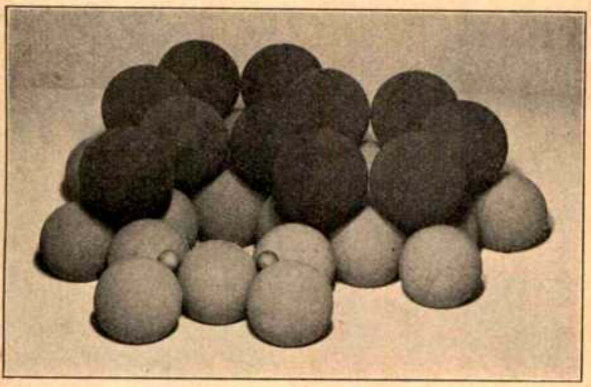
An important step forward was taken when Seger succeeded in separating extremely small particles of almost constant composition from several varieties of clays used in the manufacture of bricks, tiles, and pottery. Further investigations along this line seemed to show, however, that Seger's 'pure clay' or 'clay-substance' does not exist in the sense that 'pure silica' or any other 'pure' chemical compound exists. The variations in composition and properties of the 'purest clays' obtained from various sources differed too greatly for clay to be regarded as a definite chemical compound.

The whole subject remained in this inchoate state until a few years ago, because the 'purest' clay particles obtainable are so small as to be, for the most part, outside the range of the most powerful microscopes. Many seem to be readily converted into the colloidal state, if they do not exist in it when found, and as their precise shapes cannot be ascertained by direct observation they were regarded as amorphous. It seemed, indeed, as though the limits of investigation, as applied to clay particles, were rapidly being approached when a new line of research was opened out by the discovery that X-rays enabled the crystalline form of substances to be recognized even when the particles were of sub-microscopic dimensions. This line, so ably developed by Sir William Bragg and his son W. L. Bragg, has now changed the whole outlook on the constitution of clays and has successfully revealed the principal features of the structure of clays, though many details still await explanation.

The present position was described on November 19 by Sir William Bragg in a Friday evening discourse at the Royal Institution and may be summarized as follows:

Many mineral and other silicates have been found, by X-ray analysis, to consist of sheets or layers of atoms piled one upon the other, much as a series of balls of different sizes may be placed in a pre-arranged heap (see accompanying illustration). In both complex silicates and clays, the atoms (represented as spheres at the apices of tetrahedra) form a pattern of rectangular cells or units, and the various sheets or layers must fit perfectly in combination even if they differ slightly when in separate existence. Such differences are easily overcome when two or more layers are laid on each other or when they grow together. The lengths of the sides of these imaginary rectangles have been measured, and from them the probable structure of various clays deduced.

The structure of the halloysite crystal (which is a characteristic constituent of some fireclays) has been determined by Mehmel, and the dimensions (in angstroms) of the unit (rectangular) cell are $a = 5{\cdot}20$, $b = 8{\cdot}92$, $c = 10{\cdot}25$, and $\beta = 100$. The value of c corresponds to four oxygen or hydroxyl sheets piled on one another. The structure of several typical clays and other minerals is shown in Table 1, each sheet or layer being enclosed in a rectangle of dimensions $a \times b = 5{\cdot}2$ A. $\times$ $8{\cdot}8$ A. The height of the cell depends mainly on the number of sheets and on their thickness.



ARRANGEMENT OF THE ATOMS IN A SHEET OF HYDRATED SILICA. THE O-ATOMS FORM THE LOWEST LAYER; THE OH-GROUPS, SHOWN DARKER, REST ON THEM. THE SILICON ATOMS OCCUPY THE SPACES BETWEEN; TWO SILICON ATOMS HAVE BEEN MADE VISIBLE BY THE REMOVAL OF OVERLYING SPHERES.

It should be noted that when halloysite is slightly heated, its two middle sheets of hydroxyl collapse into one sheet consisting of four oxygens and two hydroxyls. Four oxygens and eight hydrogens are expelled in the form of water, though no water, as such, exists in the clay. This expulsion of 'combined water' has long puzzled chemists, though they were aware that it originated in the decomposition of hydroxyl groups. As shown in Table 1, the slightly heated halloysite (meta-halloysite) has the same structure and composition as kaolinite and, presumably, as kaolin and china clay. Further heating of halloysite and kaolinite appears to result in the formation of free alumina and free silica, and the expulsion of water as steam, but further investigation is necessary to prove this.

Several well-known clays appear to be derived from, or closely related to, montmorillonite, which, as shown in Table 1, consists of two sheets of silicon atoms with a sheet of aluminium atoms and two sheets of oxygens and hydroxyls between. The greater thickness of the montmorillonite cell, as compared with pyrophyllite and mica, is attributed to further intervening sheets of water. The structural analogy of montmorillonite with hydrated silica, brucite, and gibbsite is clearly shown in the table.

TABLE 1.

Hydrated silica	Brucite	Gibbsite	Halloysite	Kaolinite
4 OH 4 Si 6 O	6 OH 6 Mg 6 OH	6 OH 4 Al 6 OH	6 OH 4 Al 6 OH 4 OH 4 Si 6 O	6 OH 4 Al 4 O + 2 OH 4 Si 6 O
	thickness = 4·73	thickness = 4·86	thickness = 10·25	thickness = 7·2

Pyrophyllite	Montmorillonite	Mica (Muscovite)
6 O 4 Si 4 O + 2 OH 4 Al 4 O + 2 OH 4 Si 6 O	6 O 4 Si 4 O + 2 OH 4 Al 4 O + 2 OH 4 Si 6 O water layer or layers	6 O 3 Si + Al 4 O + 2 OH 4 Al 4 O + 2 OH 3 Si + Al 6 O 2 K
thickness = 9·4	thickness = 9·2–21·4	thickness = 10·0

In Sir William Braggs's opinion, the main problem of the constitution of clays has now been solved: there are only two different groups of clays: (*a*) those allied to halloysite, kaolinite, nacrite, and dickite; and (*b*) those allied to pyrophyllite, the latter including montmorillonite, beidellite, bentonite, and fuller's earth, which differ chiefly in their metal contents, for example, in the extent to which gibbsite is replaced by brucite.

The suggested structures explain the colloidal properties of the smallest clay particles, the relatively 'enormous' effect of minute additions of alkalis or acids to clay pastes and suspensions, and they aid greatly in explaining variations in plasticity. Recent measurements by Bradley, Grim and Clark[1] have shown the existence of a well-defined set of hydrates in which the c axis increases regularly with the water molecules introduced into the unit cell. The looseness of these water molecules gives easy movement to the clay particles and yet prevents the complete loss of shape of the mass.

This peculiar ability of absorbing water molecules and arranging them in successive sheets in the layer-like structure of the clay crystal, causing an increase in the *c* axis but not altering the lengths of the *a* and *b* axes, is, according to Sir William Bragg, "the cause of plasticity". The same structural arrangements also explain the remarkable property of 'base exchange' of some derivatives of montmorillonite clays (zeolites).

To sum up, the structures of the chief clay minerals shown in Table 1 enable clear, reasonable and simple explanations of the chief properties of clays to be formulated. Many details remain to be added, because it is difficult to obtain perfectly pure materials and because of the complications due to the numerous substitutions which are usually present. Now that the general structure of clays has been so clearly elucidated, it should not be difficult to fit the details into their proper places.

All who are interested in the molecular structure of clay, whether theoretically or in connexion with the manifold uses of this very important material, should be very grateful to Sir William Bragg for his masterly solution of a problem which has, for so long, baffled many men of science.

A. B. Searle.

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[1] *Z. Kryst.*, 97, 216 (1937).

Obituary Notices

Sir R. F. Johnston, K.C.M.G., C.B.E.

We regret to record the death of Sir Reginald Fleming Johnston, formerly commissioner for Wei-hai-wei and a distinguished Chinese scholar, which took place in Edinburgh on March 6 at the age of sixty-four years.

Johnston, who was educated at the University of Edinburgh and Magdalen College, Oxford, where he obtained a second class in the Final Honour School of Modern History, entered the Civil Service of the Hong-Kong Government in 1898 as a cadet. After serving as private secretary to the Governor and acting clerk to the Council and Assistant Colonial Secretary, he was appointed in 1904 secretary to the Government of Wei-hai-wei, then held under lease by the British Government. He remained there until 1919, when his special and profound knowledge of China and the Chinese led to his appointment as tutor to the Manchu Emperor P'u Yi, now the ruler of Manchukuo. This appointment came to an end with the flight of the Emperor in 1924. In 1926, Johnston was appointed secretary to the British Indemnity Delegation, and in the following year returned to Wei-hai-wei as Commissioner, his appointment coming to an end with the transfer of the territory to the Chinese Government. On his retirement, when he was already a C.B.E. and C.M.G., he was promoted to K.C.M.G.

On his return to England, Johnston accepted the chair of Chinese at the School of Oriental Studies in the University of London, an appointment which he held from 1931 until 1937.

As a Chinese scholar, Johnston's knowledge of the language and the people, of their ways of thought and their beliefs, was exceptionally wide, deep and sympathetic, although in this last respect it was distinctly perceptible that his understanding grew and mellowed as time went on. When he left Hong-Kong for Wei-hai-wei, he had already acquired no little insight into the widely varied conditions of life and the character of the peoples of the Far East. He made two extensive journeys of which the first in 1902 traversed Tonking, Yunnan, the Chinese Shan States, the States of the Upper Laos and the plain of eastern Siam, ending at Bangkok. A later and more ambitious journey occupied nearly a year, during which Johnston lived for the most part in close touch with native life. This journey was described in "From Peking to Mandalay". On his transfer to Wei-hai-wei Johnston found himself in the Province of Shantung in close touch with the springs of all that is most traditional and changeless in the life of the Chinese peasantry. His studies here bore fruit in his scholarly and informative "Lion and Dragon in Northern China" (1910). This was followed in 1913 by his "Buddhist China", a sympathetic study of Chinese religious belief and philosophic thought, while his "Letters to a Missionary" (1918) affords a contrast in its trenchantly critical tone. "Twilight in the Forbidden City" (1934) records his experiences as tutor of the Emperor, whom he visited in Manchukuo in 1935, before proceeding to Mukden for the purpose of studying the archives of the Manchu.

Major F. G. Jackson

Major Frederick George Jackson, the Arctic explorer who died on March 13, was born in 1860 and educated at Denstone College and the University of Edinburgh. Attracted by an open-air life, he spent some time on a Queensland cattle ranch before the Arctic regions attracted his attention. A few months on a whaler in the Greenland Sea whetted his appetite and he offered his services to Nansen for the voyage of the *Fram*. But the *Fram's* complement was full and so Jackson decided to organize his own expedition. His plan was to attempt to reach the Pole by sledging north from Franz Josef Land, beyond which he, among others, believed that there existed a land which Payer, in 1873, had called Petermann Land.

In order to test equipment and to gain experience, Jackson decided first to undertake a winter journey in Arctic Russia. He began with a journey through the little-known Waigatz Island and then, failing to achieve his plan of exploring Novaya Zemlya, he set off from Khabarova with a Russian, a few Samoyedes and reindeer sledges over the frozen tundra via the Pechora River to Archangel. From there he went on round the White Sea and across the Kola peninsula to Kirkenes in Norway. His book, "The Great Frozen Land" (1895), is full of notes on natural history and on Samoyedes' customs and folklore. With the backing of Mr. A. C. Harmsworth (later Lord Northcliffe), Jackson left for Franz Josef Land in 1894 and made his base at Cape Flora. The Franz Josef Archipelago was little known beyond the few discoveries of Payer and Leigh Smith. Jackson remained three years in the north, surveying some of the little-known islands and distinguishing himself as a hunter of polar bears, of which he shot about a hundred. Among his companions were W. S. Bruce and A. B. Armitage, who in later years distinguished themselves in South Polar work. The expedition's chief claim to fame was due to the chance meeting of Jackson with Nansen and Johansen. On their return from their long poleward march they had wintered on the north of the archipelago, and in 1895 were on their way west toward Spitsbergen when near Cape Flora they met Jackson, a few weeks before the *Windward* was due. Thus they reached Norway in safety.

After serving in the South African War of 1899–1902, Jackson contemplated a South Polar expedition but his plans came to nothing. He served in the Great War, and in 1919 had charge of Russian prisoners-of-war camps in Germany. Then in 1925 he turned to Central Africa for adventure and big game shooting, crossing Africa from east to west, visiting the Ruanda country and descending the Congo to the sea. Later he investigated the slave trade of Liberia. In addition to his book on Lapland Jackson wrote "A Thousand Days in the Arctic" (1899) and "The Lure of Unknown Lands" (1935). He was a gold medallist of the Royal Geographical Society, a medallist of the Royal Humane Society and a knight of the Order of St. Olaf.

Jackson's work was essentially of a pioneer order, and it was the opportunity to overcome physical difficulty and danger which drew him to the Arctic and later to Africa. Scientific exploration attracted him less than hunting, but he showed much interest in natural history and, where scope was afforded, in native races and their ways. R. N. R. B.

Prof. Anton Lampa

THE academic career of Prof. Anton Lampa, who died in Vienna on January 28 at the age of seventy years, was under the shadow of the political changes occurring in Austria during his lifetime. Educated in Vienna, he studied physics under von Lang and became *Privatdozent* and assistant professor in the University of Vienna. In 1909 he was called upon to fill the chair of experimental physics at the German University in Prague; when, in 1918, Czechoslovakia became an independent State, the German University in Prague came under the authority of the new Government instead of the Ministry of Education in Vienna. Although this did not cause any appreciable change of its activities, and almost all of the professors continued their work, Lampa decided to return to Vienna. Since there was no chair available for him there he again became *Privatdozent* of physics.

This resignation was no doubt facilitated by the variety of Lampa's interests. In experimental physics his name is connected especially with the production of very short electric waves; for several years he held the 'record' with a wave-length of 4 mm. He was much interested in questions of the philosophical foundations of science; here he was a devoted follower of Ernst Mach, and a short biographical sketch which he dedicated to Mach's memory is one of the best introductions into the latter's philosophy. The fact that, already in 1883, Mach, on general principles, had postulated the relativity of every type of motion (including rotation!) enabled Lampa to be one of the earliest to realize the whole significance of Einstein's theory of relativity. It was largely due to Lampa that the German University of Prague was the first to offer to Einstein a full professorship; he held there the chair of theoretical physics from 1911 until 1912, being in close touch with Lampa.

After his return to Vienna, Lampa devoted much time to educational questions. The various societies for the propagation of knowledge could always count on his support, and for a while he was president of one of them. His memory will be held in honour not only by his professional colleagues but also by many others who shared his literary or philosophical tastes and were aware of the sincerity of this very quiet and unostentatious man. F. A. P.

Mr. A. E. Munby

BY the death of Alan E. Munby on January 19, a great personality has been lost to the world of science and art. Mr. Munby's association with the cause for the advancement and development of science teaching for its intrinsic educational value is well known to many. He was for more than thirty years a member (twice chairman) of the Science Standing Committee of the Royal Institute of British Architects, and no effort did he spare in this capacity in obtaining from scientific and educational bodies all over Great Britain, their views, criticisms, and comments on scientific matters and the manner of their propagation. It is to be regretted that he has not lived to see the full benefits of his labours in this respect.

Mr. Munby was educated at Repton. His early training at Durham, where he was assistant to Prof. Bedson and lectured on chemistry in the adjoining counties, his engagement in research at Cambridge (under Sir Arthur Shipley), and at Heidelberg, and in science teaching at Durham, and Felsted School, well fitted him for that sphere of the profession of architect (which he took up at the age of thirty years) for which he is better known. There is no doubt that while a science master at Felsted opportunities occurred to him for considering the practical aspect of the planning of science laboratories which led eventually to an interest in architecture.

It is natural therefore that Mr. Munby's principal works as an architect should lean towards science. Many public schools have had the benefit of his experience. He was responsible for the new science buildings at Clifton College, Highgate School, Beaumont College, University College of North Wales at Bangor, Gresham's School, Hereford Cathedral School, Shrewsbury School, Dover College, and for redesigning the science departments at Uppingham and Cheltenham, and at the Chelsea Polytechnic. He acted also as consultant for the Institute of Tropical Medicine in Shanghai, and for the recently erected science department at Malvern College.

Mr. Munby's publications include: "Notes on Polarised Light" (1894), "Introduction to the Chemistry and Physics of Building Materials" (1909), "Laboratories, their Planning and Fittings" (1921), and "School Laboratory Fittings" (1929).

J. R. S.

Mr. M. W. Hilton-Simpson

WE regret to record the death of Melville W. Hilton-Simpson, anthropologist and African traveller, which took place on March 17 at the age of fifty-seven years.

Hilton-Simpson was the son of the Rev. William Hilton, who added Simpson to his surname in 1888; he was educated at Wellington and Exeter College, Oxford, where he obtained the degree of B.Sc. and the diploma in anthropology. On leaving Oxford, he specialized in the study of African ethnology in the field, making his first journey in North Africa and the Sahara in 1903. His next expedition was to West Africa with Émil Torday as leader, and Norman Hardy, the artist. This ethnological expedition, of the first importance as it proved to be, was carried out on behalf of the British Museum. It covered much unmapped territory in the Kasai basin of the Congo, and brought back valuable anthropological information relating to the tribes of the area, especially the Bushongo, a rich collection of ethnographical specimens, more especially examples of the art of the Congo peoples, and a gallery of paintings by Norman Hardy, which were as remarkable for their accuracy in representing the physical characters of the people, their dress and ornament, as they were for their high artistic merit.

Hilton-Simpson's interests, however, centred not so much in tropical Africa as in the ethnological problems of the northern area of the continent, and more especially in the Berber peoples. For a number of years, each season found him travelling in North Africa, while from 1912 onward he specialized still further in the study of the Algerian Berbers. Seven winters in succession were spent in travelling in the Aurès mountains, where the sporting tastes of himself and his wife established friendly relations with a sporting people and won them exceptional facilities for their investigations. Mrs. Hilton-Simpson's skill as a hockey player not only secured her a place of pre-eminence in the Shawia women's national game, but also gave her their intimate confidence, to the lasting gain of ethnological science.

The work of these years of travel was recorded in "Among the Hill-Folk of Algeria" and "Arab Medicine and Surgery", and in papers in the *Geographical Journal*, the publications of the Royal Anthropological Institute and elsewhere. An especially important contribution to the study of these peoples was a series of cinematograph films of Berber life and industry, taken by Mr. J. Haessler, an American anthropologist, who accompanied them on certain of their expeditions. Apart from his general account of these peoples, Hilton-Simpson's most valuable contribution to the study of their culture was his investigation of their practice of trephining. He made a collection of the instruments used for this purpose, and showed that, like a number of other elements in their culture, the practice was to be traced back to Roman times.

Hilton-Simpson, who served on the Western Front in the Great War and held the rank of captain, was a Chevalier of the Légion d'Honneur and was awarded the Rivers Medal of the Royal Anthropological Institute for anthropological work in the field in 1932.

Lady Gomme

BY the death of Lady Gomme, which took place on January 5 at the age of eighty-five years, folklore studies in Great Britain have lost a staunch supporter of long standing. With her husband, the late Sir George Laurence Gomme, whom she, as Alice Bertha Merck, married in 1875, she took a prominent part in the early activities of the newly constituted Folk-Lore Society, of which they were among the founders. Throughout their married life, and after her husband's death, her organizing ability, her knowledge of her subject and its personnel, and her keen critical faculty, gave her, as of right, a foremost place in every movement for promoting the recording and scientific study of folk beliefs, customs and institutions. Lady Gomme helped to found the two societies, now merged, devoted to the study of folk-dance and song, and strongly influenced the late Sir Cecil Sharp in his work of collecting folk-songs and dances. She herself was the author of two works, which have long been regarded as standard books of reference and models of their kind—"Children's Singing Games, with the Tunes to which they are Sung" (1894, Second Series, 1895) and "A Dictionary of British Folk-Lore, Vol. 1: Traditional Games of England, Scotland and Ireland" (Pt. 1, 1894; Pt. 2, 1898).

WE regret to announce the following deaths:

Mr. F. G. L. Bertram, deputy director of civil aviation from 1926 until 1935, on March 24, aged sixty-two years.

Capt. T. S. Taylor, founder and a director of Taylor, Taylor and Hobson, Ltd., manufacturing opticians, on March 14, aged seventy-four years.

News and Views

Solar Radiation as a Cause of Ice Ages

The supplement to this week's issue of Nature (p. 591) consists of Sir George Simpson's discourse at the Royal Institution on "Ice Ages". The striking advances of great ice sheets over large areas of the globe which have occurred at long geological intervals have attracted a great deal of attention from geologists, who have described their extent, oscillations and associated phenomena in a huge volume of literature, and there has been much speculation, some of it very wild and baseless, as to their causes, but they have been little discussed from the point of view of physical meteorology. With so much ground to cover in a short time, Sir George Simpson presented the geological results in broad outline, ignored the speculations, and concentrated on the theory of variations of solar radiation as a cause of ice ages which is his own especial contribution to the subject, built up by a number of important researches during the past few years. It has previously been assumed that widespread glaciation required a general fall of temperature, one cause of which might have been a *decrease* of solar radiation; Sir George demonstrated on physical grounds that glaciation is more likely to result from an *increase* of solar radiation. This would have little effect on temperature, but would cause increased snowfall in high latitudes and at the same time heavy rainfall ('pluvial periods') in lower latitudes. That such a paradoxical state of affairs is actually possible was shown by a simple and beautiful experiment in ice formation performed at the discourse and illustrated in the text.

Further Evidence relating to Peking Man

In another column of this issue of Nature (see p. 614) Prof. Franz Weidenreich describes further discoveries relating to Peking man—fragments of femora and part of a humerus. These were extracted from material excavated in the cave of Choukoutein in July last, shortly before further investigation was abandoned on the approach of hostilities. For the actual discovery science is once more indebted to the care and skill as an investigator of Mr. W. C. Pei, by whom the first *Sinanthropus* skull was discovered in the Choukoutien cave in 1929. In view of the fact that little skeletal material of *Sinanthropus* has been discovered in the cave, apart from skulls and teeth, the latter now numbering well over a hundred specimens, the new material is of no little importance, as Prof. Weidenreich shows, both in the light it throws on the build and carriage of this early member of the human family, and also for purposes of comparison with other forms. Thus, for example, Prof. Weidenreich deduces from the larger of the two femoral fragments, which he argues to be feminine, that as reconstructed, it points to the stature of its former owner having been approximately five feet, indicating a stature in the male of five feet four inches. Further, the characters of the leg bones and the humerus agree in indicating that, while the femur presents certain primitive characters, which are enumerated, distinguishing it from that of recent man, nevertheless Peking man walked upright. It is possible that in this respect *Sinanthropus* had the advantage over Neanderthal man. The upper limbs had been completely relieved from the function of locomotion. This freedom of the upper limb would accord with the relatively advanced character of the stone industry which has been discovered in the cave. In other respects the new evidence throws further light on the culture of Peking man. The scorching of one of the bones corroborates previous evidence that *Sinanthropus* had attained the use of fire, while the way in which the bones have been broken—the illustration suggests that they have been hacked off by a stone implement—points in the same direction as the evidence of the skulls—to cannibalism.

Dr. Adolf Mahr

The Court of the University of Edinburgh at a meeting held on March 22, appointed Dr. Adolf Mahr to be the Robert Munro lecturer in anthropology and prehistoric archæology for 1938–39. This lectureship was founded in memory of Dr. Robert Munro, most distinguished and widely-known of Scottish archæologists, whose work on palæolithic man and on the lake dwellings of Europe placed him in the front rank of the students of prehistory of the late nineteenth and early twentieth centuries. The choice of Dr. Mahr as Munro lecturer at the present juncture is peculiarly appropriate. Born and educated in Vienna, after holding an appointment on the staff of the Imperial (now State) National Museum of Vienna, when he specialized in studies of the Hallstatt period of the Iron Age, Dr. Mahr in 1934 was appointed director of the National Museum of Ireland and keeper of Irish antiquities. In virtue of his office, the responsibility has devolved upon him of adapting to the service of field archæology the State measures of the Irish Government for the relief of unemployment and economic depression. A large number of men have been absorbed in the work of excavating on occupation sites of all periods of Irish history from prehistoric to late historic throughout the country. A measure of these activities in archæological research, which have been pursued under the direction of Dr. Mahr and supervised by him and his assistants, is afforded by the summary of results which formed the substance of the address delivered by Dr. Mahr as president of the Prehistoric Society in 1937, and occupies no less than 175 pages in quarto of that Society's recently published *Proceedings* for 1937 (3, 2).

Royal Geographical Society: Medals and Awards

H.M. THE KING has approved the award of the Royal Medals as follows: Founder's Medal to Mr. John Rymill, for his organization and leadership of the British Graham Land Expedition 1934–37; Patron's Medal to Mr. Eric Shipton, for his explorations around Nanda Devi and Mount Everest and his conduct of the Shaksgam Expedition of 1937. The Council has made the following awards: Victoria Medal to Mr. A. R. Hinks, for his contributions to the study of geodesy and the figure of the earth, map projections, and photogrammetric survey; Murchison Grant to Mr. Martin Lindsay, for his journey across Greenland in 1934; Back Grant to Mr. Thomas Hay, for his contributions to the physical geography of the Lake District; Cuthbert Peek Grant to Mr. Bradford Washburn, for his explorations and glacier studies in Alaska; Gill Memorial to Mr. Ivan Champion, for his explorations and surveys in Papua.

The British Association and Australia

THE Australian Government has decided not to proceed further at present with the proposal to invite the British Association to meet again in the Commonwealth. As it is desired, however, that leading men of science should from time to time be afforded opportunity to visit Australia, it has been decided to issue invitations to a party of six to attend the jubilee meeting of the Australian and New Zealand Association for the Advancement of Science at Canberra in January 1939. It is hoped that the precedent so set will become regular practice at each succeeding biennial meeting of the Association. A grant of £A1,500 towards the expenses of the guests in 1939 has been promised by the Government.

Man and Animals in Great Britain

A MEETING arranged by the University of London Animal Welfare Society (ULAWS) was held in the Beveridge Hall of the University of London on March 22 to discuss "Man's Relation to Nature and his Response" with reference to "the Survey and Regulation of British Fauna". The chairman, Sir P. Chalmers Mitchell, said that the so-called 'balance of Nature' is a myth and has not existed since glacial times, when there were no animals in Britain to be balanced. We interfere too much for there to be one and interference is no good without knowledge. The Marquess of Tavistock showed how conflicting interests make legislation difficult. Fruit farmers and the owners of grouse moors oppose the protection of bullfinches and peregrine falcons respectively. There is no need to fear the introduction of wild birds for, unlike alien rodents, they find competition too strong. As regards method of control, there is no difficulty in shooting deer in the Highlands, but in the wooded Lowlands hunting is kinder. Shooting is often unkind to foxes owing to the uncertainty of aim. Otters are neutral in sporting streams, killing some game fish but keeping down eels; but they are harmful in trout hatcheries and to ornamental wild fowl. Protecting stoats and weasels to keep rabbits down is a fallacy. Prof. F. A. E. Crew referred to the need for research on the ecology of British mammals; he suggested that we should have something like the U.S. Biological Survey, that the Bureau of Animal Population should be supported, and the staffs of museums and university departments should be enlarged. Sir Roy Robinson, chairman of the Forestry Commission, said that complaints about his treatment of animals were sentimental and not based on knowledge. Rabbits should be exterminated. There are too many deer and foxes. The only mammal in need of protection is the pine marten, and he would like to harbour them. All birds, except black-game and caper-cailzie, should be encouraged in forests. Other speakers referred to the desirability and the difficulties of rabbit extermination in various parts of Great Britain.

Roman Fortifications in Yorkshire

RECENT evidence of the varied methods of construction adopted by the builders of Hadrian's Wall (see NATURE, March 19, p. 505) lent additional interest to the account of the defensive system of Roman Aldborough, near Boroughbridge, Yorkshire, which was presented to the Society of Antiquaries on March 24 by Mr. J. N. L. Myres and Miss Mary Kitson Clarke. This site, known to the Romans as Isurium Brigantium, was the capital city of the British tribe of the Brigantes, an important people, whose territory covered nearly the whole of the northern part of what is now England south of the Border. The excavation was carried out by Mr. Myres and Miss Clarke for the Roman Antiquities Committee of the Yorkshire Archæological Society. In the course of the excavation, it was found that the north-west wall did not run as shown in the Ordnance Survey map, but that its angle lay farther to the north-west. The main scheme of the defences, it was found, consisted of the wall itself, backed by a bank of clay and sand. This, however, was not constructed until the second century A.D. Previously there appears to have been no system of defence, and Roman occupation had been haphazard. Later, perhaps in the early part of the fourth century, a large bastion had been added to the angle, and at least one small bastion built on to the west wall, not far from the angle. Still preserved to a height of nine feet in parts is the lower story of an internal angle tower, which was a striking feature of the wall in its original form. This had supported some structure rising above the wall. Pottery indicates that a lean-to hut at the back of the tower was occupied in the third century. The excavations will be carried further in the coming season.

Clifton College Scientific Society

THE Clifton College Scientific Society held a conversazione in the Science School on Thursday, March 17. About 350 guests were present, as well as approximately the same number of members of the Society, but the spacious laboratories were not more than pleasantly full. Among the exhibits and experiments, arranged by the boys themselves, were a cathode ray oscillograph, a model geyser, fluorescence in ultra-violet light, a model of a hydraulic ram, the preparation of artificial silk, Bristol's share in the development of chemistry, chemiluminescence, flames and explosions, the effect of plant hormones, living elvers from the Severn, and experiments upon animal respiration. Lectures upon colour and upon liquid oxygen, with demonstrations, were given by two members of the Society, and a third entertained visitors by chemical conjuring performed to the accompaniment of an almost professional patter. The aeronautical section—a comparatively new but already vigorous branch of the Society—staged a topical exhibit of aeroplane parts, including a collection of bombs, while in the Science Library were displayed many scientific classics and autographs of famous men of science. Some of the original quartz glass, made by W. A. Shenstone while at Clifton, was on exhibit in one of the corridors, where a collection of the elements, arranged by a former member of the Society when still at school, also attracted much attention. One of the most popular features of the evening was a *tableau vivant* of Lavoisier and his wife, after the well-known picture by David. Among the guests were Sir John Inskip, Profs. M. W. Travers, W. E. Garner, C. M. Yonge, R. J. Brocklehurst, A. Rendle Short and A. M. Tyndall, Air Commodore Dalzell-McKean, and the head masters and science masters of many neighbouring schools.

Acquisitions at the British Museum (Natural History)

THE British Museum (Natural History) has received as a donation from Lord Sudeley the skins of three *Colobus* monkeys from Mount Kenya, *Colobus polykomos kikuyuensis*. One of the specimens is of exceptional interest, being nearly a full albino, the only black hairs remaining being a few scattered hairs on the back and a small V-shaped marking on the crown of the head. These specimens came from close to Nanyuki, situated on the equator on the western slopes of Mt. Kenya at an elevation of about 8,000–9,000 ft. These white or semi-white Colobus monkeys apparently belong to one family group, as they are all found in one very restricted locality on Mt. Kenya. Lord Sudeley shot the specimens himself and reports that the eyes were of normal colour and not the eyes of an albino. Lord Moyne has presented to the Museum the zoological collections made by M. J. Delacour and Mr. J. S. Colman during the recent cruise of his yacht *Rosaura*. These include material from the coast of Greenland, southwards to the West Indies, Brazil and the coast of West Africa. The collection when worked out will probably prove of prime importance for several distinct branches of zoological inquiry. The Royal Society has presented a set of specimens of the volcanic rocks of Montserrat in the West Indies, collected by Mr. A. G. MacGregor, who was a member of the Royal Society Expedition which visited the island in 1936 to investigate the causes of the recent earthquake activity and its relation to the vulcanology. A piece of meteoric iron, found last year at Kumerina in Western Australia, has been presented by the Public Library, Museum and Art Gallery at Perth. A polished specimen of 'Brazilian onyz', an ophicalcite worked in the Argentine, has been presented by Messrs. John Bolding and Sons, and the Cookson Lead and Antimony Company has presented a remarkably fine specimen of metallic antimony crystals.

Rubber Technology Conference

A RUBBER TECHNOLOGY CONFERENCE, under the auspices of the Institution of the Rubber Industry, has been arranged to take place in London on May 23–25, under the honorary presidency of Sir William Bragg. The Conference is being supported by the leading organizations connected with the rubber producing and manufacturing industries and by many other scientific and technical societies; altogether, some seventy organizations in Great Britain, Canada, South Africa, British Malaya, Ceylon, the United States, Austria, Belgium, France, Germany, Holland, Italy and Poland will be sending official delegates to the Conference. These include the Research Association of British Rubber Manufacturers and many of the other industrial research associations operating under the Department of Scientific and Industrial Research. More than seventy papers have already been promised from authors representing most of the countries just mentioned. This excellent response promises to make the Conference an outstanding event, at which a notable gathering of rubber technologists and scientific men interested in rubber from at home and over-seas is expected. A special feature of the Conference will be a symposium on methods of improving and evaluating the durability of rubber, but all other aspects of rubber science and technology will be covered by the remaining sessions. An attractive programme of social events, visits, etc., is being arranged. Those desiring to become members of the Conference or to contribute papers can obtain full particulars from the Secretary, Institution of the Rubber Industry, 12 Whitehall, London, S.W.1.

Oil in Osage County, Oklahoma, U.S.A.

A FIELD party of the United States Geological Survey has recently investigated sub-surface geology of the Osage Indian Reservation of Oklahoma, and it appears that there are many localities in this Reservation worthy of exploration from the point of view of oil production. Prior to the issue of the Geological Survey's report, a paper had been written by N. W. Bass, W. R. Dillard, and J. H. Hengst (U.S. Department of the Interior. *Bull.* 886, A) describing several of these localities. In the east-central part of the Reservation, it is believed there may be an oil pool of considerable extent in the Bartesville Sand. Three productive wells have already been drilled. One drilled thirteen years ago had produced 63,000 barrels of oil by the end of

(*Continued on p.* 599)

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SUPPLEMENT

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Ice Ages*

By Sir George Simpson, K.C.B., F.R.S.

IT is now common knowledge that there have been great changes in climate during past ages. The geological evidence is perfectly clear that luxuriant vegetation once grew in Greenland and Spitsbergen, where now the hardiest forms of vegetable life can barely exist on the small areas free from permanent ice. At the other extreme, there is no doubt whatever that at one period a great ice sheet covered the plains of Central India and discharged icebergs into a sea covering what is now the Punjab and North-West India—one of the hottest parts of the earth.

From the geological record it would appear that the climatic changes of the past were in all directions, some warmer and some colder, some wetter and some drier than at present; and some individual localities appear to have experienced all possible climates at one time or another.

It is the problem of meteorologists to study the extent and sequence of the climatic variations in all parts of the world and to seek the cause and mechanism of the changes. Very little progress has been made in that direction up to the present for two main reasons. In the first place, the geological evidence is very fragmentary and often doubtful; and secondly, we know very little of what causes climatic variations and how they are controlled.

The geological evidence of change of climate is based on the fossil relics of past vegetable and animal life and on the physical effects which climatic conditions have on the surface rocks. The former is very difficult to interpret. Heavy vegetation does not always mean warm damp conditions, and both plants and animals may, in the course of ages, change their habits so that the early representative of a species which is now warmth-loving may have been developed in cold surroundings. For this reason, one cannot be certain of climatic conditions deduced from the remains of vegetable and animal life.

The case is quite different when we base our climatic deductions on the physical features of old land surfaces. There can be no doubt when we find traces of salts left when an enclosed sea has dried up that we are dealing with a dry climate in which the rainfall was less than the evaporation. But of all evidences of climate those of ice are the most unmistakable. At the same time one has to be careful, for to-day the presence of ice does not always mean a cold climate. In mountain regions glaciers descend the valleys into climates which are far from arctic, and in New Zealand especially ice action is taking place in valleys which bear an almost subtropical vegetation. There have been periods in the past when ice formation was much more active than at present and of such an extent that only a radical change in climate can have been responsible.

The evidence of the presence of ice during these periods in places where ice is quite impossible with the present climate is so clear that these Ice Ages, as they are called, are the most appropriate subjects for the study of climatic change. If we can find a cause for an Ice Age we shall have made a long step forward towards explaining all changes of climate.

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* Friday Evening Discourse delivered at the Royal Institution on December 10, 1937.

PRE-CAMBRIAN ICE AGE

In the early days of geology, when evidence of tropical vegetation was found in regions which are now far from the tropics, it was supposed that the high temperature required by these plants was due to the earth still remaining hot from its earlier molten state. The discovery, however, of clear evidence of ice in Pre-Cambrian times, that is, at a time far anterior to the appearance of vegetation, shows that the earth had by then already cooled to its present temperatures. Evidence of Pre-Cambrian ice has been found in North America, Europe, China, South Africa, India and Australia. Some geologists have concluded from this widespread evidence of ice that the Pre-Cambrian Ice Age was extremely severe. So little is known, however, about this early age, and there is no evidence that all these places were glaciated at the same time, that it is useless to try to reconstruct the climatic conditions which then existed. The only certain conclusion is that already stated, namely, that the temperature of the earth was then already sufficiently low to allow of ice formation.

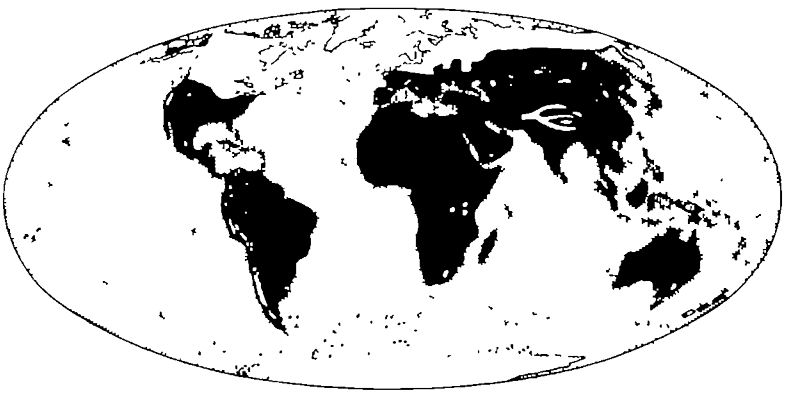
Fig. 1.
PLEISTOCENE GLACIATION: ICE ON LAND SHOWN WHITE, ICE ON SEA SHOWN BY LIGHT STIPPLE.

PERMO-CARBONIFEROUS ICE AGE

After the Pre-Cambrian Ice Age, there is little or no evidence of extensive ice until towards the end of the Carboniferous Period or the beginning of the Permian Period, when evidence of extensive ice appears. This period is called the Permo-Carboniferous Ice Age. The chief regions where the ice was extensive and the evidence undoubted are in South America, South Africa, Australia and India. The latter is well within the tropics, and the evidence is perfectly clear that an extensive ice sheet existed at sea-level in the Central Provinces, India. It is of great importance to notice that, so far as the evidence goes, the ice at this time was all situated within 40° of latitude of the equator, and mainly in the southern hemisphere. Most geologists consider that at the same time the north polar regions had much higher temperatures than at present, luxuriant vegetation growing at this time in both Greenland and Spitsbergen.

This would mean that while there was glaciation within the tropics leading to vast ice sheets at sea-level, there was an almost subtropical climate in polar regions. This is a reversal of the climatic belts which no meteorologist can accept. Owing to the shape of the earth, the equatorial belt must always be warmer than the polar regions. The only explanation the meteorologist can give—and it was given by Wegener—is that the continents were not then in the same position relative to the pole as they now occupy. In other words, the continents have moved since Permo-Carboniferous times.

THE PLEISTOCENE ICE AGE

After the Permian Period, there was another long stretch of time without any marked evidence of ice. This interval includes the whole of the Secondary and Tertiary divisions of geological time.

Evidence of ice was not entirely absent during this period, but geologists are of the opinion that the climate of the world as a whole was warmer than at present. In any event there was nothing equivalent to the extensive ice fields which left their traces in the Pre-Cambrian and the Permo-Carboniferous Periods.

The Tertiary ended with the Pliocene Period, when without doubt the climate of Europe was definitely warmer than at present. Towards the end of the Pliocene Period the temperature commenced to fall in Europe, and evidence of ice made its appearance. Some time between the end of the Pliocene Period and the present time, that is, geologically speaking, during the Pleistocene Period, there was a great extension of ice in all parts of the world.

The map (Fig. 1) shows the area which was under ice at some time or other during the Pleistocene Period. The north polar ice cap extended outwards, reaching latitude 38° N. in North America, 50° N. in Europe, and 60° N. in Asia. In the British Isles the ice sheet extended as far south as the Thames Valley but did not cross it. The ice covering of the Antarctic was then much thicker than at present, and Meinardus estimates that the flow of ice from the Antarctic continent into the surrounding seas was at least three times as much as at present.

Not only were the polar ice caps more extensive and thicker, but also the mountain glaciation was much developed and the glaciers reached much farther down the valleys. The evidence shows that this was so in all parts of the world. Not only were the mountains which now carry ice more heavily glaciated, but also many mountains which now carry no permanent ice had extensive glaciers upon them.

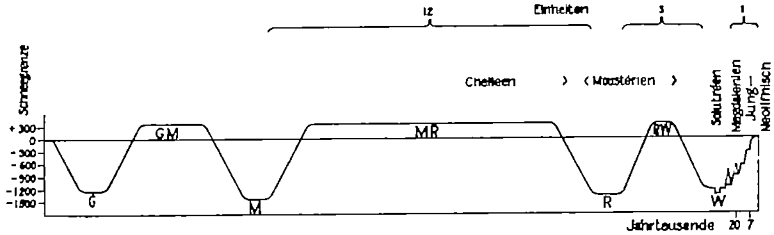

Fig. 2.

Penck and Brückner's diagram of height of snow-line in Alps during the Pleistocene ice age.

Detailed study of the deposits left behind by the ice shows that there was more than one advance and retreat of the ice during the Pleistocene Period. Glacial and interglacial epochs have been detected in all regions which were glaciated, both in regions covered by the extended polar ice caps and on the glaciated mountains. The history of the Pleistocene glaciation has been most completely studied by Penck and Brückner in the Alps. The result of their work is summarized in Fig. 2, which is a reproduction of their classical diagram showing the variation of the height of the snow-line in the Alps during the Pleistocene Period. From this diagram it will be seen that Penck and Brückner concluded that the snow-line descended far down the mountains on four occasions, the limits reached each time being practically the same, namely, about 1,500 metres (4,000–5,000 feet) below the present snow-line. They gave the names: Gunz, Mindel, Riss and Würm to the four glacial epochs. It will be noticed that the four glacial epochs occur in pairs—the Gunz with the Mindel and the Riss with the Würm—with a rather longer interglacial epoch between them.

There is no certain evidence that the history of the ice worked out in the Alps applies to other parts of the world; but meteorological considerations make it very improbable that there were different glacial histories for each part of the world; and as the evidence of glacial and interglacial epochs has been found wherever the glacial history of a country can be worked out in detail, one is justified in concluding that these epochs occurred simultaneously as the result of a world-wide cause.

This conclusion is becoming more and more accepted by glaciologists as they work out the sequence of the glacial epochs in their own regions, and a meteorologist cannot accept any other conclusion. In the sequel, therefore, we shall consider that the glacial history of the Alps is representative of the glacial history of the world as a whole.

The advance and retreat of the ice must have been accompanied by large variations in the climate. When a country such as Great Britain was invaded by an ice sheet, the climate must have been that of the polar regions to-day, and the fossils of plants and animals leave no doubt that such was the case. The climate during the interglacial periods, however, is much more interesting and unexpected. One would not have been surprised if the climate during the temporary retreat of the ice had remained cold and unpleasant. The evidence, however, is quite clear that in some, if not all, the interglacial epochs, the climate became warmer and more genial than to-day. At Hötting, in the Alps near Innsbruck, fossil leaves have been found of a rhododendron which grows to-day only in Portugal and the Caucasus, where the temperature is higher and the rainfall greater than it now is in Hötting; in the rivers of Europe (including the Thames) the shells of freshwater molluscs are found which now survive only in rivers such as the Nile, the temperature of which is 10° C. higher than that of the European rivers of to-day; and on the coasts of Holland and

Denmark, beds of sea shells were deposited containing species eighteen per cent of which to-day only occur south of the Bay of Biscay.

There is still considerable controversy as to which of the interglacial epochs these finds should be referred; so that we do not know whether all the interglacial epochs had warmer and wetter conditions than are experienced to-day. But there can be no doubt that in one or more of the interglacial epochs the climate not only returned to present-day conditions but also became warmer and wetter

Outside the areas which were invaded by the ice—the so-called glaciated regions—we must look to other records than those of ice to give us information regarding the changes of climate which occurred there during the advance and retreat of the ice. In non-glaciated regions it is difficult to find traces of changes of temperature; but changes in rainfall leave clear records in river deposits and in the levels of lakes with small or no outlets. From such evidence there is no doubt that there were long and pronounced periods of heavy rainfall during the Pleistocene Period in practically all parts of the world.

In North America the Great Basin, which is now an arid, sandy desert, was full of water, and the small existing intensely salt lakes were vast sheets of water to which the names Lake Bonneville and Lake Lahontan have been given. According to Gilbert and Russell, these lakes were twice filled during the Pleistocene Period, thus indicating that in North America there were two pluvial periods.

Wayland has reached the conclusion that in Uganda there have been two pluvial periods, one near the beginning of the Pleistocene Period and one towards the end; between these two pluvial periods the climate was much drier than it is to-day. Huzayyin has also recognized two major pluvials during the Pleistocene in south-west Arabia.*

Pluvial periods were not confined to tropical and subtropical regions, for in the Swanscombe Gravels we have evidence of a much greater Thames than exists to-day. The *Corbicula fluminaris* contained in these gravels show that they were laid down during an interglacial epoch when the temperature was considerably higher than at present.

Practically all deserts such as the Sahara, Libyan and Kalahara show signs of water action in relatively recent times, and many of them are littered with the flint tools of prehistoric man, showing that in the latter half of the Pleistocene Period they supported sufficient animal life to make them good hunting grounds.

It is probably too early to say definitely that in all parts of the world there were two pluvial periods, but the evidence is very strong, especially in North America and Africa.

The climatic conditions during the Pleistocene Ice Age may be summed up as follows:

The Pleistocene Ice Age did not consist of a simple advance and retreat of the ice but of a sequence of glacial and interglacial epochs. Based on observations in the Alps, there were four glacial epochs separated by three interglacial epochs. During some at least of the interglacial epochs the climate was warmer and wetter than to-day. In regions not subjected to glaciation there is evidence of two great pluvial periods, one early and one late in the Pleistocene Period, separated by a long interval during which there was even less precipitation than at present.

CAUSE OF THE PLEISTOCENE ICE AGE

A very large number of theories have been propounded to explain the cause of the Ice Age. It is becoming more and more generally accepted that no change located in the earth itself—such as a change in the distribution of land and water—or in the earth's atmosphere—such as a change in the amount of carbon dioxide or volcanic dust—can explain the sequence of climatic changes associated with the Pleistocene Ice Age, and we are being thrown back on to changes outside the earth. The most obvious source of climatic change would appear to be solar radiation. This seems such a simple solution. If we assume that the sun's radiation can change, all climates would appear to become possible: an Ice Age would be produced by reducing the radiation and a warm period by increasing it Unfortunately, things do not go in this simple way. As the result of a study which I made a few years ago to find what happens to the solar radiation when it falls on the earth, and how the earth returns to space the energy which it receives from the sun, I was led to the conclusion that the last Ice Age was not caused by a decrease of solar radiation but by an increase! I must now try to explain this paradox.

The sun sends out a stream of energy which we call sunshine. The earth intercepts a quantity of this energy which on absorption warms up the surface and the atmosphere. If the earth had been a 'black body' it would have warmed up to a temperature, which can be easily calculated, when it would have emitted just as much radiation as it received from the sun. In this way the temperature of the earth would have increased and decreased with an increase and decrease of the solar radiation. One of the first results of my investigation was to show that the earth does not react to changes in solar radiation like a 'black body'. I was able to show that if the solar radiation were to increase, the temperature of the earth's surface would not increase to anything like the extent that one would expect from the increase of solar radiation ; but that the cloud would increase and return the greater part of the additional solar radiation without warming up the surface of the earth.

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* NATURE, 140, 518 (1937).

In this way the balance between the incoming and outgoing radiation is maintained more by the amount of cloud than by the temperature. In present conditions just about half the sky is covered by cloud ; the amount is slightly different in the different latitudes, but not to any large extent. The clouds appear bright because they reflect the sun's light. The light which the clouds reflect cannot be used to warm up the earth ; it is just returned to space, and to that extent the solar radiation is reduced. The amount of solar radiation returned directly by the clouds has been measured and proves to be 43 per cent of the total incoming solar radiation. That is, nearly half the solar radiation which reaches the earth is intercepted and returned by the clouds without taking any part in warming up the earth.

We will now consider what happens to the radiation which reaches the earth. Because of the shape of the earth, more solar radiation falls per square foot on the surface at the equator than at the poles. The equator is therefore maintained at a higher temperature than the poles. This difference of temperature causes differences of pressure in the atmosphere, and a circulation of air is set up between the equator and the poles. This is called the general circulation of the atmosphere ; and all winds ultimately can be traced back to differences of temperature, mainly those between the equator and the poles.

In the course of time the atmospheric conditions reach a steady state with a certain temperature distribution, a certain amount of air motion and a certain amount of cloud, which combined are just sufficient to cause a balance between the incoming and outgoing radiation.

Now let us consider what would be the effect of increasing the solar radiation by a specified amount. At first the increased radiation would reach the earth's surface and warm it up, but on account of the shape of the earth the equator would be warmed up more than the poles Hence the difference in temperature between the equator and the poles would be increased and this would lead to an increase in the general circulation of the atmosphere. The increased temperature and the increased wind cause an increase in the amount of water evaporated from the oceans. This increased water in the atmosphere leads to greater formation of cloud and, as the precipitation must equal the evaporation, to an increase in precipitation also.

The increased cloud, however, reacts on the solar radiation and reflects an increased proportion of it. The final state is a new balance between the incoming and outgoing radiation produced mainly by the increased amount of cloud, the only temperature change being that necessary to produce the greater amount of cloud.

Different parts of the world will be affected differently by these changes. In equatorial and temperate regions where the precipitation all falls as rain, the effects of increasing the solar radiation are simple : there is a slight increase of temperature and a general increase of rainfall. Thus the most important effect of increasing and decreasing the solar radiation is to increase and decrease the precipitation, and the two keep step with one another : a period of increased solar radiation is always a period of increased rainfall and vice versa.

When, however, we approach the poles, where the precipitation may be either in the form of snow or rain, the conditions are much more complicated and must be studied in more detail.

Let us fix our attention on a region where at present the summer temperature does not rise above the freezing point, so that there is little or no summer melting of the ice—the Antarctic is such a locality. Now let the solar radiation increase. In consequence, the precipitation and the mean annual temperature both increase, as indicated by Curve I of Fig. 3. At first all the precipitation is in the form of snow, but when the summer temperature approaches the freezing point—say, at *A*—some of the summer precipitation falls as rain. Curve II represents the annual snowfall, and as the radiation increases beyond the point marked *A* the curve for snowfall falls increasingly below the curve for the total precipitation. Curve III represents the evaporation and summer melting combined. At first there is no melting, only evaporation, but after *A* melting becomes more important, and at *B* the loss of ice through evaporation and melting equals the total snowfall. Curve IV in the lower half of the diagram represents the annual accumulation of snow ; it is obviously the difference between Curves II and III. At first, the annual accumulation of snow is small ; as the solar radiation increases, the accumulation of snow increases until it reaches a maximum, after which it rapidly decreases, owing to the rapid increase in the amount of melting. Finally, in spite of the greater total precipitation and large annual snowfall, the melting is so great, especially in the summer, that no accumulation at all takes place.

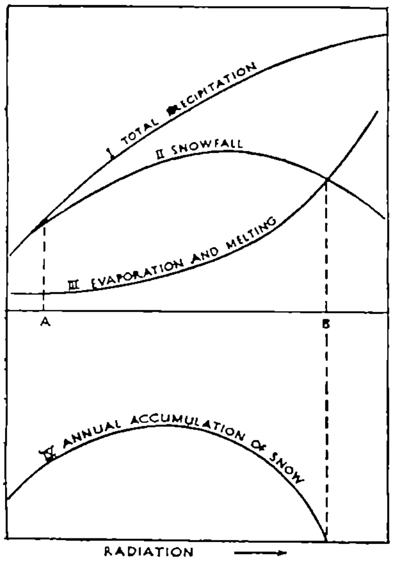

Fig. 3.

EFFECT OF INCREASING RADIATION ON PRECIPITATION AND ACCUMULATION OF SNOW.

Although it may seem strange that an increase of temperature can produce increased glaciation, it may be demonstrated by a simple experiment. In four identical glass jars (Fig. 4) each containing a layer of water in the bottom and a metal vessel at the top which can be cooled by solid carbon dioxide, the water at the bottom represents the equator and the metal vessel at the top the polar regions. One jar (second from the left) contains water at the temperature of the room and there is an appreciable deposit of ice at the top. By adding ice to the water in the vessel to the left, equivalent to lowering the equatorial temperature, the deposit of ice at the top is much reduced. The water in the third vessel has been warmed by a small gas jet, and the effect of the heating has been greatly to increase the deposit of ice. In the fourth bottle the temperature has been raised still higher, with the consequence that the ice has almost entirely disappeared by melting.

These four bottles can be regarded as representing increasing radiation as shown in Fig. 3. The first bottle has a low temperature (little radiation) and the ice deposit is thin, corresponding to *A* on the diagram. The second bottle has a higher temperature (more radiation) and therefore corresponds to a point to the right of *A* on Fig. 3 and shows a greater accumulation of ice. The third bottle represents the conditions where the ice deposit reaches its maximum, and the fourth bottle represents some point beyond *B* where the melting and evaporation exceed the deposit.

The conditions represented by Fig. 3 and the experiment apply to the polar regions and high mountains. At first an increase of solar radiation causes an increased accumulation of snow and ice in spite of increased temperature. During this stage, ice sheets form and glaciers advance, giving rise to a glacial epoch. As the radiation increases still further, the ice melts away and we have overcast skies and much precipitation but no ice accumulation. When the solar radiation decreases, conditions are reversed and the whole sequence is gone through in the reverse order.

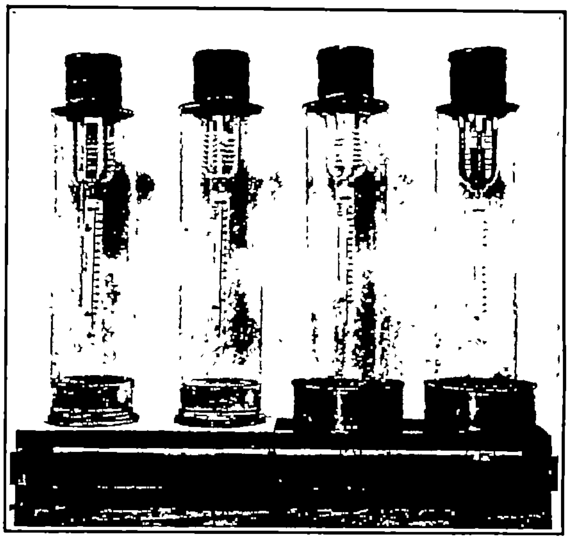

Fig. 4.

EXPERIMENT SHOWING EFFECT OF INCREASE OF TEMPERATURE ON AMOUNT OF ICE FORMATION. TEMPERATURE OF WATER AT BOTTOM OF BOTTLES INCREASES FROM LEFT TO RIGHT.

Fig. 5 has been prepared to show the sequence of changes of ice and meteorological factors when the solar radiation makes two complete oscillations. The abscissæ represent time increasing towards the right. Curve I represents two complete cycles of solar radiation and Curve II represents the mean temperature of the world as a whole. Curve III is the curve of precipitation and therefore follows directly the curve of solar radiation. Curve IV is the curve of snow accumulation. As drawn, it shows some accumulation at the minima of the solar radiation, but a complete disappearance of the accumulation owing to increased temperature at the maxima of the radiation. The ice which accumulates year by year in the specified area must escape; if the area is a mountain top, the escape will be by way of glaciers; if it is a polar cap, the escape will be by an ice sheet spreading over the surrounding country. In either case the ice is transported into regions where the melting is greater than the snowfall, and the greater the annual accumulation the farther will the ice penetrate, down the mountain side if a glacier and into lower latitudes if an ice sheet. Curve V shows the advance and retreat of the ends of the glaciers or of the front of an ice sheet.

Examining the last curve, we see a close resemblance to Penck and Brückner's curve for the height of the snow-line in the Alps (Fig. 2). In each there are four advances of the ice. The advances are arranged in pairs, with short interglacials between the advances in the pairs, and the pairs separated by a longer interglacial. This arrangement comes from the fact that there are two glacial epochs for each maximum of the solar radiation. The interglacials have different climates according as they occur at the maximum or a minimum of the solar radiation. The former are warm and wet and the latter are cold and dry. We are at present approaching a minimum of solar radiation. In consequence our rivers are smaller and our temperature lower than they were in the last interglacial. We now see why there were only two pluvial periods in non-glaciated regions for the four glacial epochs in polar regions and on mountains. If the theory is correct, the last interglacial—the Riss-Würm interglacial—was a warm one, and to it the evidence for a warm wet climate which I have described above should belong.

Thus we see how two oscillations of radiation have produced in non-glaciated regions two pluvial periods, and in glaciated regions four glacial epochs separated by three interglacial epochs, two of which were warm and wet and one cold and dry. If the theory is correct, we are now living in a cold dry epoch owing to the decrease of solar radiation from its last maximum. If the solar radiation again increases, there will be another glacial epoch and our epoch will become a second cold dry interglacial.

An obvious objection to the explanation of the last Ice Age which I have given above is that with their present temperatures no amount of precipitation would result in the formation of an ice sheet over England and Scotland and still less over Ireland; yet we know that such ice sheets did exist. The objection is still stronger when it is remembered that the theory requires the increase of precipitation to be accompanied by an increase of temperature.

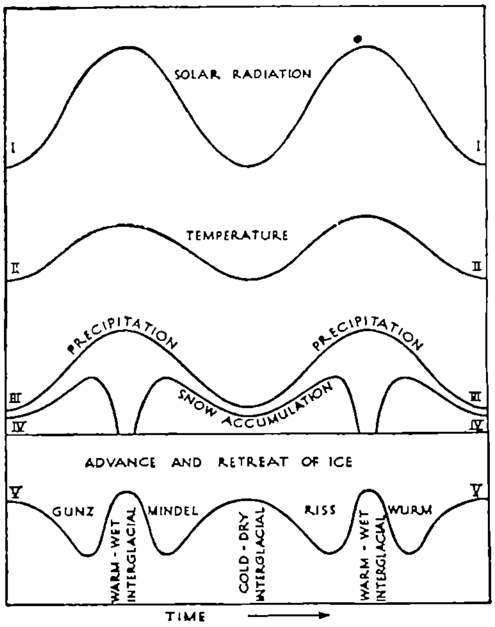

Fig. 5.

Effect of two cycles of solar radiation on glaciation.

There is another problem which has puzzled everyone who has studied the cause of the Ice Ages. If we plot on a circumpolar map the limits of the ice sheet, we find that the area covered by the ice was not concentric with the North Pole. It extended much farther south over Europe and the east of North America than it did over Asia and the east of America; in fact the centre of the ice sheet was in the middle of Greenland, 20° of latitude from the Pole.

The answer to both these problems is the same and gives strong support to the correctness of the theory. If the area around the North Pole were land instead of sea, we should have at the Pole a great ice sheet, similar to that over Greenland and the Antarctic, rising many thousands of feet above sea-level. With increased precipitation this ice cap would increase in height and extent and grow symmetrically about the Pole. With the present distribution of land and sea such a north polar cap is not possible. The ice which forms in the Arctic Ocean during winter breaks up in the summer and a certain amount escapes into the North Atlantic Ocean. At the maximum of a glacial epoch when the coasts around the Arctic Ocean were under ice, there would be a great flow of ice throughout the year into the sea The whole Arctic Ocean would become packed with ice which would have to find an outlet somewhere. The Bering Strait between Asia and America is both narrow and shallow, and no appreciable amount of ice would escape that way. There was always, however, a wide, deep connexion between the Arctic Ocean and the Atlantic Ocean between Greenland and Norway. Through this passage icebergs and thick pack ice would move southwards, filling the North Atlantic with ice and lowering the temperature.

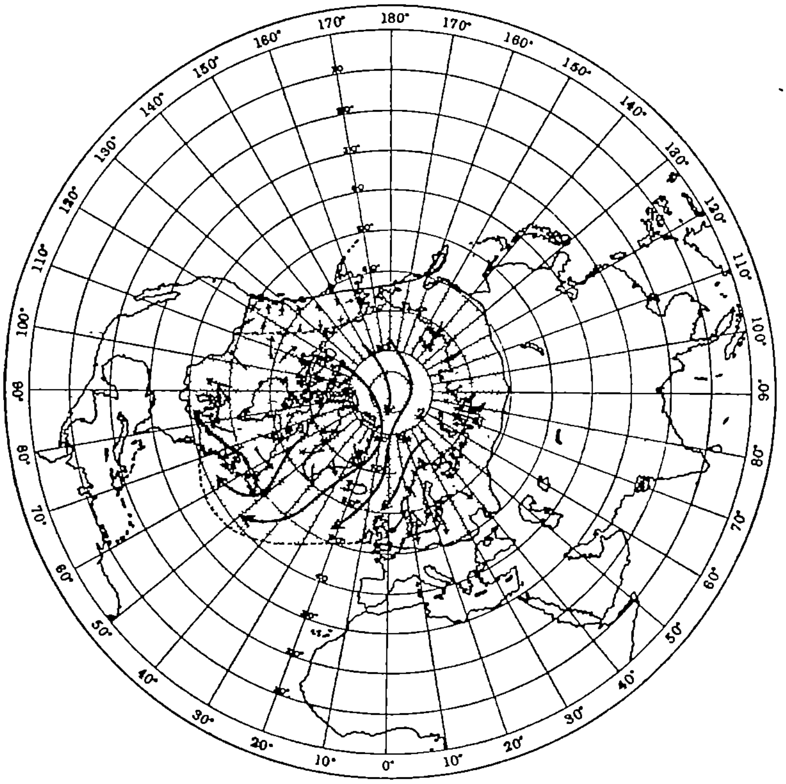

Fig. 6.

Lines of flow of ice: thick arrows floating ice, thin arrows land ice.

Fig. 6 has been drawn to illustrate this. The ice-covered area has been stippled and it will be seen at once that this area is not concentric with the Pole. The flow of ice on the land is shown by thin arrows. Ice flows into the Arctic Ocean from the northern coasts of America and Asia, and moves, as shown by the long thick arrows, into the North Atlantic, where it is replenished by ice from Greenland and Norway, and a stream of ice passing down Davis Straits joins it to the south of Greenland. The whole of the North Atlantic was filled with ice.

These conditions would have far-reaching effects on the climate of the British Isles and the adjacent parts of Europe. In the first place the Gulf Drift would no longer exist, so that instead of the western coasts of Europe being washed by relatively warm water they were washed by cold seas dotted with ice. In the second place the Icelandic depression would either cease to exist or would be displaced to the south, so that the warm south-westerly winds to which we owe our mild climate were replaced by cold north-westerly winds. With these large changes there is no wonder that ice sheets formed on the British Isles. On the American coast the winds would be north-east and drive the ice-laden water on to the American coast. Thus glacial conditions extended far to the south on both coasts of the Atlantic Ocean. As there was no corresponding flow of ice into the Pacific Ocean, there was no similar glaciation of the Pacific coasts.

Thus the glaciation of the British Isles and the unsymmetrical position of the ice sheets relative to the Pole were both due to flow of ice from the Arctic Ocean into the North Atlantic. If this connexion had not existed, the distribution of the ice would have been quite different.

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July 1936, and is still producing at the rate of approximately 10 barrels a day. Another situated half a mile south-east gave a 30-barrel show of oil in the Bartesville Sand in 1922; and a third, a considerable distance to the north-east of the other two, produced about 25 barrels of oil in 1921. The presence of productive oil sand in these three wells points to the probability that oil-bearing Bartesville Sand occurs in this district in a characteristic lens-shaped body. In addition, there are known to be in the Reservation two small domes, as yet untested, but structurally similar to two nearby domes producing from the Siliceous Lime. The productive domes are fairly typical of the oil fields, being of small extent but giving large yields. On one of these there are eight wells which have yielded oil, and on the other five. The approximate yield per acre of the former dome up to July 1936 was 6,964 barrels of oil, and of the latter, for the same period, 6,300 barrels. Recently, also, the rate of yield from both domes has been materially increased by treating the oil-bearing beds in the upper part of the Siliceous Lime with hydrochloric acid.

Plastics and Insulation

A JOINT meeting of the Institution of Electrical Engineers and the Plastics Group of the Society of Chemical Industry was held at the Institution of Electrical Engineers on March 24 to discuss a paper on "Plastics and Insulation" by L. Hartshorn, N. J. L. Megson and E. Rushton. It is largely based on an investigation carried out at the National Physical Laboratory and the Chemical Research Laboratory for the British Electrical and Allied Industries Research Association. Broadly speaking, a plastic is any material from which rigid objects of predetermined shape may be made by moulding processes. Their most characteristic property is that by suitable treatment they may be made to pass through a plastic condition, that is, a state between the solid and liquid states, like that of dough or damp clay. The property of hardening instead of softening on the application of heat is one of considerable practical importance to both moulders and users of plastics. It increases the working temperature of the material and improves its mechanical properties. It also allows the finished article to be removed from the mould while still hot. The primary function of an electrical insulating material (a dielectric) is to act as a barrier to the flow of electricity. Dielectrics always pass a leakage current, sometimes through the body of the material and sometimes over its surface. These currents can be taken as a measure of a defect of the material. With alternating current we have in addition an expenditure of energy due to the pulsating current in the dielectric. Polystyrene and polyindene, materials not yet produced in Great Britain, are hydrocarbon plastics, made in the form of clear glass, like solids, and are almost ideal for use in cables for high-frequency work; for example, in television, and in ultra-short-wave radio work, and in junctions for high-voltage cable work they are almost ideal.

Report on Street Lighting

DR. J. W. T. WALSH gave an introductory account to the Illuminating Engineering Society on February 8 of the final report of the Ministry of Transport Committee. It was then discussed by the Society and the discussion is published in the February issue of *Light and Lighting*. The members constituting the Committee were the chairman, four lighting specialists, two engineers associated with local authorities and two Government officials. Its final report was issued in November 1937. The Committee received evidence from several organizations and made inspections of a large number of existing installations. It also carried out experimental work on a special roadway (Lonsdale Road, Barnes) set aside for the purpose. The Committee classified roads into two groups only, A and B, and gave technical recommendations for each group. In the recommendations the Committee insisted on the importance of satisfactory maintenance and approved of lighting from dusk to dawn. Whilst it was recognized that special study of measures for the guidance of traffic during fog was necessary, it was urged that the general design of installations should not be prejudiced by special adaptation to fog conditions. The report also recommends that a formal specification for street lighting should be issued without delay by the British Standards Institution. In conclusion, Dr. Walsh showed a film of a lighted street just as it would appear in practice, in which various objects (persons stepping into the roadway, dogs, etc.) were continually coming into view and then disappearing. The number of such disappearances was stated to be fifty-six. But very few of the observers succeeded in identifying half this number. This showed the danger of bad lighting.

Journal of Neurophysiology

THE new *Journal of Neurophysiology*, under the editorship of Prof. Dusser de Barenne, J. F. Fulton and R. W. Gerard, made its first appearance in January. It is designed primarily to provide a means of publishing papers dealing with the experimental analysis of the phenomena of the central and peripheral nervous system, and descriptive neuroanatomy and pathology are intentionally excluded. The publisher, Thomas of Springfield, Illinois, intends to produce a number every other month, and the editorial board undertakes to deal with submitted papers within one or two months of receipt. This accelerated publication is certainly desirable, as the existing channels for the publication of papers in this field in the United States are overcrowded, and there is an inevitable delay. The first number, of 55 pages, contains nine papers dealing, *inter alia*, with cerebral action potentials, effects of experimental cerebral lesions, degeneration of nerve, and changes in the salt content of nerves as a result of the transmission of impulses. The format is pleasing, and the standard of the illustrations is high. A little more uniformity in certain details is desirable; authors are cited in different papers either by numbers, by year or by an abbreviation of the year; the date of receipt of papers is not always given. A more uniform lettering of the illustrations might also receive attention, and the adoption of a bold face type for the volume numbers in the lists of references would add to the ease of reading. These criticisms are, however, minor and are points which will probably be dealt with as the journal becomes more mature. The periodical certainly fills a need, and should serve, as the editors point out, actually to help to counteract undue subdivision in physiology by bringing together in one journal many divergent investigations on the nervous system.

Social Applications of Physics

IN an address on the "Social Applications of Physics" at a symposium at the University of Sydney on September 21, which was published in the *Union Recorder* (October 7), Prof. O. U. Vonwiller, pointing out that the man of science to-day must consider the bearing of his work on the problems of civilization and recognize his responsibility for some of the economic and social difficulties of the times, suggested these difficulties were due primarily to our inability to accommodate social and economic conditions to the rapidly changing methods of production following the application of scientific discovery. The main cause of these rapid changes was the changed status of the inventor, and while the success of the man of science as inventor had brought many real benefits to mankind, much distress had also arisen because in applying scientific discovery the first consideration was that of financial benefit. Prof. Vonwiller considered we could not continue to ignore ameliorating measures and suggested that the most promising method for dealing with the evils of over-production was to reduce the hours of employment. No satisfactory and lasting improvement in our difficulties could be expected, however, unless we adopted much from the methods of scientific investigation and discovery, with their honesty of inquiry and statement. In economic questions the difficulty of avoiding prejudice, however, was very great, and Prof. Vonwiller did not suggest that the adoption of scientific method would remove all our difficulties, though he appealed strongly for a courageous endeavour to understand and make understood the possibilities and limitations of scientific progress.

Twenty-fifth Anniversary of Laue Diagrams

LAUE first used his method of X-ray analysis of crystal structure in 1912. The twenty-fifth anniversary of this event has been celebrated by *Die Naturwissenschaften* by the publication of two interesting articles on the progress made in this branch of crystal chemistry. One, by F. Laves (*Naturwiss.*, 25, 705, 721; 1937), deals with the theory of the method and its development, and mentions its applications, particularly to the determination of atomic distances in crystals. A full account of our present knowledge of the radii of ions and atoms and their separations in crystals, and the dependence of these on the type of linking, is given, and there is a useful bibliography. The second article deals with the use of X-ray interference methods in the investigation of the fine-structure of animal tissues, and is contributed by F. O. Schmitt (*Naturwiss.*, 25, 709; 1937). It mentions particularly progress made in the examination of nerve, sinew and muscle, and other tissues in which there is a high degree of orientation of proteins or lipins. It will be recalled that *Current Science* also had special articles in connexion with this anniversary (see NATURE, 139, 517; 1937).

History of Science and Medicine

WE have received the fourth volume of *Osiris*, a journal edited by Dr. George Sarton and dealing with the history and philosophy of science. This volume is entitled "Incunabula Scientifica et Medica", by A. C. Klebs, and contains the titles of books on science and medicine printed up to the year 1500, with references to catalogues indicating where the books may be found. This list is very convenient to students of the history of science and medicine, since it contains information which was previously to be found only in large and expensive library catalogues. The volume is quite a substantial one, having 359 pages, so that it is evident that an unexpected range of material of this class was printed at an early period. In a book purporting to give accurate information on dates of publications, it is somewhat surprising to find the title-page dated 1938, whereas the volume was received in October 1937.

Proposed List of Current Geographical Publications

MORE than eight hundred technical and scientific periodicals are received by the library of the American Geographical Society. From these a careful selection of material of geographical interest is made, to be entered in the library's research catalogue. A current index is thereby provided to an extremely important body of geographical material that does not appear in the usual library catalogue. There is thus afforded a continuous, up-to-date record of current material of value not only to geographers but also to geologists, economists, anthropologists, and workers in many other allied fields. So useful has the research catalogue proved to the staff of the Society and to those consulting its library that the Society now proposes to make this material more generally available if there is sufficient demand. It is planned to publish ten mimeographed lists a year of the material catalogued during the month (material for July and August to be listed in the following issues). The subscription rate will be 3.75 dollars.

Fisheries Research in Australia

THE 138-ton motor ship *Warreen* (an aboriginal name for the sea), built for the fisheries section of the Australian Council for Scientific and Industrial Research, has been launched in Melbourne. The vessel will be used for the study of pelagic fish in the waters around Australia, commencing in the south-eastern seas. The headquarters of the section will be at Port

Hacking, some eighteen miles south of Sydney, on a reserve beautifully situated for the purpose. Plans have been drawn for a laboratory to cost £12,000, which should be finished by the end of the year.

International Society of the History of Medicine

The eleventh Congress of the International Society of the History of Medicine will be held in Yugoslavia on September 2–11 at Zagreb, Belgrade, Serajevo and Ragusa. The stay at Ragusa will coincide with the birthday fête of the King, who will be patron of the Congress. The following subjects will be discussed: (1) the history of medicine in different countries, introduced by Prof. Gomoiu; (2) the history of malaria in the Balkan peninsula and especially in Yugoslavia; (3) natural history in popular medicine (animals, plants, minerals); (4) mystery and magic in popular medicine; (5) medicine in folk poetry; (6) psychogenic diseases and psychotherapy in popular medicine. Further information can be obtained from the general secretary, Dr. Vladimir Bazala, Vlaska Ulica 95, Zagreb, or from Dr. Guiart, 58 Boulevard de la Croix Rousse, Lyon.

Schools and the Way to Peace

An international conference of teachers to be held in London on April 22–25 is being organized by the Education Committee of the League of Nations Union. It is intended to re-examine the whole question of 'peace teaching' in the schools in view of recent changes in the international situation in Europe and the Far East. The opening session will be in University College and the closing session at Guildhall, where members will be entertained to luncheon in the crypt. Other sessions will be in the London School of Economics and Political Science, and there will be an afternoon reception by the Vice-Chancellor of the University in the Senate House. Among those who will take part in the conference are the Duchess of Atholl, Lord Cecil, Lord Allen of Hurtwood, Prof. Gilbert Murray, Mr. Kenneth Lindsay and Mr. H. G. Wells. The last-named is to speak at a public discussion on "The Teaching of History". In connexion with the conference, a schools' poster competition has been organized with the object of advertising the value of the League of Nations and the International Labour Organisation as a means of securing the improvement of social conditions and of human welfare through international action. Further particulars can be obtained from the L.N.U., 15 Grosvenor Crescent, S.W.1.

Announcements

The Forestry Commissioners have appointed a committee, under the chairmanship of Lieut.-Colonel J. C. Wynne Finch, to advise them about the suitability of the Forest of Dean as a national forest park. Mr. Frank H. Harris and Mr. E. S. J. Hinds, Forestry Commission, 55 Whitehall, London, S.W.1, are joint secretaries to the Committee.

The Linnean Society of London will celebrate the one hundred and fiftieth anniversary of its foundation on May 24–26. The president, Dr. J. Ramsbottom, will deliver an address on May 24 at 6 p.m., and on May 25 and 26 symposia on "The Concept of Species from the Time of Linnæus to the Present Day" will be held. Further information can be obtained from the Assistant Secretary, Linnean Society, Burlington House, Piccadilly, London, W.1.

Flying Officer A. E. Clouston and Mr. Victor Ricketts arrived at Croydon on March 26, having accomplished a return flight between England and New Zealand (about 24,000 miles) in 10 days 21 hours. This is the first time that a direct double flight has been made, and several new records were set up. The aeroplane was the de Havilland Comet which won the international air race from London to Melbourne in 1934.

Prof. Camille Gutton, of the Ecole Nationale supérieure de l'Aéronautique and the Ecole professionnelle supérieure des Postes et Télégraphes, Paris, has been elected a free academician of the Paris Academy of Sciences, in succession to the late Paul Janet.

The first International Congress of Cosmobiology, organized by the Société médicale de Climatologie et d'Hygiène du Littoral Méditerranéen, will be held on the Côte d'Azur on June 2–8. Prof. D'Arsonval will preside over the radiological section and M. Lumière over the biological section. Further information can be obtained from the secretary, 24 rue Verdi, Nice.

The following have recently been nominated members of the Imperial Leopold Caroline German Academy at Halle: Dr. Matsujiro Takenouchi, professor of bacteriology at Tokyo, Dr. Antonio Dias Albertini, president of the Finlay Institute at Havana, Dr. Sven Petrus Ekman, professor of zoology at Uppsala, Dr. Mokoto Ishiwara, professor of physiology at Fukuoka, Japan, Dr. Gustav Senn, professor of botany at Basle, and Dr. S. P. L. Sørensen, head of the Carlsberg Institute at Copenhagen.

Reprints of fourteen papers by Mr. T. S. Subbaraya, Central College, Bangalore (University of Mysore), and his collaborators, published between 1929 and 1937, have been received. Particular acknowledgment is made of indebtedness for the help and collaboration of Prof. B. Venkatesachar, professor of physics in the University. The scope of the papers is too wide to permit of description in a short paragraph. The topics divide themselves almost completely into two classes, one dealing with nuclear structure and nuclear magnetic moments, and the other with problems in spectroscopy. In the latter category is a series of important papers on the spectrum of ionized mercury. There are papers dealing with the spectrum of ionized zinc, and with the band spectra of cadmium, zinc, cadmium iodide, and mercurous iodide. An early paper discusses the range of distinct vision of the unaided eye under water.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 610.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Aerial Drift of Insects

SINCE the summer of 1932 the distribution of insects by aerial currents has been studied in this Department. The present communication concerns the experiments made with kites over the land; investigations over the sea were briefly reported last year[1]. The methods employed have been borrowed from oceanography and inverted. Tow-nets, with a three-foot diameter mouth, have been carried into the air by kites to heights ranging from 150 ft. to 2,350 ft. The nets were sent up closed, opened automatically at the desired height, and closed again at the end of the sampling period before being hauled down. 82 samples were obtained, yielding 839 insects in a total collecting time of 124½ hours from May until September.

Fig. 1 shows the average density of the aerial population based on more than 10 hours collecting in each of the height ranges: 150–300 ft., 300–500 ft., 500–750 ft., 750–1,000 ft. and 1,000–2,000 ft. The curve represents the average number of insects taken per 10 hours collecting with our standard 3-foot diameter net in each height range and the scale of dots represents the average number of insects at each height drifting over a 10 *yards frontage* in an hour; each dot represents a hundred insects. It shows clearly the aerial food available for swifts and swallows. Incorporated in the curve are values (*T*) obtained from an intensive study of the insect drift at lower levels made by Mr. J. A. Freeman using nets flown simultaneously at heights of 10 ft., 177 ft. and 277 ft. on each of three masts over a 5/6 mile frontage at the Beam Wireless Station at Tetney, Lincolnshire.

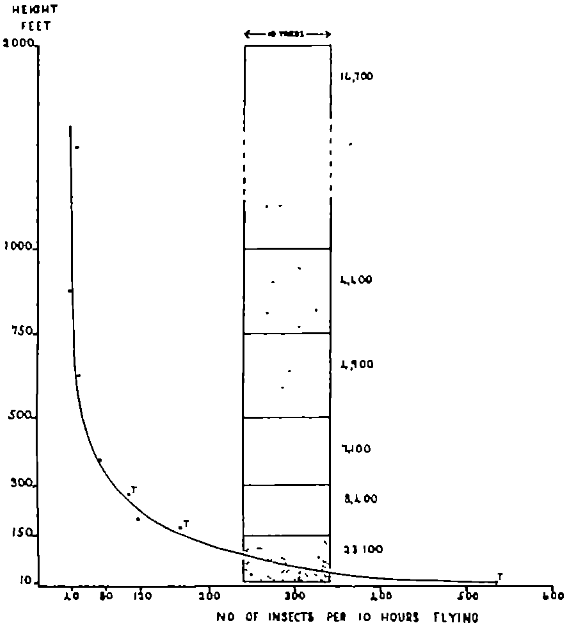

Fig. 1.

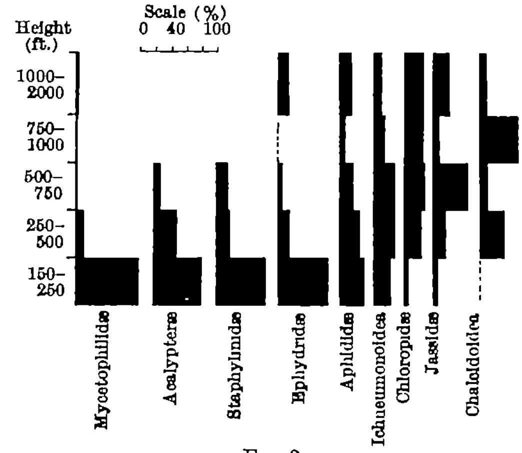

Fig 2.

The 'aerial plankton' is made up essentially of small light-bodied insects with weak powers of flight, but with a relatively large wing surface compared with body mass. Fig. 2 shows the comparative vertical distribution of the nine more important families encountered between 150 feet and 2,000 feet; the average number of any one family per 10 hours collecting in each height range is shown as a percentage of the total of that family taken (per 10 hours collecting) at all height ranges. Nearly all the families recorded in the aeroplane collections of Collins and Baker[2] in America and Berland[3] in France have been taken in our kite nets.

Whilst different insect groups are shown to be influenced somewhat differently by atmospheric conditions, it is found for all that high temperature and low humidity are more favourable to aerial drift than the reverse conditions.

Among agricultural pests, the frit fly, *Oscinis frit* Linn., was taken on many occasions up to 600 feet, thrips up to 450 feet and aphides, including the grain aphis *Macrosiphum granarium* Kby., up to 1,600 feet. That so many insects have been taken over the sea when more than a hundred miles from land[1] emphasises the importance of wind drift in the dispersal of insect pests both from one part of the country to another as well as the infection of Great Britain from the continent. Whilst migrating birds may well be the carriers of foot-and-mouth disease, the possibility of insects also being the carriers should not be overlooked.

With the kind co-operation of the London and North Eastern Railway a study of the varying abundance of insects along a line of country was begun last summer by using collecting nets on railway trains between York and Hull. By changing the nets at definite points along the line and repeating the lines of observation throughout the summer, the variations in population densities have been studied in relation to meteorological data. Marked distributional changes are observed over quite short periods of time. It is hoped that the experiments may be extended over a wider area in the future.

A first full report will be published in the *Journal of Animal Ecology*.

A. C. HARDY.
P. S. MILNE.

Department of Zoology
and Oceanography,
University College,
Hull.
Feb. 21.

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[1] NATURE, 139, 510 (1937).
[2] *J. Econ. Ent.*, **27**, 320–327 (1934).
[3] *Ann. Soc. Ent. France*, **104**, 73–96 (1935).

Distorted Mountain Strata in Relation to Final Isostasy

ISOSTATIC equilibrium ensues only after disturbances have ceased. The strata of mountains must originally have been deposited horizontally. They may be held to have attained to heights much greater than now exist. As they accumulated locally gravity would be disturbed by their weight, and if they rested on a much deeper foundation of slightly viscous but more dense material they would gradually sink down into it until they floated in hydrostatic equilibrium. It is assumed that this sinking is a slower process than the deposition of the strata. As the result, if a level datum surface is imagined as traced in the viscous foundation, at a level below the sunk roots of the deposited strata, hydrostatic equilibrium along it requires that the weight of material in all columns standing on this surface should be uniform. This is the observed isostasy; thus, beneath a more elevated region its roots of lighter density would penetrate deeper and so compensate the extra column aloft. The depths of these floating roots should even exceed the heights of the elevations, so the height of the original deposited strata would have been much greater than that of the present compensated mountains. In the deep sinking of such horizontal local strata they would be broken up, with result reminiscent of the distorted fragmentary mountain strata that are observed. But an analogy to the breaking up of an Arctic ice-floe would be excessive.

This order of ideas may doubtless be entertained with reluctance, but it appears to offer the only path by which the actual recognized degree of isostasy can have been arrived at. For the case of a linear mountain range the sinking of the strata would be smoother on the two sides of the central axis. It may be that the main part of the mass has been pushed up from below, but it has still to fall back into isostasy, which any sedimental part clinging to it will show by warping.

After an inconclusive survey by Bouguer in the Andes, the earliest effective exploration in that direction was by Maskelyne and Cavendish on the wedge-shaped isolated mountain Schiehallien in Scotland, made with a view to estimating the mean density of the earth from the deviation of the plumb-line by the horizontal attraction of this mountain mass of perhaps roughly ascertainable density. If the mountain rests on floating roots less dense than the average the horizontal attraction would thereby be diminished, so that the apparent result for the earth's mean density would be increased from the true value: but actually the result was considerably less. Formal isostatic discussion was initiated from the early surveys of the corps of Royal Engineers in the Himalayas as analysed by Archdeacon Pratt of Calcutta. They revealed defects of density beneath the mountains. The principle of compensation was more recently extended as a working hypothesis to the whole earth, mainly by Hayford in America. It is now submitted that the undoubted facts of isostasy may provide the clue, however unexpected, to the inner mystery of mountain structure, so that only the later stages of mountain carving are due to atmospheric denudation.

JOSEPH LARMOR.

Holywood,
N. Ireland.
March 5.

Coenzyme of the *d*-Amino-acid Oxidase

IT has been shown by Das[1] that the soluble amino-acid oxidase of Krebs[2] requires for its activity the co-operation of a thermostable factor or coenzyme which can be obtained from animal tissues and from yeast.

The object of this investigation was to determine the nature of this factor. This could only be achieved after separation of the enzyme system into its two components: the thermolabile enzyme and thermostable coenzyme, followed by their purification. While this work was in progress, Warburg and Christian[3] announced in a preliminary note that they have succeeded in separating this enzyme system into its two components, and in purifying the coenzyme. They have not, however, revealed their method of preparation and purification of these components.

I propose to give here the main results of my work on amino-acid oxidase, together with a description of the methods used in the preparation and purification of the enzyme and coenzyme.

Preparation of Enzyme. Finely powdered acetone-dried pig's kidney is extracted with 20 vol. water and the insoluble residue centrifuged off. To each 100 c.c. solution is added 1 gm. tricalcium phosphate gel, which is centrifuged off together with adsorbed inactive protein. To every 100 c.c. of this solution is added 22 gm. ammonium sulphate, and the mixture left standing 12 hours at room temperature. The precipitate is dissolved, reprecipitated in the same way, redissolved in water, dialysed and centrifuged. The solution is adjusted to *p*H 6·5, the enzyme is adsorbed on alumina gel (*A*) and eluted with phosphate buffer *p*H 7·8, giving an almost colourless solution of enzyme, inactive in absence of coenzyme but highly active ($Q_{O_2} = 1{,}000$) in its presence, and oxidizing the unnatural isomers of alanine and proline.

Preparation of Coenzyme. Horse heart muscle is minced and washed twice in 10 vol. tap water. 1 kgm. of washed mince is extracted with a mixture of 850 c.c. acetone and 150 distilled water at 50° C.

The warm mixture is pressed through muslin, cooled, filtered with kieselguhr, treated with 0·5 c.c. concentrated ammonia and concentrated to 20 c.c. The solution is then treated with 50 c.c. acetone and 0·5 c.c. acetic acid. The precipitate is removed and the solution mixed with 200 c.c. acetone. The precipitate, which contains the coenzyme, is dissolved in 5 c.c. water, centrifuged, and the clear solution treated with 50 mgm. barium acetate and 10 c.c. ethyl alcohol. The precipitate is collected, decomposed with 2–3 c.c. dilute sulphuric acid, the barium sulphate centrifuged off and the coenzyme solution precipitated by 10–15 volumes acetone.

This yellow powder which contains the coenzyme is readily soluble in water, but insoluble in organic solvents. It is precipitated by salts of mercury, lead and barium, but not by calcium, even in the presence of 2 vol. alcohol. It is very unstable in acid solution but not affected by weak alkali. A slightly alkaline solution of coenzyme has a characteristic yellow colour with the greenish fluorescence of flavines and a spectrum similar to that of lactoflavine. The colour disappears on reduction with $Na_2S_2O_4$ and reappears on shaking the solution with air.

2·5 kgm. heart muscle yields about 12 mgm. of very active coenzyme containing about 20 per cent flavine.

The activity of the reconstructed system tested ærobically in Barcroft differential manometers is shown in the following table:

OXYGEN ABSORPTION IN AIR AT 39°.

	1	2	3	4
Enzyme solution	1·0	1·0	1·0	1·0
M/10 phosphate buffer *p*H 7·8	2·0	2·0	2·0	0·2
3·3 per cent *d*,1-alanine solution	0·3	0·3	0·3	0·3
Coenzyme, added in buffer sol.	—	1·5γ	3·0γ	6·0γ
c.mm. oxygen absorbed in 10 min.	1·0	34·5	63	105
c.mm oxygen absorbed in 20 min.	2·8	69·0	124	207

While in presence of enzyme and substrate only, methylene blue (0·5 c.c.; 1 : 5,000) is not reduced anaerobically even in 12 hours; on addition of coenzyme (10 γ) it becomes reduced in about 27 minutes.

The fact that the flavine content of coenzyme preparations was proportional to their activity supports the view that the flavine is a part of the active compound. It is conceivable that the coenzyme is related to a compound containing 40 per cent flavine isolated by Theorell, Karrer, *et al.*[4] from animal tissue, a compound which has different properties from phosphoric esters of flavine obtained synthetically or isolated from yeast.

The ubiquitous presence of the coenzyme described in tissues, where no deamination is observed, suggests that it can also play an important part in other oxidation reactions of the cell.

F. B. STRAUB.

Molteno Institute,
University of Cambridge.
Feb. 22.

[1] Das, N. B., *Biochem. J.*, **30**, 1080, 1617 (1936).

[2] Krebs, H. A., *Z. physiol. Chem.*, **217**, 191 (1933).

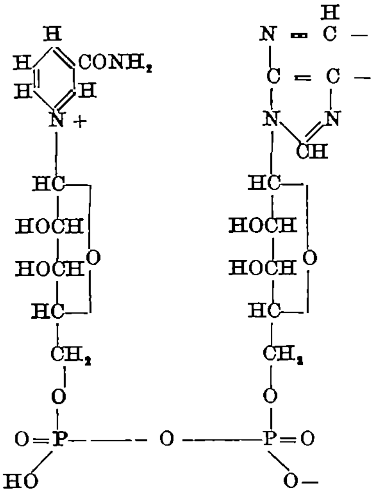
[3] Warburg, O., and Christian, W., *Biochem. Z.*, **295**, 261 (1938)

[4] Theorell, H., Karrer, P., Schopp, K., and Frei, P., *Helv. chim. Acta*, **18**, 1022 (1935); Karrer, P., Frei, P., and Meerwein, H., *Helv. chim. Acta*, **20**, 79 (1937).

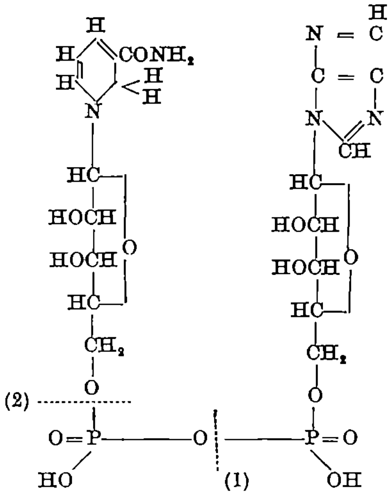
Enzymic Dephosphorylation of Cozymase

FOLLOWING the observations[1,2,3] that cozymase is inactivated by vegetable as well as animal tissues it was considered to be of interest to study the mechanism of inactivation. Euler, Adler, Günther and Hellstrom[4] found that cozymase was inactivated by dialysed muscle extract, but that the latter was active in glycolysis only when cozymase and adenylic acid were added. They concluded that no adenylic acid was formed and suggested that the inactivation of cozymase might possibly be due to dephosphorylation. The present investigation shows that cozymase is rather slowly dephosphorylated by nucleotidase which dephosphorylates adenylic acid and inosinic acid much more rapidly (the former more easily than the latter). On the other hand, dihydro-cozymase is dephosphorylated about twice as fast as cozymase. In animal tissues cozymase is present in the oxidized as well as in the reduced form, and the present observation might suggest some biological indications.

According to Euler and Schlenk, the cozymase molecule is as follows:



Cozymase



Dihydro-cozymase

Considering the biological functions and structure of cozymase as well as dihydro-cozymase, it might be suggested that dihydro-cozymase is capable of being split enzymatically[4] at position (1) to adenine nucleotide and nicotine nucleotide and that the enzyme nucleotidase dephosphorylates the mononucleotides. Alternatively it might also be suggested that dihydro-cozymase is split at position (2) forming adenosin-diphosphoric acid, which is dephosphorylated by adenylpyrophosphatase present in the enzyme preparation. In either of these cases it seems probable that dephosphorylation of dihydro-cozymase, on account of its dibasic character, is facilitated more than dephosphorylation of monobasic cozymase.

No definite statement can be made as to the implications of the present observation until further investigations have been carried out.

Nucleotidase was prepared from intestinal mucosa according to Klein[6] and was purified by isoelectric precipitation at *p*H 4·7. The precipitate was dissolved in alkaline water and dialysed overnight.

Cozymase free from adenylic acid was reduced with sodium hydrosulphite at *p*H 7·2–7·4, and the excess of hydrosulphite was removed by aeration. The resulting dihydro-cozymase was carefully maintained at *p*H 7·6–8·0. The amount of dihydro-cozymase was estimated spectrophotometrically.

The experiments were carried out *in vacuo*, the substrate being added after evacuation in order to prevent re-oxidation of dihydro-cozymase and the reaction was stopped by 4 per cent CCl_3COOH without letting air enter the reaction mixture before it was acidified. Veronal buffer at *p*H 7·6 has always been used in the reaction mixture. It has been found that the dephosphorylation of dihydro-cozymase was not due to sulphate present. The parallel experiments with cozymase and dihydro-cozymase were done with the same cozymase preparation under identical conditions. Under the same experimental conditions, dephosphorylation of adenylic acid is about four times as large as that of oxidized cozymase.

The following table shows typical results :

Reaction time (min.)	Purity of cozymase per cent	γ P/mgm. cozymase	γ P/mgm. dihydro-cozymase
30	100	18·75	34·0
30	100	31·25	50·0
15	90	16·12	35·64
15	90	17·12	26·14
30	90	25·75	44·68

N. B. Das.
H. v. Euler.

Biochemical Institute,
University of Stockholm.
Feb. 26.

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[1] Euler and Myrback, *Hoppe-Seylers Z* , 177 (1928).

[2] Euler and Gunther, *Hoppe-Seylers Z.*, **243**, 1 (1936).

[3] Euler and Helwinkel, *Naturwiss.*, **25**, 269 (1937).

[4] Euler, Adler, Gunther and Hellstrom, *Hoppe-Seylers Z* , **245**, 217 (1937).

[5] Euler and Adler, *Hoppe-Seylers Z.*, **252**, 41 (1938).

[6] Klein, W , *Hoppe-Seylers Z.*, **207**, 125 (1932).

Standardization of Gonad-stimulating Hormones

In view of a recent publication by Hamburger and Pedersen-Bjergaard[1] relating to methods of standardization of the gonad-stimulating hormones, the following observations made in these laboratories may be of interest.

I am in complete agreement with Hamburger and Pedersen-Bjergaard's contention that the corpus luteum method in mice and the vaginal smear method in rats are the most accurate available for standardization of the urinary gonad-stimulating hormone (Gonan, Physex, etc.). Formerly, it seemed to me more logical to use the corpus luteum method[2], since I was engaged on problems in which this phase of activity of the hormone was of particular interest. With the widening of the scope for such preparations to include even treatment of male gonadal dysfunction this argument disappears. I now standardize Gonan in terms of its ability to produce œstrus in 50 per cent of immature rats (40–50 gm. in groups of not less than ten), when given over a period of 2½ days. Smearing is begun 1½–2 days after the last injection, if the vagina is open. The ratio of this rat unit to the mouse unit (luteinizing) has been found to be about 1 : 12 ; this compares with a 1 : 15 ratio found by the Danish workers.

With regard to standardization of the hormone of pregnant mares' serum (Serogan, Antex), I am not in such complete agreement with these workers. In the first place, it is interesting to note that they consider the rat a more suitable animal than the mouse when the criterion of activity is increase of ovarian weight. They give the average weight of a pair of infantile mouse ovaries as 2·2 mgm. ; in these laboratories I find a figure of 1·7 mgm. for our stock and, although I work with minimum groups of ten, I feel that dissection cannot be carried out with sufficient accuracy with organs of this size, and I invariably prefer to work with rats when adopting this criterion of activity.

It is, however, generally recognized that the gonad-stimulating hormone of the serum of pregnant mares is predominantly follicle-stimulating (or œstrus-producing), and it seems to me that the vaginal smear technique is therefore a logical one to use, apart from its (in my opinion) greater accuracy. With a view to the use of this method, I have therefore carried out a series of tests to determine the ratio of the mouse unit, that is, the amount required to double the weight of the ovaries in 4 days, to the rat unit, the definition of which is the same as described above in dealing with the gonad-stimulating hormone of human pregnancy urine. Groups of ten rats were used, and 1 rat unit was found to be about 1/10 mgm., the ratio R.U. : M.U. (as described above) being 1 : 2.

Finally, it will be observed that throughout this communication I have avoided using the term 'gonadotropic', which has been in common use for a considerable time. A recent letter from Dr. Parkes[3] has stimulated interest in the question of nomenclature, but I do not feel entirely satisfied with the suggestions made by him. I therefore prefer to adopt a system used for some years particularly by the American workers in this field, that is, to refer to the 'gonad-stimulating' hormones, until some general international agreement can be reached.

P. G. Marshall.

Biochemical Laboratories,
British Drug Houses, Ltd.,
Graham Street, N.1.
Feb. 18.

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[1] Hamburger and Pedersen-Bjergaard, *Quart. J. Pharm.*, **10**, 662 (1937).

[2] Marshall, *Biochem. J.*, **27**, 626 (1933).

[3] Parkes, Nature, **141**, 36 (1938).

Failure of Anaphase Separation in Species Hybrids

In the meiosis of species hybrids we are accustomed to finding abnormalities which are due to structural differences, abnormalities such as failure of pairing of chromosomes. There are also instances in which the genotypic upset in the hybrid gives rise to an abnormal course of meiosis, usually likewise causing a failure of pairing, for example, *Drosophila pseudo-obscura*[1]. In a cross between two grasshopper species, *Chorthippus bicolor* Charp. and *Ch. biguttulus* L., which I have succeeded in obtaining experimentally as well as in Nature, I have found an example of genotypic abnormality which shows itself acutely for the first time during the anaphase separation of the normally paired chromosomes.

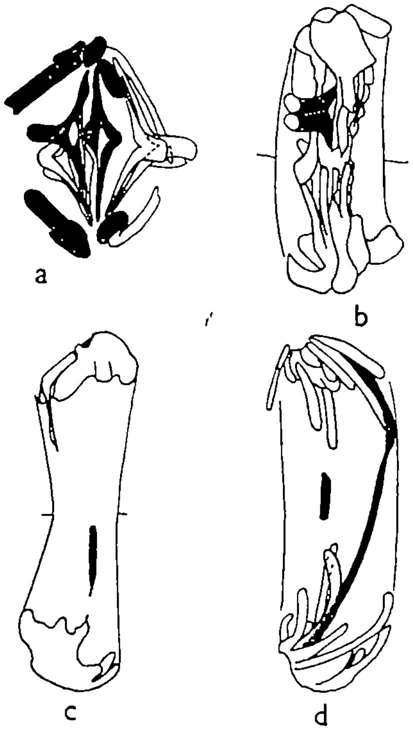

Fig. 1.

a, Meiotic anaphase in the hybrid. V-chromosomes shown in outline. *b*, Early telophase. Unseparated chromatids, one of which is broken, in black. *c*, Telophase. Piece of chromatid left behind. *d*, Gonial mitosis. Non-separation of two chromatids and piece of another chromosome left behind.

The chromosomes of *Ch. bicolor* have been described by Darlington[2] and those of *Ch. biguttulus* do not differ appreciably from them. In meiotic metaphase the bivalents are of the more contracted type found among the grasshoppers. But in the hybrid they are long and slender throughout, rendering the analysis of chiasmata very simple indeed. They are like the chromosomes of *Mecostethus*[3] and *Chrysochraon*[4], save for the variable arrangement of chiasmata which resembles that in the parent species. Owing to their slenderness, however, irregularities in the metaphase movements occur, showing that repulsions between the centromeres fail to be effective in causing movement when they are exceptionally far apart.

With this exception the beginning of anaphase is normal, but the further it proceeds the more obvious does it become that normal separation is being hampered (Fig. 1*a*). The parts between the centromeres and the nearest chiasma are often drawn out and not infrequently break. The chromatids beyond this chiasma, which should separate, stick to each other instead. In some cells they seem to yield eventually to the stress exerted by the spindle and separate. But very often they break (Fig. 1*b* and *c*), the pieces being included in the daughter cells or left behind. In a great many cases a single restitution nucleus is formed. The second division is still more irregular. Spermatid nuclei therefore vary in size and are often polyploid. In spite of all this a good deal of seemingly normal sperms are seen, but whether they are functional is not yet known.

During the examination of the hybrid cells the following explanation has suggested itself. In metaphase the chromatids are closely associated, nay optically indistinguishable in most cases. There is a specific attraction between them. This attraction is a condition for the tension between centromeres so often seen in metaphase of meiosis in bivalents with chiasmata close to the centromeres. As pointed out by Darlington[5], a necessary condition of anaphase separation is the lapsing of the specific attraction. That the chromatids become free by an autonomous lapse of attraction rather than by the pulling force of the centromere movement is evident from the observation that the chromatids (particularly of long chromosomes) in anaphase often let loose one another's distal parts without stretching of the already free proximal parts. It is true that on the other hand the chromatids not infrequently appear to be actively separated by the pull of the centromeres But if we assume that the lapse of attraction between the chromatids begins at the centromere and proceeds towards the ends at a rate that normally varies from one adjusted so as to keep pace with the centromere movement to a somewhat greater rate, such a variation in the appearance of the anaphase separation would be expected. All this, I think, holds good for mitosis as well as for meiosis, although perhaps often not so easily tested in the former case.

Assuming now that in certain circumstances the lapsing process is proceeding too slowly in relation to the centromere movement, or in other words that the distal parts remain in metaphase condition too long, the observed anaphase disturbances would appear. The bringing together in the hybrid of two different genotypes has, on this view, caused such an alteration of the synchronization of the anaphase events. That this may also happen in mitosis is shown by cases as in Fig. 1*d* and by the occurrence of incompletely separated meiotic prophase nuclei. It is obvious that in these hybrids the timing unbalance which shows itself in anaphase is correlated with the reduced or semi-mitotic contraction, both falling in the wide class of phenomena brought under a single aspect by Darlington's precocity theory.

It is interesting to note that occasionally a failure of the ends of chromosomes to separate has been observed in the parental species also. The process of anaphase is naturally affected by environmental variations like all genotypically controlled properties.

The behaviour of chromosomes in the meiosis of the hybrid is strikingly similar to that found by White[6] in *Mecostethus* 7¼ hours after X-ray treatment. In fact, his figures correspond exactly with those published here. Sax[7] has recently given an account of the varying agents (X-rays, temperature changes, chemicals, genes, ageing, etc.) which are known to affect nuclear division after division of the chromosomes. He points out that in most cases the irregularities seem to be similar and appear to be effected by disturbing the synchronization of nuclear and cytoplasmic activities. This disturbance may in some cases at least be of the kind inferred above.

To what extent permanent structural changes can be attributed to breakage in hampered anaphases remains yet to be studied.

HOLGER KLINGSTEDT.

John Innes Horticultural Institution,
Merton, S.W.19. Feb. 14.

[1] Dobzhansky, *Z. Zellf. u. mikr. An.*, 21, 169 (1934).
[2] Darlington, *J. Gen.*, 33, 465 (1936).
[3] Janssens, *La Cellule*, 37 (1924).
[4] Klingstedt, *Mem. Soc. pro Fauna et Flora Fennica*, 12, 194 (1937)
[5] Darlington, *Proc. Roy. Soc.*, B, 121, 281 (1936).
[6] White, *Proc. Roy. Soc.*, B, 124, 183 (1937).
[7] Sax, *Amer. J. Bot.*, 24, 218 (1937).

Double Structure of Chromosomes

IN response to our demonstration[1] that the metaphase chromosomes of *Trillium* are composed of four strands twisted about each other in pairs, while the anaphase chromosomes contain two intertwined threads, Dr. Darlington[2] states that the appearance of two threads is an artefact induced by a fixative containing acetic acid, and due to "bubbles" arising in the chromatid. In confirmation of this, he publishes a photomicrograph of a cell in telophase which bears little resemblance to our figures.

The preparations photographed in our letter were fixed in strong Flemming, which contains acetic, but other preparations made at the same time and fixed in Benda without acetic, following treatment with vapour of ammonia, hydrochloric or nitric acid, gave the same result. This disposes of Dr. Darlington's argument that the double threads are due to the treatment, even if it were not untenable on other grounds. His "bubble" theory is a revival, under another name, of the conception which was current in 1911, and earlier, that anaphase and telophase chromosomes developed alveoli or vacuoles in passing into the resting condition. Also, according to definition, bubbles are composed of gas or vapour in a liquid medium, so that the use of the word is incorrect.

Dr. Darlington's question regarding the possibility of three threads in metaphase chromosomes is misleading, because a photograph in one plane of two intertwined threads twisted around two other intertwined threads will give, in places, a superficial appearance of alveoli side by side. But a photograph at this magnification cannot be taken in three dimensions.

Dr. Darlington has introduced the subject of chromomeres which has been dealt with in a paper now in course of publication. Suffice it to say that all recent critical observations on plant chromosomes show a continuous chromonema and not a discontinuous row of chromomeres.

Finally, it may be pointed out that the photomicrographs published in our previous letter[1], showing the doubleness of the chromosomes in *Trillium sessile*, were only the final proof concluding a long line of increasingly cogent evidence. That evidence is contained in innumerable papers from many laboratories, some of them so early as 1926, including a series of papers from this laboratory beginning in 1931. Dr. Darlington and his supporters face this mass of evidence with the assertion that the chromosomes must be single in anaphase and telophase because some of the X-ray experiments can be interpreted in this sense. White's work[3] on the X-irradiation of the first meiotic division in three species of insects casts doubt on this interpretation.

R. R. GATES.
S. V. MENSINKAI.

King's College,
London. March 9.

[1] NATURE, **140**, 1018 (1937).
[2] NATURE, **141**, 371 (1938).
[3] White, M. J D., *Proc. Roy. Soc*, B, **124**, 183-196 (1937).

Effect on Organisms of Summer Drought in Caves

AMONG the most interesting of cavicolous invertebrates from Herzegowina is the Serpulid, *Marifugia cavatica* Abs. and Hrabě[1]. This remarkable worm, although belonging to a typical marine group, forms its calcareous tubes in great quantities over the walls and ceiling of the inland limestone cave known as Crnulja, in Popovopolje. The worm itself is known from this and a few neighbouring caves only; deserted tubes or their debris are more widely distributed, and may point to the existence of the worm in uninvestigated recesses of caves as far north as Istria. While visiting Popovopolje in August 1937 I found debris of the tubes in the much-explored Vjetrenica pećina, where Remy[2] has stated that it does not occur. I brought back some of the living worms from Crnulja to England, and am indebted to Mr. C. C. A. Monro for confirmation of the species.

During the winter the worms are immersed in fresh water; for the rest of the year they live retracted within their tubes, covered by only a thin film of water of condensation. The conditions then are so dry that Remy records the desiccation of a Plumatellid and its formation of statoblasts. In this connexion, I would record finding among the tubes of my *Marifugia* quantities of sponge gemmules, which have been identified by Dr. M. Burton as those of *Ephydatia mülleri* Lieberkühn. Above ground the gemmules of related Spongillidæ are stimulated to germinate by increase in temperature and give rise to young sponges in the spring. But, in the cave, conditions are reversed; the gemmules occur in summer and must give sponges in winter, the only time when the cave is flooded and sufficient water is available for active sponge life.

On returning to England, I made germination experiments with the cave gemmules, using gemmules of epigean *Spongilla lacustris* as a control. Of the latter, 50 per cent germinated in 10 days, and gave good sponges, with oscula and flagellated chambers. Of the cave species, however, only 2 per cent germinated in a period of 22 days; and the development here was quite abortive, neither oscula nor flagellated chambers appearing, although the germinating sponge material lived long enough and was extensive enough to have thus differentiated. It would seem, then, that in respect of gemmule germination, this cavicolous strain of *E. mülleri* reacts quite differently from the epigean *E. fluviatilis* L., which, according to Brien[3], behaves similarly to the control, *Spongilla lacustris*.

R. S. HAWES.

Zoology Department,
King's College,
University of London.
Feb. 21.

[1] Absolon, K., and Hrabě, S., *Zool. Anz.*, 88, 249 (1930).
[2] Remy, P., *Bull. Mus. Hist. Nat, Paris*, 9, No. 1, 66 (1937).
[3] Brien, P., *Arch. Zoöl. exp. gen*, 74, 461 (1932).

Stomatal Movement and Epidermal Water-Content

PROF. D. THODAY has suggested[1] that the remarkable stomatal behaviour of coffee may be explicable on a hypothesis involving variations in the water content of the epidermis as distinct from that of the leaf as a whole. As he says, a critical experiment would be the determination, in saturated air, of the relation between stomatal aperture and radiation. This has not been done.

However, the climatic range over which coffee is grown is wide: and I have determined its stomatal behaviour in semi-arid, cloudless, windy, unshaded and exposed conditions, and in moist, cloudy, shaded and almost wind free habitats. In the former, the relative humidity is very low, and the evaporating power of the air is consequently high. In the latter, the reverse is true, and relative humidity may remain very high throughout the day. Yet the relation between stomatal behaviour and incident radiation is similar in both habitats, and the stomata always close in strong light.

A sunfleck, illuminating one leaf on a coffee tree under dense shade and in a nearly saturated atmosphere, will cause rapid stomatal closure in that leaf, although physical evaporation and hence cuticular transpiration must be minimal.

It seems, therefore, unlikely that the peculiar stomatal behaviour of coffee, under these varied conditions, can be explained on the lines suggested.

F. J. NUTMAN.

East African Agricultural Research Station,
Amani,
Tanganyika Territory.

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[1] NATURE, 141, 164 (1938)

IN view of the information given by Mr. Nutman, I agree that my suggestion can scarcely apply. Mr. Nutman's observations appear to add a new type of response to the possible complexities of stomatal behaviour and make it still more evident that specific differences have to be considered.

D. THODAY.

Penetration of Ultra-Violet Rays through Chitin

ALTENBURG in 1928 found that the fluorescence of certain salts was only very slightly, if at all, affected when *Drosophila melanogaster* were interposed between the discharge tube of a Cooper Hewitt lamp and the salts at which the rays were directed. From this he concluded that the ultra-violet rays penetrated the chitin rather freely. His conclusion has been accepted by subsequent workers. Altenburg did not state, however, which salts were used, how many layers of flies there were, or how closely they were arranged. Besides, the shortest wave-lengths of visible light also cause fluorescence of salts.

In order to obtain more definite data, we planned experiments, using a Hanovia quartz mercury vapour lamp, to determine the limit of thickness of chitin that can still be penetrated effectively by the ultra-violet rays produced by this lamp. It was found that 60 minutes irradiation through a vitreosil plate 0·5 cm. in thickness had a striking effect on the wing development of rather aged pupæ. The distance was maintained at 11 inches. Of the imagines which emerged, approximately 60 per cent showed distinct wing modifications of great variety. Undoubtedly the hypodermal cells between the two chitinous layers of the immature wings were effected by these rays which must, therefore, have penetrated effectively through the chitin of the puparium and of the pupal wing. The control flies were treated in the same manner but the dishes, instead of being covered by a vitreosil plate, were covered by ordinary glass of the same thickness.

The control material showed no effect even after several hours of irradiation, while a dosage of more than 80 minutes proved very deleterious to the experimental material. A uniform dosage of 60 minutes irradiation was maintained for all pupæ treated in these experiments. Besides the wing abnormalities observed, the viability of the experimental material, that is, the pupæ covered by vitreosil plate, was reduced by about 30 per cent as compared with the controls

This positive effect of the ultra-violet rays on the wing development suggested a means of testing out the effective penetrability of chitin to ultra-violet rays. For this purpose the flying wings of the locust *Nomadacris septemfasciata* were used in preparing small screens 2 in. × 2 in. Sections of wings of this locust species showed that the thickness of the wing ranges from 4 μ to 10 μ. The wings were carefully pasted on to frames of fairly thick paper, care having been taken to keep the window portion clean of paste. In this manner screens of 1-, 2-, 3- and 4-wing thickness respectively were made, and irradiation experiments carried out as stated above.

A spectrographic analysis was then made of the wave-lengths which penetrated the prepared chitin screens distinctly. The results are shown in the following table:

Screen	Absorption in A	Percentage wing abnormalities
0·5 cm window glass	<3650	0
4 wings vitreosil	<3650	0
3 wings ,,	<3650	0
2 wings ,,	<3125	40
1 wing ,,	<2967	54
vitreosil	<2534 <2398 } (?)	60
quartz lens	<2225	62

The spectrum was mapped from 1900 A. to 4400 A. No lines were found below 2224·7 A. The range of the instrument is just outside the very intense mercury line 1849·6 A. As the absorption increases both with the increased thickness of the filters and with the decrease in wave-length, it is reasonable to suppose that light of wave-length 1849·6 A. will behave similarly to longer wave-lengths.

As a photo-densitometer was not available, quantitative expressions of absorption were not possible. It is hoped to rectify this in future experiments.

From these results it appears that our dosage was ineffective when the chitin layer was 3 wings (about 21 μ) thick or thicker; the wave-length 3125 A. was still biologically effective, but 3650 A. and longer wave-lengths were not.

We wish to thank Prof. G. H. Stanley, director of the Minerals Research Laboratory for the use of apparatus and Mr. L. W. Vermeulen for technical assistance.

G. ELOFF.

V. L. BOSAZZA.

Department of Zoology,
and
Minerals Research Laboratory,
University of the Witwatersrand,
Johannesburg.
Feb. 22.

An Effect of X-Radiation on the ξ Potential of Colloidal Graphite

IN their recent communication on the above subject[1], Prof. J. A. Crowther and H. Liebmann have discussed results obtained with graphite sols containing only a little ammonia.

A later paper[2] describes an effect, which, if genuine, must be of importance in connexion with the biological effects of X-radiation. They find that on adding a "small quantity of surface-active material" to a sol of the above type, the sensitivity of the sol to X-rays is completely destroyed.

If this is the case, it is unlikely that the striking effect of X-rays upon the surface-charge of a colloid discovered by these authors can occur during the irradiation of cancerous animal tissue, since most living cells contain surface-active substances.

IAN KEMP.

70 Penns Lane,
Birmingham 24.
Feb. 25.

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[1] NATURE, 140, 28 (1937).

[2] Crowther, J. A., Liebmann, H., and Lane, T. B, *Phil Mag.*, 24, 654 (1937)

I AM very much aware of the fact that there is a very wide gulf between the simplicity of a graphite sol and the complexity of the intra-nuclear structures of living cells. If, from any unguarded expression in our paper, Mr. Kemp has been led to suppose that we imagined the gulf to have been crossed, he is wise to lodge a caveat. The curious effect of irradiation on the cataphoretic velocity observed by us in the case of colloidal graphite seems to be common to lyophobic sols, in general, and we have obtained it not only with amorphous carbon, both positive and negative, but also with gold, quartz, and ferric hydroxide.

The effect of irradiation on colloids of biological interest is now under investigation. Pending the results of these experiments, we should hesitate to draw general conclusions from the single observation to which Mr. Kemp directs attention, nor would we dogmatize as to possible applications to living cells. Too little is known about the chemistry of the cell and its nucleus. It is known, however, that biological changes are produced in the nucleus by doses of the order of magnitude which we are using in our experiments; and in view of the importance of the subject, any possible line of approach is worth exploring.

J. A. CROWTHER.

The University,
Reading.
March 5.

Structure of Heavy Elementary Particles

THE discovery of the heavy electron has recently led Bhabha[1] and Heitler to discuss in detail Yukawa's suggestion to account for nuclear forces by the assumption that a heavy particle is surrounded by a heavy electron of mass m during a fraction of time q.

It may be emphasized that this theory permits a very elementary treatment and allows us to obtain several consequences without extensive calculations. This is due to the fact that the emitted heavy electron, satisfying a wave equation of the type

$$\Box u - \varkappa_0^2 u = f(r) \,.\, \delta(r)\, exp\left(\frac{2\pi i}{h} Wt\right), \ \varkappa_0 = \frac{2\pi mc}{h}$$

is provided with an energy of the order of mass difference between proton and neutron, $W \sim \Delta Mc^2 \sim 10^6$ ev. (Taking the recoil into account: $W \sim \frac{1}{2}\, mc^2 \frac{m}{M} \pm \Delta M;\ m \gg \sqrt{2M\Delta M}$.) It behaves outside the proton (or neutron) like a free particle in the limiting relativistic case $W \ll mc^2;\ u \sim \exp(-\varkappa r)/r$.

The theory meets with difficulties similar to those of electrodynamics, but it is not unlikely that the problem of light nuclei falls within its domain of applicability. If this is the case, we are led to the following conclusions:

(1) The theory gives for the degree of dissociation the value

$$q = \frac{1}{1 + \sqrt{1 - (W/mc^2)^2}} \sim \tfrac{1}{2},$$

which means that proton-proton forces are only slightly smaller than proton-neutron forces.

(2) The magneton of the dissociating heavy electron becomes

$$\mu = \frac{h}{2\pi} \cdot \frac{ec}{W},$$

of the order of one ordinary Bohr magneton. Thus, only a small percentage of the dissociation can be directed by the spin of the heavy particle.

A detailed account of these considerations will be given in the *Physical Review*.

GUIDO BECK.

Cité Universitaire,
Fondation Hellénique,
45 Boulevard Jourdan,
Paris (XIV).
March 1.

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[1] NATURE, 141, 118 (1938)

Methods of Estimating Mental Factors

IN a recent letter[1], Prof. G. H. Thomson has deduced an interesting relation between the equations which he and I have respectively proposed for estimating mental factors. It seems worth noting that this relation depends on a simple connexion between our estimates that previously I had not realized. Let the test scores for any one person depend on his or her group and specific factors, f_0 and f_1, according to the (vector) equation:

$$z = Mf = M_0 f_0 + M_1 f_1.$$

From the identity $K = J(1 - K)$, where $J \equiv M'_0 M_1^{-2} M_0$, $K \equiv M'_0 R^{-1} M_0$, $R \equiv MM' = M_0 M'_0 + M_1^2$, it is easy to establish the reversible relation between our respective estimates for f_0,

$$\hat{f}_0 = K\check{f}_0, \ \ \check{f}_0 = K^{-1}\hat{f}_0.$$

Thus *as a* (*vector*) *statistic* one estimate is equivalent to the other. Their different interpretation and properties might conveniently be summarized here by the formulæ:

$$E\{\hat{f}_0\} = E\{f_0\} = 0,\ E\{(\hat{f}_0 - f_0)(\hat{f}_0 - f_0)'\} = 1 - K;$$

$$E_1\{\check{f}_0\} = f_0,\ E_1\{(\check{f}_0 - f_0)(\check{f}_0 - f_0)'\} = J^{-1} = K^{-1}(1 - K),$$

where E denotes averaging over all persons, E_1 over all possible sets of tests (comparable with the given set in regard to the amount of information on the group factors f_0).

To anticipate obvious criticism, it should be remembered that these formulæ are at present somewhat theoretical, owing to the necessity of *postulating* the initial equation $z = Mf$; but, as I have mentioned before, more empirical methods of statistical analysis are always available which may ultimately help to justify and establish such postulated equations.

M. S. BARTLETT.

100 Netherwood Road,
London, W.14.
Feb. 8.

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[1] NATURE, 141, 246 (Feb 5, 1938).

"Foundations of Terrestrial Life"

IN the brief account in NATURE[1] (Dec. 25, 1937) of a lecture by Sir Frederick Keeble on "Foundations of Terrestrial Life: The Soil and the Green Plant", the conclusion to which he had come is stated thus: "This hypothesis is that the health and strength of people and their evolution, and the permanence of human societies depend on the soil and the green plant." This recognition of the fundamental importance of the green plant suggests a reference to another but very ancient résumé of science contained in the much-discussed first chapter of Genesis (verse 30). "And to every beast of the earth and to every fowl of the heavens and to every creeping-one upon the earth in which is the soul of life, I have given every greenness of herb for food." (President Harper's translation.) The customary translation is "every green herb"; but the Hebrew words are far more emphatic than the English translation; they read: "every greenness of green herb". The Hebrew word for "green herb" is one of the widest significance, and seems, according to Gesenius, to include every herb that has food value both for man and beast.

It is interesting to observe that the earliest and the latest pronouncements of science on this point are in perfect accord.

FRANK ALLEN.

University of Manitoba,
Winnipeg.
Jan. 31.

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[1] NATURE, 140, 1107 (1937)

Points from Foregoing Letters

A CURVE showing the average number of insects at various heights up to 2,000 ft., and diagrams indicating the comparative distribution of the nine more important families of insects, are submitted by Prof. A. C. Hardy and P. S. Milne. High temperature and low humidity were found to favour the aerial drift of insects. The insects were caught in nets 3 ft. in diameter, carried into the air by kites. The authors point out that wind-borne insects contribute not only to the spread of insect pests but also may possibly be carriers of foot-and-mouth disease.

Sir Joseph Larmor considers that if mountain ranges rest on a viscous foundation of *denser* material then, as the mountains accumulate locally, they would gradually sink down. The roots of the mountain would thus penetrate into the denser viscous material to an extent exceeding the height of the mountain, in order to compensate for the extra column aloft, very much like a submerged iceberg.

A description of the methods used in the preparation of the soluble amino-acid oxidizing enzyme of Krebs (from pig's kidney) and of its coenzyme (from horse-heart muscle) is given by Dr. F. B. Straub. The activity of the coenzyme is found to be proportional to its flavine content, and the author considers that flavine may be part of the active compound.

Nucleotidase (an enzyme which hydrolyses phosphoric esters) splits off the phosphate group from the molecule of cozymase (a coenzyme assisting the oxidation of carbohydrate), according to N. B. Das and Prof. H. v. Euler. The dephosphorylation takes place more slowly than in the case of the adenylic and inosinic acids. Dihydrocozymase also is dephosphorylated about twice as fast as cozymase, and this is attributed by the authors to the dibasic character of the former.

For the determination of the biological activity of urinary gonad-stimulating hormones (Gonan, Physex, etc.), P. G. Marshall prefers the vaginal-smear method in rats to the corpus luteum method in mice. Also in the case of the standardization of the hormone of pregnant mares' serum (Serogan, Antex) the author considers the vaginal-smear technique in rats preferable to the determination of the increase of ovary weight in mice, and gives the ratio of the mouse unit (amount necessary to double the weight of ovaries in four days) to the rat unit (amount needed to produce œstrus in 2½ days in 60 per cent of the immature rats).

In a grasshopper hybrid, studied by H. Klingstedt, owing to a failure in the separation of chromatids at anaphase, the chromatids often break or the separation of nuclei may be prevented. This abnormality is ascribed to a maintenance of metaphase attraction beyond its normal limit.

Prof. R. R. Gates and S. V. Mensinkai state that the double structure of chromosomes at metaphase was observed in preparations fixed with various reagents, and this excludes Dr. Darlington's objection, that the double-thread appearance is due to the treatment employed. The authors point out that much other evidence favours their view, and cast doubt on the X-ray experiments which have led Dr. Darlington to the opinion that chromosomes must be single in the anaphase and telophase stages.

R. S. Hawes describes the behaviour of the serpulid worm *Marifugia cavatica* in the inland limestone caves of Herzegowina which are flooded in winter and dry in summer. In the calcareous tubes of these worms he has found gemmules of the sponge *Ephydatia mülleri*. Only 2 per cent of these gemmules of the cave-dwelling species germinated under experimental conditions which were suitable for the development of the surface species *Spongilla lacustris* (which conditions had also been found to be suitable for the nearly related surface species *E. fluviatilis*).

Experiments carried out by Dr. G. Eloff and V. L. Bosazza show that chitin of approximately 0·02 mm. in thickness absorbed wave-lengths less than 3650 A. The biological effects are in keeping with the physical data. A Hanovia quartz mercury vapour lamp was used.

Research Items

Nayadis of Malabar

Mr. A. Aiyappan, in introducing his study of the social and physical anthropology of the Nayadis, a beggar caste of Malabar (*Bull. Madras Govt. Museum, N.S. Gen. Sec.*, 2, 4; 1937), points out that the centrifugal aspect of caste has diverted attention from the function of caste in the caste *milieu*. The Nayadis are the lowest known caste in India, polluting even the Pariah by their approach. When begging for alms in the stentorian voice, which is their most noticeable characteristic, they must stand yards away from the road. Their poverty and degradation constitute them a serious problem, which for long has engaged the attention of missionaries, administrators and social reformers. The origin of the Nayadis is obscure. A persistent tradition derives them from the Namputiri Brahmins, the highest grade in the Malabar social hierarchy, from which their forbears are said to have been ejected as 'unclean'. Sanctity is added to the repute of the caste by this tradition of origin. As beggars the Nayadis do not need to excite the compassion of the charitable as do those who have fallen on evil days. Their alms arise from the religious faith of the donors. They receive gifts on regular occasions—regular days of the week, and special occasions, such as the twelfth day of the waxing and the waning moon, and death-gifts. It is as much a sin to omit to give to them as to the Brahmins. Physically, the Nayadis stand midway between the hill jungle tribes and the castes of the plains; and in some there are distinctly Veddoid characteristics. The head is dolichocephalic and high. The estimated capacity shows that they belong to the microcephalic group. Their stature equals that of the lower castes, but is distinctly below that of the Namputiri Brahmins and Nayars. They are more platyrrhine than the lower castes, but less so than the Paniyans of the Wynad Hills.

The Zoology of Iceland

Under this title a work in five volumes is in preparation. A few parts are now published (Copenhagen and Reykjavik: Levin and Munksgaard, 1937) and include two by K. Stephensen: Marine Isopoda and Tanaidacea (vol. 3, Pt. 27) and Pycnogonida (vol. 3, Pt. 58). The Isopoda and Tanaidacea in the waters around Iceland (including the Faroes and Greenland) have been dealt with already by H. J. Hansen (Danish Ingolf Expedition 1913, 1916). Saemundsson (1937) has recorded the Icelandic Isopods from the Reykjavík Museum, and Stephensen himself (1929) has given a list of the species from Iceland in depths from 200 (300) metres. In the present work, the Isopods from 0–300 metres (the limits of the shelf) number 42 species and the Tanaidacea 9. *Aega tridens* alone is noted from Iceland for the first time. As the author points out, the comparatively small number of species is no doubt partly, but not exclusively, due to the somewhat isolated site of the island and is thus more apparent than real. The difference between Norway and Iceland is most marked in the very small forms, which have been thoroughly investigated in Norway, whilst the large easily noticed species occur nearly equally in both regions. Most of the Isopods and Tanaidacea found around Iceland are widely distributed in the northern part of the Atlantic with adjacent arctic waters. The main interest is connected with the fairly numerous species which are East Atlantic lusitanic-boreal, distributed in the north-eastern part of the Atlantic from the Mediterranean or south-west Europe northwards to Norway, the Faroes and Iceland, but found in Iceland only along the southern and western coasts. The Pycnogonida have not been hitherto so thoroughly investigated. Nineteen species are recorded, down to a depth of 300 metres, four of these for the first time. They are mainly widely distributed in the littoral and sub-littoral zones in the northernmost part of the Atlantic with adjacent arctic waters, with a few representing more special areas of distribution.

Mineral Deficiency affecting Farm Animals

The extent and influence of mineral deficiency on the growth and reproduction of farm animals have been investigated in Canadian agricultural research centres, as well as elsewhere, and are of special interest as part of the general study of the function of minerals in the thrift of domestic stock. As an aid to the investigation, the National Research Council of Canada has published a bibliography, compiled by Muriel E. Whalley, of papers dealing with mineral deficiencies as affecting the growth and reproduction of farm animals (Ottawa, 1937). The list contains 987 numbered entries arranged in alphabetical order according to authors, and covers the literature to the end of 1936. Cross references to the principal subjects mentioned in the titles have been included to assist the reader in gaining some idea of the scope and nature of the reference listed. Under each subject there is a numerical list of relevant references. The bibliography occupies 89 pages of duplicated typescript matter. The Council announces that a single copy of the bibliography will be sent free to anyone engaged in, or with special interest in, this field of research, on application to the Division of Research Information, National Research Council, Ottawa, Canada.

Larval Crustacea from the Red Sea

In his series of papers on Decapod larvæ, Dr. R. Gurney has contributed largely to our knowledge. A recent work ("Notes on some Decapod and Stomatopod Crustacea from the Red Sea" (3–5), *Proc. Zool. Soc. London*, Series B, 1937) deals in addition with certain Stomatopod larvæ. The natural position of the Stomatopoda is always a controversial point and the author's remarks on the larvæ are suggestive, showing that in many ways they are nearer to the Euphausiacea than to the Decapoda proper. He is of the opinion, and rightly so, that the difference between the *Lysiosquilla* type (Antizoea) and the *Squilla* type (Pseudozoea) is fundamentally important, showing as it does a different kind of locomotion, on one hand by the thoracic appendages and on the other by the abdominal. He was fortunate in obtaining eggs of *Gonodactylus glabrous* and the first and second larvæ from them as well as several stages from the plankton, making an almost complete series. *Lysiosquilla* larvæ (almost certainly the first stage), also described, are interesting in being intermediate between the Antizoea and Pseudozoea type, having the head and thorax of an Antizoea but with well-developed pleopods. *Callianassa* larvæ are discussed. Here there is always much that is difficult owing to the lack of definite identification. Two types exist, one (of which *C. subterranea* is an example) being found in a number of widely separated species, the other, less known, being closely related to that of Axius. The larvæ of a species of *Chlorotocella*, regarded as a Pandalid by Balss, is unusual in having the legs exceptionally backward in development and in having no exopods on the last four pairs of legs.

Elm Disease in Great Britain

A BRIEF memorandum on the elm disease was issued by the Forestry Commission in 1934. This Leaflet No. 19 is now reprinted (1938). The elm disease was first discovered in Holland in 1919 and is therefore referred to as the Dutch elm disease (*Ophiostoma ulmi*). It has been noted in Great Britain since 1927 and is fairly widespread over England, but does not extend to the north of Alnwick and is not reported from Scotland. The disease is now common throughout western and northern Europe; also in the United States. Many trees have been killed by it in Belgium, France, Germany, Holland and Italy. The first sign of the disease is a discoloration and withering of the leaves in the crown or at the ends of the branches. This is usually followed by defoliation, dead shoots being characterized by a drooping of the twigs, particularly noticeable in the months of summer. The trouble about this disease and the chief remedy (felling the tree affected) is that the severity of attack and the rate of progress of the disease are very variable. Trees may be killed in a single year, or the dieback may be more gradual, and if left standing they may entirely recover. Trees of all ages may be attacked, but small plants in nurseries and elm hedges are less frequently attacked than older trees. It is said that elms which have been pollarded, or severly lopped, are especially liable to infection. It is also held that the disease is spread by the elm bark beetles, *Scolytus destructor* and *S. multistriatus*; but observers are not at present unanimous upon this point. As regards the present position in Great Britain, between 1927 and 1931 the disease increased steadily. In 1932 there was a definite check, since when the disease has made steady progress, especially rapid in Worcestershire, but even in the worst regions it is said that the proportion actually killed is small. Attacked trees, therefore, should not be felled unless they become unsightly or die.

Fungi of Cyprus

GREATER knowledge of the problems of fungus ecology is one of the surest foundations for economic plant pathology of the future. One of the first requisites is an exact taxonomy of the fungi which occur in regions of characteristic climate. Dr. R. M. Nattrass has ministered to this need by publishing "A First List of Cyprus Fungi" (pp. xvi + 87. Nicosia, Government of Cyprus, price 2*s*. net, 1937). Details of climate and characteristic husbandry are given, and most of the fungi recorded seem to be typical of the Mediterranean region. There appears to be, however, a distinct mycological link with India. Six new species are proposed. Several cosmopolitan parasitic fungi which are usually found in widely varying habitats are absent from Cyprus. *Nectria cinnabarina*, the coral-spot fungus, *Stereum purpureum*, the cause of silver-leaf in plums, *Ophiobolus graminis*, or 'take-all' of wheat, and the wart disease of potatoes, *Synchitrium endobioticum*, are examples. Fifteen plates delineate the characters of the new species and other uncommon fungi.

Assyrian Chemistry of the Seventh Century

DR. R. CAMPBELL THOMPSON delivered a lecture on March 16 to the Society for the Study of Alchemy and Early Chemistry on "Assyrian Chemistry of the Seventh Century B.C." The lecture showed that cuneiform records going back to the seventeenth century B.C. contain recipes for carrying out chemical processes, but the greater part of the abundant literary material is from the seventh century and is in the British Museum. The translation of these tablets by Dr. Thompson has made it possible to reconstruct with considerable probability the range of materials used by the ancient Assyrian chemists, and it is interesting to find that enamels and glasses coloured by metallic oxides and possibly gold were made by processes depending on the use of definite weights of materials. Elaborate lists of stones were drawn up and it seems as if these include scales of hardness similar to the modern Mohs' scale. Various salts were in use, and it is even possible that fuming sulphuric acid was obtained by distilling green vitriol. An account of the lecture will be published in *Ambix*, the journal of the Society.

The Photographic Image

R. W. Gurney and N. F. Mott (*Proc. Roy. Soc.*, A, 164, 151; 1938) have applied the quantum theory of solid photo-conductivity to the production of the photographic image. If an electron is introduced into the silver halide lattice it is able to jump from ion to ion through the crystal, its energy lying in a band of 'conduction levels'. Such electrons are liberated from the halogen ions by the action of light, and whenever they come in contact with a speck of metallic silver they are captured. The negatively charged silver specks then attract silver ions which have left their normal lattice positions as a result of heat motions. This explains the direct darkening of silver halides by light (print out effect). It is clear that the efficiency of the process will be reduced at low temperature, and this is in agreement with experiment. The formation of the developable 'latent' image is due to the production of a sub-microscopic silver speck on the surface of a halide grain. The well-known sensitizing effect of traces of sulphur may be due to the sulphide specks localizing the formation of silver specks at points on the surface of the grain where the developer can get at them. It is shown that the silver specks will not be able to grow unless a certain concentration of electrons is provided by the photo-electric action, and on this basis the relations between time of exposure, intensity of light and blackening may be explained. There is a short discussion of the reversal of the image by red light and of the sensitization of emulsions by dyes.

Quantitative Methods in Psychology

A MEETING of the Royal Society was held on March 24 to discuss the application of quantitative methods to certain problems in psychology. The discussion, which was on three different problems, was introduced by Dr. C. S. Myers, who pointed out that conscious experience can only be measured numerically in terms of the antecedent physical stimulus, the concomitant physiological activities, or the consequent changes in outward behaviour. If mathematical operations on psychological data are to be of psychological value, each step in such operations must be carefully studied so as to be assured that it is psychologically warranted and not merely of interest to the mathematician. The psychological whole being greater than the sum of its parts, and the nature of these parts being dependent on the whole, the limitations of psychological atomism and psychological mechanics must always be borne in mind. But even if factorial analysis, although mathematically possible, may have only a limited use in applied psychology, nevertheless occupational guidance and selection, as at present practised, are demonstrably of considerable value.

STATISTICAL METHODS

Prof. C. E. Spearman, who opened the first discussion, on recent developments of statistical method, described the development of factorial analysis as illustrated by his own work and that of Kelley, Thurstone and Holzinger. Prof. G. H. Thomson said that in his view vocational prediction entails the projection of a point, given by *n* oblique co-ordinate axes called 'tests', on to a vector representing the 'occupation', the direction cosines of which are known but which is not in the *n*-space of the tests. The use of factors, whether oblique or orthogonal, merely involves reference of that point to a new set of co-ordinate axes called 'factors', instead of to the original test-scores—a procedure which, he argued, cannot define the point any better and may, unless great care be taken, define it worse. The chief value of the factor theory probably lies in its serving as a spur to further investigations and hypotheses. His belief is that the comparatively low rank to which so many matrices of mental correlation coefficients can be reduced indicates that the human mind is comparatively undifferentiated, protean and plastic, rather than that it is composed of separate faculties.

Prof. C. Burt regarded the factors isolated by analysis as merely convenient descriptive concepts which may, or may not, have a psychological basis. They need have no 'real existence', but serve much the same purposes as the lines of latitude or longitude upon a terrestrial map. In statistics the important measurement is not that of the clue and its consequence, but the measurement of the probability connecting the two. He referred to the great value of R. A. Fisher's formulæ for small samples, before the discovery of which it was considered that statistical methods could not be applied to less than 50 or 100 cases, and consequently the more detailed studies of the individual tended to give place to vast collections of inaccurate data. He also alluded to the easy comprehension and to the great value of matrix algebra for analytical purposes in statistical psychology—a method rarely utilized in the textbooks of pure statistics ; and to certain close analogies between recent developments in factor psychology and those in quantum mechanics.

A discussion of this subject followed by Drs. H. B. Heywood, J. O. Irwin and W. Stephenson.

INDUSTRIAL ACCIDENTS AND SICKNESS

Prof. M. Greenwood introduced the next subject—industrial accidents and sickness. He described how his early work at the Ministry of Munitions in 1918, on the distribution of accidents among those exposed to the same risk of them, led to later investigations conducted with the object of arriving at a statistical expression of the true and popular view that some people are 'all thumbs'. He was followed by Dr. May Smith, who gave an account of investigations conducted by the Industrial Health Research Board into the comparative absenteeism through sickness of those employed in selling, office work and manufacture. She indicated how dependent absenteeism also is on age, sex, incentives and management.

Mr. Eric Farmer and Mr. E. G. Chambers contributed to the discussion of this subject by describing their work on tests for the 'accident-prone', which provide with fair accuracy a prediction of accident rate for different groups of workers, although they are not sufficiently reliable in the case of any individual worker.

INDUSTRIAL SELECTION

The last discussion, on psychological tests in industrial selection, was opened by a communication from Sir Frederick Marquis, who described the promising value of special tests for salesmanship introduced a year ago into Lewis's stores, but had found tests for general intelligence to be of no value. Mrs. Raphael pointed out that in another large stores the National Institute of Industrial Psychology had found no linear correlation between intelligence and retail salesmanship, too much intelligence being as undesirable a qualification as too little.

Wing Commander R. H. Stanbridge described an experiment on the selection of aircraft apprentices with the aid of psychological tests. He found tests of intelligence and mechanical aptitude to be correlated with the passing-out results and to be definitely serviceable. Dr. W. G. Hiscock described the use of selection tests devised by the National Institute of Industrial Psychology for the Grangemouth branch of the Dye-stuffs Group of Imperial Chemical Industries, Ltd. Since 1934 all applicants for employment in the works have been submitted to these tests, as well as to a special medical examination, and not a single chemical process-worker has been discharged on the ground of inefficiency. Dr. Millais Culpin gave an account of an interesting investigation into the relation between 'nervousness' and the satisfactory and continued work of telegraph operators.

Discovery of the Femur and the Humerus of *Sinanthropus Pekinensis*

By Prof. Franz Weidenreich

Cenozoic Research Laboratory, Peiping Union Medical College

THE FEMUR

AMONG the extensive material recovered from Locality 1 at Choukoutien during the excavations of 1936–37 and afterwards prepared in the Laboratory, Dr. W. C. Pei discovered two fragments of femora. The general appearance of these specimens led Pei to believe that they were of human origin and probably belonged to *Sinanthropus*. A careful study and comparison with human and anthropoid thigh-bones resulted in the conclusion that the femora undoubtedly belong to *Sinanthropus*.

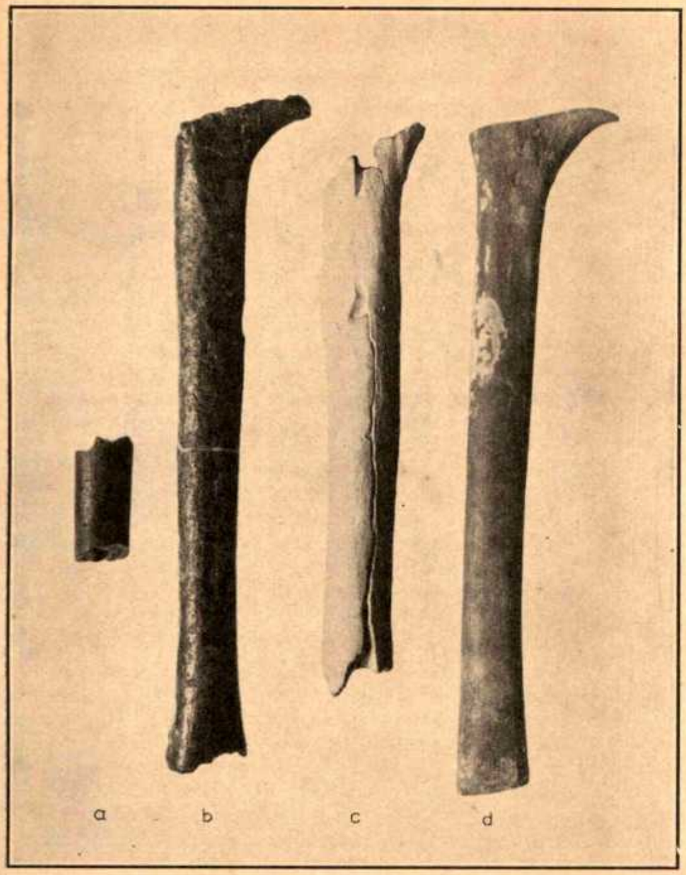

Fig. 1.

COMPARATIVE VIEW OF THE ANTERIOR SURFACE OF FEMORA: (*a*) *Sinanthropus* FEMUR *J*; (*b*) *Sinanthropus* FEMUR *M*; (*c*) THE FRAGMENT OF A FEMUR OF THE MAN OF WEIMAR-EHRINGSDORF (NEANDERTHAL GROUP) WHICH HAS NOT BEEN DESCRIBED (CAST); (*d*) FEMUR OF A FEMALE INDIVIDUAL OF RECENT MAN (MORAVIAN)—UPPER AND LOWER PARTS REMOVED TO CONFORM TO THE SIZE OF THE *Sinanthropus* FEMUR *M*. (×3/10.)

Femur fragment I was recovered from Level 23 in the western area of the cave, that is to say, Site *J*, from which we already have several fragments of an adult female skull described as Skull *J* in 1937, and four skull fragments of a very young child recently found among the prepared material. Femur fragment II comes from Level 26 of the western area of the cave, from which we have two fragments of one adult male and one adult female mandible as yet not described. Femur specimen I will be known as Femur *J* and specimen II as Femur *M*.

Femur *J* (Figs. 1 and 2, *a*) represent a portion of the middle of the shaft and measures 58 mm. The bone is completely fossilized and burnt, as is evident by the marked blackening of the entire anterior and medial surface and on the part where it was broken off. That we are actually dealing with a human femur is demonstrated by the form and size, but particularly by the existence of a rather distinct pilaster (Broca) which occupies the middle of the posterior surface and bears a well-developed linea aspera dividing into characteristic medial and lateral lips toward the end of the fragment.

Femur *M* (Figs. 1 and 2, *b*) embraces almost the entire diaphysis. Its length is 312 mm. At the upper end, the head and trochanters are broken off, whereas the entire inferior border of the neck is preserved. The lower end is likewise missing but the upper end of the suprapatellar fossa is still recognizable. This femur also is strongly fossilized. Certain parts of the surface are weathered but all the characteristic features are sufficiently preserved to permit a criterion. Like specimen *J*, this piece shows a distinct pilaster running along the middle of the posterior surface and bears a linea aspera consisting of two lips. Its relative completeness, however, makes it possible to determine the general form and the peculiarities of the shaft. Estimated on the basis of the length of the preserved portion of the femur, the total length may have been 400 mm.

The femur of *Sinanthropus* has, in common with that of recent man (Figs. 1 and 2, *d*), the general shape and the formation of a pilaster with a two-lipped linea aspera. In addition, there is a suprapatellar fossa, its lateral border being formed by a distinct ridge which gradually disappears towards the middle of the shaft. The trochanter tertius and the intertrochanteric line are missing. On the other hand, the femur differs from that of recent man by its stoutness—it seems that the distal end in particular was shorter and broader than in recent man in proportion to the length and breadth of the femur—and by the following specific features: (1) a very pronounced platymery of the entire length of the femur combined with the formation of a distinct pilaster (Figs. 2 *b*; 3 *a*-*c*); (2) a very faint curvature the greatest height of which is located near the lower end of the diaphysis (Fig. 2 *b*); (3) the transversal diameter of the shaft is narrowest near the lower end and gradually increases toward the upper portion (Fig. 1 *b*); (4) there is a distinct but only faintly developed crista lateralis superior (Fig. 1 *b*); (5) sections show that the cavity is narrow with rather thick walls, especially the anterior and posterior ones (Fig. 3 *d*).

Femora of the Neanderthal group (Figs. 1 and 2, *c*) differ from the femur of *Sinanthropus* by their greater stoutness, the transversal diameter being narrowest in the middle of the shaft, by a much more pronounced curvature the greatest height of which is also located near the middle of the shaft, and finally by the development of a very strong crista lateralis superior (Fig. 1 *c*). To what extent these differences are due to sexual characters is difficult to define. It seems that all the femora available of the Neanderthal group belong to male individuals, whereas I consider the two femora of *Sinanthropus* as belonging to females on account of the smallness of the two main diameters of the shaft (Table 1, Figs. 1 *b* and 2 *b*). In addition, femur *M* comes from the same site as a fragment of a lower jaw (*M* I) with two teeth which had been attributed to a female individual.

When compared with the femora of the great apes, those of *Sinanthropus* represent quite a different type. The general character of the shaft does not conform to any of them. It is of special interest that the *Sinanthropus* shaft also fails to show any similarity to that of a gibbon, the shaft of the latter being slender as in recent man, with the narrowest part at its middle. It may be deduced from this fact that the frequently stated similarity between femora of gibbon and recent man is of secondary nature and not in the least a fundamental one.

These discoveries of the *Sinanthropus* femora may also serve to shed some new light upon the problem connected with the *Pithecanthropus* femur. Its discoverer, E. Dubois, attributed it as belonging to the same individual or type as that represented by the *Pithecanthropus* skull cap. The fact that the femur closely resembled one of recent man not only in respect to its general character but also in certain other details was at no time held in doubt and distinctly admitted by Dubois. According to him, one of the most essential differences between the femur of *Pithecanthropus* and that of recent man should be a pronounced convexity of the upper portion of the popliteal surface of the former.

Femur *M* of *Sinanthropus* differs from the *Pithecanthropus* femur by exactly those features by which it differs also from that of recent man. But with reference to the popliteal surface it shows the same slight convexity as is common in recent man, the platymeric index of this region being 76·4 in *Sinanthropus* against 100·0 in *Pithecanthropus* (Table 2). The convexity of the popliteal surface of the *Pithecanthropus* femur, therefore, cannot be considered a primitive character.

It results from these facts that the *Pithecanthropus* femur is either one of recent man and with no close relationship to the skull cap, or it really belongs to the latter and thereby testifies that *Pithecanthropus* represents a much more advanced hominid type than *Sinanthropus*. I consider the first alternative to be the correct one. As proved by the skulls, both *Sinanthropus* and *Pithecanthropus* exhibit in general approximately the same degree of primitiveness. On the other hand, the femur of *Sinanthropus* reveals that the *Pithecanthropus* femur, besides other differences, is much too long and too strong for so small a skull.

In a lecture delivered in December 1937 before the Peking Society of Natural History, I pointed out that the character of the then available specimens of extremity bones of *Sinanthropus*, particularly the collar bone, indicated a more man-like appearance than the skulls and more especially the teeth. On the basis of this, together with the cultural remains, I came to the conclusion that *Sinanthropus* must have already adopted a completely upright posture and that the approach of the extremity bones to those of man preceded that of skull and teeth. Such a conception has now been confirmed by the discovery of the femur of *Sinanthropus* and thus leaves no room for doubt that the posture of *Sinanthropus* was erect. Since the total length of the femur (female) may have approximated 400 mm., the stature of the woman can be estimated to have been about 5 feet (152 cm.), a height which would correspond

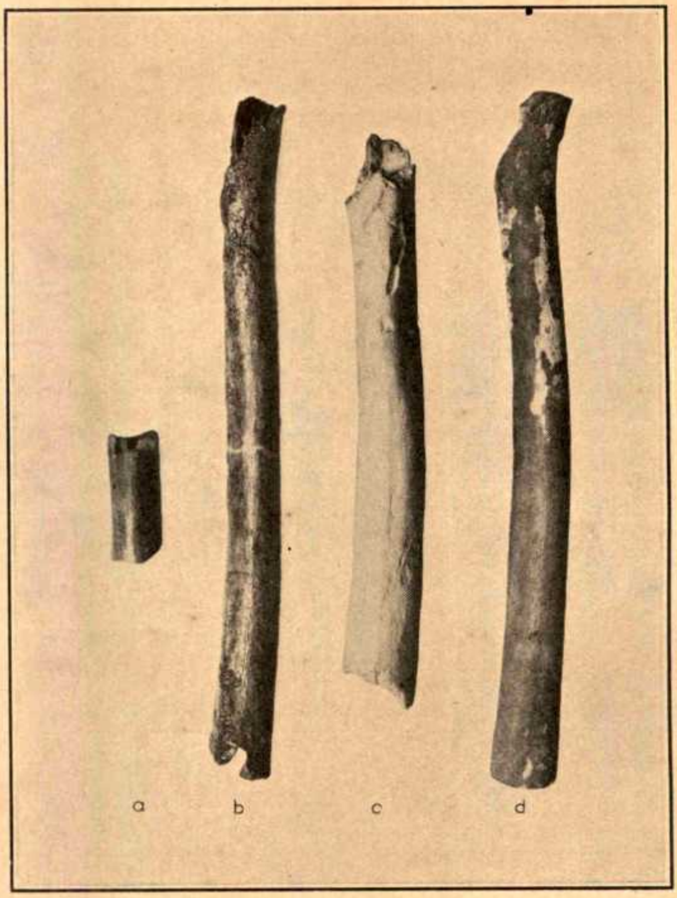

Fig. 2.

THE SAME FEMORA AS IN FIG. 1 VIEWED FROM THE LATERAL SIDE. (× 3/10.)

to 5 ft. 4½ in. for male individuals. With such a height, *Sinanthropus* ranges within the group composed of medium-sized people of to-day. At any rate, it is certain that *Sinanthropus* was not a pygmy.

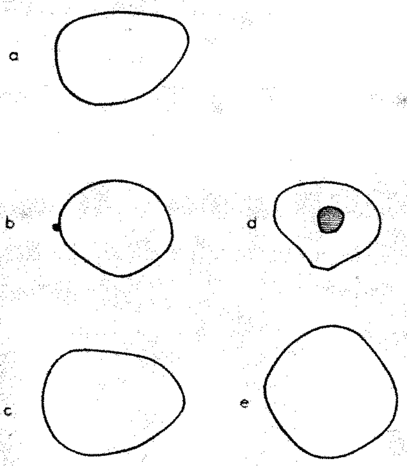

Fig. 3.

SECTIONS OF *Sinanthropus* AND *Pithecanthropus* FEMORA: (*a*) *Sinanthropus* FEMUR *M*, IMMEDIATELY BELOW THE LESSER TROCHANTER; (*b*) THE SAME FEMUR, SECTION OF THE MIDDLE OF THE SHAFT; (*c*) THE SAME FEMUR, SECTION OF UPPER PART OF THE SUPRAPATELLAR FOSSA; (*d*) *Sinanthropus* FEMUR *J*, SECTION OF THE MIDDLE OF THE SHAFT WITH THE CAVITY MARKED; (*e*) *Pithecanthropus*, SECTION OF THE UPPER PART OF THE SUPRAPATELLAR FOSSA IN CORRESPONDENCE TO SECTION *c* OF *Sinanthropus* FEMUR *M*. (× ½.)

The three facts, namely, that the two femora were found as isolated pieces without any other human bones; furthermore, that they represent only more or less complete specimens, and finally that the fragment of femur *J* was burnt, point in the same direction as the finds of skull and jaws. All the *Sinanthropus* bones recovered from Locality 1 of Choukoutien had received the same treatment as the game which *Sinanthropus* hunted. This hominid, therefore, was a cannibal. *February 10.*

TABLE 1.

PRINCIPAL MEASUREMENTS OF FEMORA (IN MM.).

	Sinanthropus M ♀	*Sinanthropus J* ♀	*Pithecanthropus* ♂
1. Transversal diameter			
(*a*) upper end	34·3	—	34·6 ?
(*b*) middle	29·0	27·3	28·0
(*c*) upper popliteal region	36·0	—	34·3
2. Sagittal diameter			
(*a*) upper end	22·1	—	31·0
(*b*) middle	24·1	22·6	29·0
(*c*) upper popliteal region	27·5	—	34·3
3. Circumference (middle of shaft)	88·0	77·0	89·0

THE HUMERUS

Shortly after the discovery of two fragments of the femur of *Sinanthropus pekinensis*, Dr. W. C. Pei recognized, among the material of Locality 1 of Choukoutien now in preparation in the Laboratory, a fragment of a humerus. This fragment comes from the same level (23) as the femur fragment *J*, but was found about 13 m. away from the latter.

The fragment is strongly fossilized and represents the greater part of a left diaphysis the total length of which is 187 mm. Both end parts are missing and apparently broken away previous to the process of fossilization. There is no doubt that the humerus belongs to *Sinanthropus*, its general appearance being rather similar to that of Neanderthal or recent man. But at the same time conspicuous differences are evident, namely, the diaphysis is very slender, the smallest circumference being only 60 mm. and the

TABLE 2.

INDEXES AND ANGLES.

	Sinanthropus M ♀	*Sinanthropus J* ♀	*Pithecanthropus* ♂	Neanderthal ♂	Recent Man	Gorilla	Chimpanzee	Orang	Gibbon
1. Length-circumference index	22·0 (?)	—	19·5	22·3	♀ 17·5–21·3	♀ 31·0	♀ 33·7	♀ 30·3	♂ ♀ 18·1
2. Robusticity index	17·3 (?)	—	12·5	13·5–14·1	11·7–12·5	17·2	15·7	♂ ♀ 15·7	10·8
3. Pilastric Index	84·0	84·0	103·8	99–100·5	100–122	♂ ♀ 75·4	♂ ♀ 84·6	78·5	97·1
4. Platymeric index :									
(*a*) upper end	64·5	—	89·8? or more	69·8–85·3	♂ 64·3–85·9	♂ ♀ 81·0	♂ ♀ 82·8	♂ 71·2	82·8
(*b*) popliteal region	76·4	—	100·0	—	—	♀ 66·3	♂ 80·3	66·9	—
5. Index of the curvature (after Ried)	2·03	—	2·15	5·0–5·5	3·3 (1·8–5·0)	♀ 2·73	♂ 2·88	♂ 1·86	—
6. Indexes of the position of the vertex of the curvature (after Ried)									
(*a*) Index I	35·9	—	47·2	—	—	♀ 57·5	♂ 55·3	♂ 55·8	—
(*b*) Index II	37·5	—	46·3	43–45·1	56·0	48·7	52·9	50·4	—
7. Index of the robustness of the wall									
(*a*) ant. wall	37·1	30·1	—	—	♀ 23·9				
(*b*) post. wall	37·1	40·7			33·4				
(*c*) lat. wall	39·4	39·7			34·2				
(*d*) med. wall	30·8	36·3			24·7				
8. Collar angle	circa 110°	—	123°	115–120°	121–133°	115°	120°	130°	130°

circumference immediately below the surgical neck only 71 mm. The markings of muscle insertion, however, are surprisingly well pronounced, especially those of the deltoid and pectoralis major. The tuberositas deltoidea continues in a ridge-like projecting crest, the total length of which is 15 mm. The crista tuberculi majoris is likewise strongly developed, and there is also a well-circumscribed tuberositas corresponding to the attachment for the m. teres major. The sulcus radialis is also rather distinct, indicating a well-developed torsion of the humerus. In addition, the borders represent sharply demarcated edges, so that a cross-section of the upper part shows an almost quadrangular outline, while one of the lower parts beyond the end of the tuberositas deltoidea has the form of a real triangle. These features combined give the humerus of *Sinanthropus* a specific character.

In view of the deficiency of the fragment, it is not possible to determine with any degree of certainty the original length of the humerus. On the basis of the form and length of the fragment, however, the total length may be estimated to have been at least 310 mm. Despite the strong development of the muscle markings and the edge-like character of the borders, I consider the humerus as belonging to a female individual on account of its extraordinary slenderness.

As is evident from this brief description, the humerus of *Sinanthropus* does not show any special similarity to the humeri of great apes. It is specifically human in its entire appearance. The strong development of the muscle markings, especially those of the deltoid, pectoralis major and teres major and the edge-like character of the borders indicate that the upper limb was used in the same manner as in recent man, that is to say, it was already completely freed from locomotion. So far as is possible to deduce from the fragments of femur and humerus, their proportion in length may have been the same in principle as in recent man.

The view I have recently put forward that the skeleton of *Sinanthropus* approached that of man much closer than the brain case and the teeth do, receives additional support by the discovery of the humerus.

February 17.

Science News a Century Ago

Medical Missions

The March issue of 1838 of the *Gentleman's Magazine* contains the following information: "The first evening meeting of the Royal College of Physicians was held in Trafalgar Square on February 5, and a more crowded audience of members and visitors has, perhaps, never occurred. Amongst the latter were his Royal Highness, the Duke of Cambridge, the Duke of Wellington, the Archbishop of Canterbury, the Bishop of London, the Chief Justice of the Common Pleas, Sir Lancelot Shadwell, Sir Robert Peel, etc., etc. The President, Sir Henry Halford, read a paper recommending in eloquent terms the union of medical with theological knowledge in the attainments of missionaries to the eastern nations, and pointing out the great advantages which would result from such a connexion. He observed that great progress had been made in China and the other Asiatic countries in the healing art by the energy of the missionaries, and that vaccination and other European improvements in medicine had been introduced by their instrumentality. Sir Henry also took a view of the state of national physiology and pathology as understood in China, and pointed out the absurdities of the system of the natives."

English Physicians in France

The issue of the *Lancet* of March 31, 1838, contains the following information: "The affair of the English physicians in France (prosecution for unauthorised practice at Boulogne) has terminated in the condemnation of Drs. Carter, Scott, Shuter, Allatt and Galbraith to the payment of a trifling sum, which, however, is equivalent to an interdiction from practising medicine in France. This decree has naturally been very unsatisfactory to the British residents at Boulogne who have forwarded a petition to the King of the French on the subject; but their application will probably be of no avail, for we have been informed that, at a recent meeting of the Senate of the University of France, not less than ten demands from foreign physicians for permission to practise have met with a decided refusal. A leading French journal suggests that physicians furnished with diplomas from any foreign university or chartered body should be immediately admitted to the final examination (at a reduced fee) before the Faculty of Medicine of Paris. This appears to be the only feasible way of compromising the matter."

Faraday's Researches in Electricity

On April 5, 1838, at a meeting of the Royal Society, the reading of Faraday's Thirteenth Series of "Experimental Researches in Electricity" was resumed and concluded. "The author, in this paper," said the *Athenæum*, "pursues the inquiry into the differences observable in the luminous phenomena of the electric discharge, according as they proceed from bodies in the positive or the negative states, with a view to discover the cause of those differences. For the convenience of description, he employs the term *inductric* to designate those bodies from which the induction originates, and *inducteous* to denote those whose electric state is disturbed by this inductive action. . . . He also directed his attention to the peculiar luminous phenomena attending the disruptive electrical discharge, which he terms a glow, . . . and the *convective*, or carrying discharge—namely that effected by the translation of charged particles from one place to another. He lastly considered electric currents, not only in their effects on the bodies they traverse, but also in their collateral influences, as producing inductive and magnetical phenomena. He announced his intention shortly to give further views he entertains concerning the nature of electric forces and electric excitation in connexion with the theory he had advanced."

The Ant-tree of Guiana

At a meeting of the Botanical Society on April 6, 1838, the Secretary read a paper from R. H. Schomburgk (still in British Guiana) on the *Triplaris Americana*, the ant-tree of Guiana. The trunk, the letter said, is slender, grows up straight, and its erect branches form a pyramid. It is unisexual; and the flowers of both sexes are insignificant: those of the male last only for a few days, when they dry up; this is likewise the case with the petals of the female. The segments of the calix, however, continue to grow from green to white and vermilion, and become so attenuated that the branched nerves are easily perceptible. The tree presents a most elegant appearance. The incautious botanist who, allured by the deceptive appearance, should approach to pluck the blossoms, would rue his attempt. The trunk and branches are hollow like those of the trumpet tree (*Cecropia*) and provided between space and space with partitions, which answer to the position of the leaves on the outside. These hollows are inhabited by a light brownish ant, about two- to three-tenths of an inch long, which inflict the most painful bites, causing swelling and itching for several days. If they find themselves captured, they attack and kill one another like scorpions. The Aramah Indians call the tree 'Jacuna' and the ant 'Jacuna Sae'.

The British Association and Steam Navigation

At the Liverpool meeting of the British Association in 1837, a grant was placed at the disposal of a committee to investigate the speed and fuel consumption of steam vessels, and the Peninsula Steam Navigation Company had liberally offered to cooperate with the committee in trials to be made in their ship the *Tagus*. With the view of making the necessary records, Dr. Lardner had made an apparatus which would enable the steam engine to make a journal of its own proceedings.

According to the April 1838 number of *The Civil Engineer and Architect's Journal*, his apparatus was intended to record the pressure of steam in the boiler, and in the engine, the vacuum in the condenser, the revolutions of the paddlewheel, the amount of water in the boiler and its density. The records were made by coloured pencils on a paper driven by clockwork, the apparatus being enclosed in a case 3½ ft. high and 3 ft. in diameter which was to be locked at the beginning of a voyage and was not to be opened until the ship returned to port. The coal consumed was to be ascertained from the amount on board at the beginning and the end of the voyage.

University Events

Cambridge.—J. A. G. de Courcy has been appointed superintendent of the Engineering Workshops.

The Managers of the Frank Edward Elmore Fund have appointed Dr. J. C. Sinclair to a studentship.

J. R. Robinson, of Emmanuel College, has been awarded the Allen scholarship.

Leeds.—C. L. Bird has been appointed lecturer in dyeing.

Liverpool.—Dr. Rupert Montgomery Gordon, director of the Sir Alfred Lewis Jones Research Laboratory, Freetown, Sierra Leone, has been appointed to the Dutton Memorial chair of entomology in succession to Prof. W. S. Patton, who resigned in December last.

London.—Dr. F. R. Winton has been appointed, as from October 1, 1938, to the University chair of pharmacology tenable at University College. Since 1933 he has been reader in physiology in the University of Cambridge.

Dr. R. V. Christie has been appointed as from April 1 to the University chair of medicine tenable at St. Bartholomew's Hospital Medical College. Since 1935 he has been assistant director of the Medical Unit and assistant physician at the London Hospital.

Societies and Academies

Paris

Academy of Sciences, January 31 (*C.R.*, 206, 289–384).

Ernest Esclangon: Clocks indicating simultaneously mean solar time and sidereal time. It is possible to have a master clock, showing mean solar time, connected by a train of wheels to another clock showing sidereal time. The choice of the number of teeth on the connecting wheel work is worked out and a number of examples given showing the gear train and the corresponding error in seconds after 100 years starting with 1938.

Gabriel Bertrand and Georges Brooks: The composition of fibres, shells and other lignified plant tissues. Studies from the point of view of the chemical or biological utilization of these plant products.

Dimitri Riabouchinsky: Comparison of the method of the variables $(\varphi, \psi_1, \psi_2, t)$ with those of the variables of Euler and of Lagrange.

Marcel Godchot and Mlle. Germaine Cauquil: The molecular transpositions obtained in the dehydration of the 1-methyl-3-cyclohexylisopropyl pinacones.

Edouard Chatton: The plurality of the species of *Orchitosoma* and on their nature: the spermatogenetic evolution of Metazoa taking place in the parasite state in the ovary of Copepods.

Jules Dubourdieu: Remarks relating to the theory of assurance accidents.

Wolfgang Dœblin: First elements of a systematic study of the ensemble of powers of a law of probability.

Karl Menger: A simplified axiomatic of the algebra of projective geometry.

Gustave Choquet: Study of certain networks of routes.

André Lichnerowicz: Regular space-time exteriors.

Louis Sackmann: The comparative study of the *portance* of a wing of an aeroplane and of the régime of flow on the extrados.

Jean Mandel: The equilibria through plane parallel sections of plastic media at the limit of flow, and, in particular, of earth and of the ductile metals.

Jean Louis Destouches: Centre of gravity and relations of uncertainty.

Mlle. Natalie Rein: A form of differential equations of the limited elliptical problem.

André Danjon: The determination of the elements of the orbits of visual double stars.

Joseph Mikulaš Mohr: The dependence of the observed radial velocity and of the term K of stars of type B with distance.

Dikran G. Dervichian and Maurice Joly: Homogeneous transformation points in monomolecular layers.

Constantin Salceanu and Corneliu Istraty: The determination of the positions of resonance in tubes by means of a galvanometric deviation. An application of the resonance method of Bungetzianu, in which the telephone method of defining the resonance positions is replaced by a galvanometer method. Results obtained with water, alcohol, acetone and carbon tetrachloride are given graphically.

Raymond Zouckermann: The variations of the explosive potential of a discharge tube without internal electrodes, under the influence of ultraviolet or visible light. The curve showing the relation between the explosive potential in hydrogen, in a tube with external electrodes, and the pressure of the gas, is changed when the gas is exposed to light, the explosive potentials being always lower in the latter case. The cause of this phenomenon is obscure.

Amédée Guillet : Vagueness in the working of systems formed, like the microphone and the coherer, of a large number of associated elementary contacts.

Mlle. Milka Radoïtchitch : The influence of the solvent on the infra-red absorption spectra of various solutions of neodymium and samarium acetylacetonates. The infra-red absorption bands of salts of the rare earths in solutions of organic solvents undergo displacements and variations of intensity depending on the solvent, a result analogous with that already found in the visible spectrum.

Maurice Parodi : Study of the transmission of some benzene derivatives in the extreme infra-red.

Pierre Grivet : The modulation of light at high frequency. Its application to the measurement of very short periods of time.

Jacques Rabinovitch : The magnetic double refraction of benzene solutions of the pinenes.

Mlle. Yvette Cauchois and Mlle. Marie Louise Allais : The L spectra of emission and absorption of thorium and its characteristic levels.

Pierre Auger : The new heavy particles of cosmic radiation.

Marc Foëx : The solubility of oxides in fused boric anhydride at 1200° C. Experimental data for the solubility of various metallic oxides in fused boric oxide at 1200° C. are given. From the figures it is concluded that the solubility of the oxides varies regularly with the molecular weight. Several oxides, hitherto considered as insoluble in fused boric oxide, have in reality an appreciable solubility.

Guy Gire and François Fouasson : Basic selenates and tellurates.

François Olmer : The reduction of the oxides of iron by carbon monoxide in the presence of some natural impurities. The catalytic action of iron on the decomposition of carbon monoxide is impeded, or even entirely stopped, by the presence of phosphoric anhydride or of alumina.

Jacques Parrod : A reaction of ethyl dihydroxymalonate. Application to the detection of mesoxalic acid. The reaction between ethyl dihydroxymalonate, zinc sulphate and ammonia produces an intense green fluorescence.

Gaston Gibault : The magnetic disturbance of January 25, 1938.

Charles Maurain : Remarks on the preceding communication.

Roger Faillettaz : An anemometer with photoelectric cells for the study of atmospheric turbulence.

Robert Bureau : Ionospherical disturbances starting suddenly and their effects on the long waves.

Marius Chadefaud : The plasts and amylogenesis in the Dasycladaceæ.

Georges Mangenot : The oospheres, the pollen tubes and fertilization in the maritime pine.

Antonin Tronchet : The optical properties of the papillous cells of the tendrils of *Eccremocarpus scaber*.

M. and Mme. Fernand Moreau : The hormonal formation of the perithecium in the Neurospora.

André Hollande : The parabasal apparatus of the Cryptomonadines.

Maurice Fontaine and René Guy Busnel : The localization of the role of flavine or of a body similar to flavine in the skin of fish.

Antoine Magnan, Charles Perrilliat-Botonet and Henry Girerd : Simultaneous cinematographs in three perpendicular directions, two by two, of a bird in flight.

Serge Tchakhotine : Experimental parthenogenesis of the egg of the *Pholas* by ultra-violet micropuncture, terminating with a living larva.

Marcel Mazille : A dry and irreversible dialysis of blood serum.

Alexandre Besredka : The disappearance of the vaccinating power of diphtheric anatoxin in the presence of antidiphtheric serum. Whilst the anatoxin, injected alone, exerts an immunizing power, it ceases to have this influence in the presence of antidiphtheric serum. The animal behaves as if the anatoxin were annihilated by the serum.

Henri Violle : Contribution to the study of endemic exanthematic typhus.

P. G. Charpentier, Maurice Doladilhe, Charles Morel and Louis Placidi : The anaphylactizing properties of the blood serum are localized in the viscous protein of this serum.

Prague

Czech Academy of Sciences and Arts

January 15, 1937.

J. Milbauer and J. Vodrážka : Simultaneous estimation of SeO_3'', SeO_4'', AsO_3''', AsO_4'''. Arsenates are precipitated by magnesium solution, arsenites are oxidized to arsenates by ammoniacal H_2O_2 ; selenates are estimated as $BaSeO_4$ by using $Ba(ClO_4)_2$ instead of $BaCl_2$.

Fr. Kostečka : Transplantation of tooth germs.

R. Brdička : The application of the polarographic protein reaction for cancer diagnosis. The polarographic estimation of proteins in blood serum shows that the results in cases of cancer are distinctly lower than in normal cases, provided that time is allowed for the denaturation of the proteins.

J. Goll : Metallography of nickel ores from Dobšina.

K. Žebera : The Cretaceous formation at Kladno.

Fr. Fučíková : An anthropometric contribution to rib morphology.

March 12, 1937.

Fr. Němejc : The cone called Discinites Feistmanteli.

J. Wolf : The surface relief of resorption cells.

E. Votoček : The carbohydrates of papyrus pith (*Cyperus papyrus*).

E. Votoček and R. Muller : New reagents for the identification of ketoses.

E. Votoček and O. Wichterle : Additive products of hydrocyanic acid, glycosylarylamines, and glycosylpiperidines.

B. Němec, J. Babička and I. Smoler : Spectroscopic and chemical estimation of gold in plants. The amount of gold in the ashes of various plants was determined, and found to be surprisingly high in some specimens.

Z. Kocher : The influence of higher sulphonated alcohols on the resorption through the epithelium of the gastro-intestinal tract.

J. Korous : Development of the functions of one real variable into a series of certain orthogonal polynoms.

V. Rypáček and T. Martinec : Dependence of the titration acidity of soil suspension and soil filtrate on the size of the soil particles.

R. Kettner : Geological structure of the northern slope of Kralova Hole near Liptovská Teplička (Low Tatras).

Forthcoming Events

Thursday, April 7

BRITISH MEDICAL ASSOCIATION, at 8.—Dr. H. Crichton-Miller: "Mental Health as a National Problem" (Sir Charles Hastings lecture).

INSTITUTION OF NAVAL ARCHITECTS, April 6–8.—Annual meeting to be held at the Royal Society of Arts, John Street, Adelphi, W.C.2.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

PROFESSOR OF EDUCATION in the University of Cambridge—The Vice-Chancellor (April 18).

LECTURER IN HYGIENE AND BIOLOGY in the Avery Hill Training College, London, S E.9—The Education Officer (H.2/1), County Hall, London, S E.1 (April 30).

UNIVERSITY LECTURER IN GEOGRAPHY in the University of Cambridge—Dr. F. C. Phillips, Department of Mineralogy and Petrology, Cambridge (April 30).

UNIVERSITY READER IN MATHEMATICS in the Imperial College, Royal College of Science—The Academic Registrar, University of London, Senate House, London, W.C.1 (May 2).

DEMONSTRATOR AND ASSISTANT LECTURER IN CHEMISTRY in the Royal Holloway College, Englefield Green, Surrey—The Principal (May 7).

JUNIOR LECTURER IN METALLURGY in the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (May 31)

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol 21 (N S), No. 57: Conidia from Infected Bud-Scales and Adjacent Wood as a Main Source of Primary Infection with the Apple Scab Fungus *Venturia Inaequalis* (Cooke). By R. McKay. Pp. 623–640+19 plates (Dublin: Hodges, Figgis and Co; London. Williams and Norgate, Ltd.) 2*s*. [93

Board of Education: Science Museum. One Hundred Years of Transatlantic Steam Navigation, 1838–1938: a Brief Outline of the History and Development of the Atlantic Ferry since the Advent of the Steamship, as illustrated by a Special Exhibition at the Science Museum. By H P. Spratt. Pp. 24+3 plates. (London: H.M. Stationery Office.) 6*d*. net. [93

National Physical Laboratory. Notation for Piezo-electric Quartz. Pp. 10. (London: H.M. Stationery Office.) 3d. net. [93

Student Health: the Report of an Inquiry into University Health Services by the National Union of Students. Pp. 104. (London: National Union of Students.) [93

University of Sheffield. Report on Research Work carried out in the Departments of Mining and Fuel Technology during the Session 1936–1937. Pp. 20. (Sheffield. The University.) [103

Proceedings of the Royal Irish Academy. Vol. 44, Section A, No. 5. On the Uncertainty Relations in the Measurement of Space–Time By R. W. Ditchburn and H. Motz. Pp. 45–76. 1*s*. Vol. 44, Section A, No 6: The Creation of Electron Pairs by Nuclear Capture of Neutrons By H. S. W. Massey. Pp. 77–86. 1*s*. Vol. 44, Section A, No. 7 Negative Ions in Discharge Tubes. By K. G. Emeleus and J Sayers. Pp. 87–100. 1*s*. Vol. 44, Section A, No. 8: On Functions of Quaternions. By Dr V. C. A. Ferraro. Pp. 101–108. n.p. Vol. 44, Section B, No. 5: The Geology of the Rathmullan District, Co. Donegal By William J. McCallien. Pp. 45–60+3 plates. 1*s*. 6*d*. Vol. 44, Section B, No. 6. The Mammals of Ireland. By C. B. Moffat Pp. 61–128. 2*s*. 6*d*. (Dublin Hodges, Figgis and Co.; London. Williams and Norgate, Ltd.) [143

Economic Proceedings of the Royal Dublin Society. Vol. 3, No 6: The Rôle of Albumen in Cheese-Making. By G. T Pyne and L ó Droma. Pp. 75–82. (Dublin. Hodges, Figgis and Co.; London Williams and Norgate, Ltd.) 6*d*. [153

Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N S.), No. 58. Annual Changes in the Osmotic Value of some Arctic and Temperate Plants. By Elizabeth Mary Wager and Dr. Harold Geoffrey Wager. Pp. 641–653. (Dublin: Hodges, Figgis and Co., London. Williams and Norgate, Ltd.) 1*s*. [153

British Museum (Natural History). Great Barrier Reef Expedition 1928–9. Scientific Reports, Vol. 6, No. 1: The Larvae of the Decapod Crustacea Palaemonidae and Alpheidae. By Dr Robert Gurney. Pp. 60. (London: British Museum (Natural History).) 5*s*. [163

Report of the Marlborough College Natural History Society for the Year 1937. Pp. 63. (Marlborough: Marlborough College Natural History Society.) Members, 3*s*.; Non-members, 5*s*. [163

Other Countries

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 18, No. 11 (Mathematics No. 26). Beiträge zur Geometrie der Kreise und Kugeln (20) Von Sozi Matumura. Pp. 241–256. Vol. 18, No. 12 (Mathematics No. 27): Beiträge zur Geometrie der Kreise und Kugeln (21). Von Sozi Matumura. Pp. 257–274. (Taihoku: Taihoku Imperial University.) [78

Studies from the Connaught Laboratories, University of Toronto. Vol. 9, 1937. Pp. v+50 papers. (Toronto: University of Toronto Press.) [73

Journal of the Indian Institute of Science. Vol. 20A, Part 12. Hydrogenation of Oils by the Continuous Process. Part 1: Hydrogenation of Groundnut Oil by Catalysts of Nickel and its Alloys. By V. T. Athavale and S. K K. Jatkar Pp. 95–110. 1.4 rupees. Vol. 20A, Part 13: Activation and Clarifying Properties of Fuller's Earth. Part 2: The Decolourising Action of some Indian Fuller's Earths. By B S Kulkarni and S. K. K Jatkar. Pp. 111–118. 12 annas. Vol. 20A, Part 14. Activation and Clarifying Properties of Fuller's Earth Part 3. Bleaching of Safflower Oil by Fuller's Earths. By B. S. Kulkarni and S. K K. Jatkar. Pp. 119–124. 10 annas. (Bangalore Indian Institute of Science.) [73

Ochrona Przyrody. Organ Państwowej Rady Ochrony Przyrody. Rocznik 17. Pp. vi+361. (Kraków: Państwowa Rada Ochrony Przyrody.) [73

Reports of the Biochemical Research Foundation of the Franklin Institute. Vol 4, 1936–1937. Pp. iv+25 papers+xxvi (Philadelphia: Biochemical Research Foundation of the Franklin Institute.) [83

Conseil International des Unions Scientifiques: Union Géodésique et Géophysique Internationale: Association de Séismologie. Publications du Bureau Central Séismologique International. Série A. Travaux Scientifiques. Fasc. No. 15, 2e Partie (Communications présentées a la Conférence d'Édimbourg, Septembre, 1937) Pp 115–333+1 plate. (Nogent-Le-Rotrou: Imprimerie Daupeley-Gouverneur.) [93

U. S. Department of Agriculture. Technical Bulletin No. 596: Composition and Fractionation of American Steam-Distilled Wood Turpentine. By S. Palkin, T C. Chadwick and M B. Matlack. Pp. 30+1 plate. (Washington, D.C.. Government Printing Office) 5 cents. [93

Kungl. Sjokarteverket, Jordmagnetiska Publikationer Nr. 11 Earth Magnetic Researches along the Coasts of Sweden. Part 2: Dip, Horizontal Force and Vertical Force at the Epoch July 1, 1929. By Gustav S. Ljungdahl. Pp. 49+4 plates. (Stockholm: Statens Reproduktionsanstalt.) [93

Geological Survey of British Guiana. Bulletin No. 6: 1. Report on the Groete Creek and Mariwa Goldfields of the Lower Essequibo and Lower Cuyuni Rivers, by Dr. D. A. Bryn Davies, 2. Report on the Occurrence of Manganese Ore at Saxacalli, Lower Essequibo River, by D. W. Bishopp. Pp. ii+17+ii+4+7 maps. (Georgetown. Geological Survey of British Guiana.) 24 cents. [93

Fiskeridirektoratets Skrifter, Serie Havundersøkelser (Report on Norwegian Fishery and Marine Investigations, Vol. 5, No. 4: Rekefisket som Naturhistorie og Samfundssak. Av Johan Hjort og Johan T. Ruud. With an English Summary. Pp 158. (Bergen: A.s John Griegs Boktrykkeri) [93

Ministry of Agriculture, Egypt. Technical and Scientific Service. Bulletin No. 189: Egyptian Cotton: Studies in Spinning and Growing, 1935–36 By H A. Hancock. Pp. v+58+13 plates. P T 10. (Cairo: Government Press.) [93

Annales Bryologici: a Year-Book devoted to the Study of Mosses and Hepatics. Edited by Fr. Verdoorn. Vol. 10, 1937. Pp. iv+160. (Leiden. Chronica Botanica Co.) [93

Universidad Nacional de Tucumán. Departamento de Investigaciones Regionales. Lilloa: Revista de Botanica. Tomo 1. Pp. 413+61 plates. (Tucumán: Universidad Nacional.) [103

Australasian Antarctic Expedition, 1911–14. Scientific Reports. Series C: Zoology and Botany. Vol. 2, Part 2: Isopoda and Tanaidacea. By Herbert M. Hale. Pp. 45. 6*s*. 6*d*. Vol. 2, Part 3: Ticks (Ixodoidea). By Prof. T. Harvey Johnston. Pp. 19. 3*s*. Vol. 2, Part 5: Amphipoda Hyperiidea. By Dr. K. H. Barnard. Pp. 4. 1*s*. 6*d*. Vol. 3, Part 4: Rhabdopleura. By Prof. T. Harvey Johnston. Pp 8. 2*s*. 6*d*. Vol. 10, Part 4. Cestoda. By Prof T. Harvey Johnston. Pp. 74. 10*s*. Vol. 10, Part 6: Acarina. By H. Womersley. Pp. 24+11 plates. 6*s*. (Sydney: Government Printer.) [143

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok. 17, 1935, 3. Vattenstånden vid Rikets kuster. Pp. 23. 2.00 Kr. 17, 1935, 4 Meteorologiska iakttagelser i Sverige, Band 77. Pp. x+107. 7 00 Kr. 18, 1936, 5. Hydrografiska mätningar i Sverige. Pp. 12. 3.00 Kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [143

Department of Agriculture. Straits Settlements and Federated Malay States. Observations on Stem-Rot of the Oil Palm By A. Thompson. Pp. ii+28+14 plates. (Kuala Lumpur: Department of Agriculture.) [143

176de Beretning fra Forsøgslaboratoriet. Stuefluen (*Musca domestica*) og Stikfluen (*Stomoxys calcitrans*): Undersogelser over Biologi og Bekoempelse samt en Oversigt over andre til Hysdyr eller Boliger knyttede Fluearter. By Prof. Mathias Thomsen. Pp. 352+13 plates+xlii. (Copenhagen. I. Hovedkommission hos fli. August Bangs Forlag.) [153

Lunds Universitets Årsskrift, N.F. Avd. 2, Bd. 34, Nr 7: Kungl. Fysiografiska Sallskapets Handlingar, N F. Bd. 49, Nr. 7. Meddelande från Lunds Astronomiska Observatorium, Ser. 2, Nr. 93: Positions of 75 Stars supposed to be Members of the Taurus Cluster By Helge Nordstrom. Pp. 17. (Lund: C. W. K. Gleerup; Leipzig: Otto Harrassowitz.) 1 kr. [163

Annals of the Observatory of Lund, No. 7. Contributions to the Photographic Study of Colour, Resolution and Total Magnitude of Anagalactic Objects, with special regard to Objects photographed at Helwan. By Bjorn Svenonius. Pp. 160+16 plates. (Lund: The Observatory.) [163

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Blood and Soil

THE history of mankind is largely a story of the conflict of man's ideals, or, as the cynic would say, of his illusions. Of these the most potent, and in the long run the most enduring, are those affording the herd instinct fullest opportunity for play. This instinct, binding individuals by a bond of brotherhood in communities armed at all points for attack and defence, is at once self-regarding and altruistic. Appealing to both sides of human nature, in the struggle for existence it is the most effective of all the means of survival.

Among manifestations of the herd instinct the concept of 'race' has played a greater part in the development of modern civilization than any other factor, except perhaps religion. It is capable of wide extension ; and on occasion it over-rides the closest and most intimate ties, even, paradoxically enough, those of the family, from which it takes its origin. For the apotheosis of 'race', which is the very heart of the aggressive nationalism of modern Europe, derives the strength of its appeal, not so much from tribal origins, as from the blood-call which goes back to the intimate association of the primitive individual family and its blood-relationship. It is this tie which by a process of enlargement provides the binding force and the emotional colour in the progression of social organization from family to kin, tribe, people and nation ; and when transferred from the group to the territory it occupies, is capable of inspiring the noblest self-sacrifice and deeds of the loftiest patriotism. Cultural association and religious tradition undoubtedly play their part ; but the ever-recurrent theme is the blood-tie.

Recent events in Central Europe have demonstrated how the racial idea could add dynamic force to a political movement for which neither historic tradition nor economic advantage had inspired adequate enthusiasm. In his speech before the Reichstag on March 18, Herr Hitler, reviewing the course of events of the preceding week, described the incorporation of Austria in the German Reich as "a racial triumph", and the culmination of a movement of "national-thinking people—to set up in place of a lying democratic violation of a people, the more holy rights of the eternal racial life". The sanctity of the racial life is to be further impressed on the population by the extension forthwith of German racial legislation to Austria.

To those who hold to the ideal of individual liberty and freedom of thought as the fundamental principle in intellectual and social progress, though they may admit the dynamic force inspired by a thoroughgoing acceptance of the racial idea, the intolerance, arrogance and injustice apparently inseparable from the discriminations of racial doctrine, when harnessed to political action, are wholly repugnant. What could be more significant as an example of the repression of individual judgment and the arrogant assumption of a right to eliminate the free expression of opinion, than Dr. Goebbels' own words, commenting on the statement that criticism was not allowed in Germany. They had no objection to criticism, he said, but it must be criticism from the superior to the inferior (*The Times*, March 23).

Germany does not stand alone. Wherever in social contacts discrimination has been imposed on the basis of racial groupings or the colour line—purely physical distinctions, be it said—these distinctions are made, unjustifiably, an imputation of innate inferiority, both intellectual and moral, in the excluded race or group. So it is said by a member of a people so highly race conscious as the Japanese, "From the fact of the divine descent of the Japanese people proceeds their immeasurable superiority to the natives of other countries"; thus the scholar Hirata, while the learned publicist, Dr. Uesugi Shinkichi, holds "it is now most clear that the salvation of the entire human race is the mission of our Empire".

Aryan doctrine perhaps has not yet gone so far as this except by implication, though its upholders maintain that all progress in civilization has been the work of the Aryans, of whom the German people as Nordics are the characteristic modern representatives. No student of European prehistory and ethnology, outside Germany, could endorse this claim. It is not known either that the Aryan-speaking peoples were racially homogeneous, all conforming to the Nordic type, nor would it be accepted as probable that a nomad pastoral people, such as the Nordics on their first appearance on the scene, were pioneers of a higher culture, when they impinged, for example, on the Minoan civilization of the Mediterranean, or the 'Dravidians' of India.

The discussion of innate racial superiority and inferiority in mental character is bootless. Too little is as yet known of racial psychology to justify a correlation of mental and physical characters, which would warrant the imputation of mental and moral superiority or inferiority in certain types of physical make-up. Even difference in cultural level—the state of backwardness—has yet to be shown to be a sign of inferiority in innate intellectual calibre. Investigation, so far as it has gone, affords no sufficient ground for the conclusion that 'primitive' peoples are intellectually stunted, even though their mental processes are environmentally conditioned; and it would be difficult to accept any assumption of inferiority where the members of the two racially contrasted groups have grown up and lived in an identical cultural environment, as have most of the Jews who have been expelled or excommunicated of late years in Central Europe. Even if, however, it were possible to correlate certain types of mental character with racial characters, the doctrine, if carried to its logical conclusion, demands purity of racial type, which, indeed, German policy would now seem to regard it as its aim to make coterminous with 'nation'. But most anthropologists hold the 'pure' race a fiction, while 'the racial type' in this context can only be regarded as an ideal, towards which peoples are continually evolving. This is apparently the view of Sir Arthur Keith, when he maintains that a race is a nation in the making. Even in Germany, however, though the extent of the broad-headed element has been consistently minimized, the existence of mixed types has always been admitted; while even recently it has been advanced that a blonde pigmentation is not an essential criterion of Aryan descent. In fact, in the theory of a pure Aryan race, of which the Germans are the descendants, Nazi doctrine appears to have slipped into the familiar fallacy of translating the ideal at which it aims into a pseudo-historical fact of the past.

To be of any scientific value, 'race' as an entity must be susceptible of exact definition; but anthropologists are by no means agreed as to the criteria and precise value of the term. That there are such differences in physical character and appearance between individuals as to afford a strong presumption of ancestry and origin, and, therefore, in that partial sense racial, is a matter which, as Sir Arthur Keith is fond of pointing out, can be verified by anyone who walks down the street. If, however, an attempt is made to analyse the basis of this judgment, more often than not it will be found to depend to a large extent upon colour, primarily of the skin, then of hair, and then eyes. An entertaining and instructive exercise is to imagine a white skin on some of our darker fellow-subjects encountered in street and train. It is surprising to find how often even an African might in feature pass for European, if the lips are not too thick. Yet there may be nothing to suggest European admixture. At the same time the Mongolian fold over the eye usually betrays the eastern Asiatic; yet occasionally it is found with other Mongolian facial characters in Europeans, both normal and abnormal.

On one fact anthropologists are agreed. Modern man belongs to one species, *Homo sapiens*, and that in this species are many varieties, or races, but that none of these can now be regarded as 'pure'. For purposes of classification and analysis, these varieties are grouped in terms of type, according to physical characters recorded by measurement and descriptive observation; but these racial types are abstractions for methodological convenience. When this type classification is applied to observation in the field, it is found that any given group no more than tends to conform to type within a certain range of variation. In effect, man is the most variable of all animals. The most that can be said of the races of man is that within the range of his variation at certain points certain physical characters show a tendency to become dominant, forming a nucleus, which for purposes of convenience is regarded as a racial type.

It by no means follows that this type is either universal within its area, or confined to it. In Europe, for example, Nordic, Alpine, Mediterranean may be the dominant types within the regions from which they take their respective names, but they are inextricably intermingled in varying proportions throughout the whole continent. Nordics and Alpines appear in Mediterranean lands, dark and broad-headed among the long-headed, blonde Scandinavians. For from the dawn of civilization, Europe has been swept from end to end by racial migrations and invasions, which have left their legacy in an inheritance of fused racial characters, while in modern times facilities of transport and a freedom of intercourse in international relations have further tended to confuse the geographical distribution of physical type and racial distinction. In these conditions the racial type becomes a theoretical postulate and purity of race a claim without counterpart in fact. Nor do these conditions prevail in Europe alone. Ever since time began, man's wanderings and his conquests have tended to obliterate distinctions which isolation, inbreeding and tribal prejudice promoted and preserved, until only broad distinctions remain valid.

Acceptance of the strict biological view of race and the inheritance of physical characters in man does not preclude recognition of the patent fact that there are differences, some of them considerable, between the national and other local groupings of man which afford ostensible support for nationalist doctrine ; but they are due to environmental conditions rather than a physical inheritance. If, moreover, in physical character modern man is specifically one, it is no unfair assumption, unless due cause is shown to think otherwise, that in mental character man is also one, and that underlying cultural differences, which can be shown to be due to environmental and historical causes, there is a psychic unity, which can at need transcend nationalist and other separatist influences. In science, for example, man speaks a universal language and joins in a world-wide activity.

It is evident that in the development of the social organism from the primitive horde or individual family to the nation, the differences between local and other groupings have been subordinated to such elements as they have in common, in order that other groups, ever increasing in size and complexity, may be formed, in which, when once internal harmony has been established, the good of the whole may be pursued. Out of such groupings for a common end the modern civilized nations have arisen ; and there is no inherent reason, so far as scientific studies of the growth of societies would go to show, why development should come to an end at the point which it has now reached. There have been, in fact, in recent years two experiments in carrying development further. Of these one is the British Commonwealth of Nations, which has still to be submitted to a crucial test, the other the League of Nations, which, apart from its more widely advertised political action, has done a great work in science, economics and social reform for the advancement of the interests of mankind at large. In these fields of its activity, racial and national differences have proved no bar to co-operation, even though the time is not yet ripe for the joint political action which it was hoped that the League would promote. It is to some such larger unity that the scientific analysis of the history of human associations would appear to point as the goal of the future, rather than to an antagonism of rival national or racial entities, engaged in a struggle which belongs more properly to a pre-social stage of development.

In its origins science is one form of the response to man's eternal quest for law and order in the universe ; but from the earliest times it has also served his material needs. When primitive man first observed the ordered movement of the stars, it was not so much in satisfaction of a divine curiosity, as from the desire to arrive at some such law of seasonal progression as would enable him so to order his life as to ensure the proper care of flocks and herds and the sowing and harvesting of his crops ; and so in the world of modern civilization. Knowledge may be pursued for its own sake, but it is no less the function of science to share in that planning for the future, which the development of social and economic organization makes more and more imperative every day. If, however, the study of man, his kinds and varied modes of life is to contribute to the solution of our problems, as it is only reasonable to anticipate, it must be as a study based on impartial and objective observation of fact, and not the forcing of fact to fit a biased and distorted political dogma born of fear and hatred—a science travestied in masquerade.

Health Services of Great Britain

Report on the British Health Services:
a Survey of the Existing Health Services in Great Britain with Proposals for Future Development. (P E P (Political and Economic Planning).) Pp. iv + 430. (London: Political and Economic Planning, 1937.) 7*s.* 6*d.* net; cloth, 10*s.* 6*d.* net.

THIS large and heavy book of 430 quarto pages, said to contain 200,000 words, is described by its anonymous authors as a survey of the existing health services in Great Britain, with proposals for future development. The writers constitute an independent, non-party group of industrialists, distributors, local government officials, medical men, university teachers, and so forth, "who give part of their spare time" to social and economic studies, and issue fortnightly 'broad-sheet' plannings.

Early in the nineteenth century, the sanitary services of Great Britain were strengthened and invigorated by the introduction, and ultimately the Parliamentary imposition, of what have come to be known as 'special medical services'. It was a new factor or method of dealing with the national ill-health. Speaking generally, it began with the Poor Law medical service, originating in the Elizabethan period, and that deeply instructive movement led on to factory and workshop reform dating from 1802, to the registration of births and deaths, vaccination, and official inquiries into the causes of epidemic disease. It found legislative expression in a long series of Public Health Acts, the development of 'the sanitary idea' and the beginnings of a 'sanitary conscience'. It was Disraeli who coined his party's watchword, *sanitas sanitatum et omnia sanitas*; and it was Sir John Simon who gave us the classic record of the administrative rise of "English Sanitary Institutions" in 1890.

The foundations of all the British health services were laid before the present century opened, yet it was not until after the great Education Act of 1902 that they took their present form, the form which is discussed in this volume. But there can be no wise or mature consideration of their existing basis or purpose without a historical understanding of their origin. In our own day, and particularly since the Liberal Government of 1906, there has been wide and rapid growth of these services. The feeding and medical supervision of school children, maternity and child welfare, old age pensions, health insurance—with 19,000 panel doctors and nineteen million insured persons —a vastly enlarged hospital service (voluntary and municipal), industrial health, a reorganized medical profession, medical education, dentists, official midwives, nurses, sanitary inspectors, physical education, organized research—all this is novel and in the early process of initiation and administration.

No responsible body has previously attempted the very formidable task of showing how these services work, are co-ordinated, and can be conjunctly developed. This compilation furnishes a mine of important and interesting information, derived in the main from official reports, local and central. It is an encyclopædic summary, made lively by numerous criticisms, not all equally valid or well conceived. Indeed, occasionally it would appear that the writers would greatly enjoy the task of re-creating *ad hoc* the growth of two centuries, not only of Parliamentary legislation but also of the will and education of the English people. In which case it may be added that they are not alone, in Great Britain or in Russia.

More than fifty years ago, one of our foremost statesmen, trained in a long experience of the diplomatic service, reminded us that the basis of all government and the object of all statesmanship must always be *expediency*—that which is, on the whole, best for the entire community. He urged that the test of statecraft is not truth or falsehood, but good or evil. All political action, in his view, was good or bad, right or wrong, according to its consistency not with theory but with *circumstance*, and such circumstance is not simple, uniform, general or consistent, but infinitely varied, fluctuating and divergent. We cannot, he said, apply to courses of political action or administration the methods which are properly applicable to trains of reasoning, for the object of the latter is to arrive at abstract truth, of the former to bring about concrete good of a particular kind for a particular multitude of human beings, whose condition is extremely composite and whose interests are rarely identical. "Government", he believed, "is neither more nor less than the trustee or guardian of the collective interests of a State. Institutions are not made, they grow, not logical, simple or symmetrical, but various, intricate and full of salutary anomalies". Hence in a general review of statecraft it is prudent to proceed with caution, and have regard to history, experience, circumstance and expediency; and, especially when dealing with the administration of science and the scientific method, to keep in mind the existing state of science itself.

This summary of the existing health services of Great Britain, official and voluntary, is the best we have seen, and its compilation ought to serve and assist all who are actively concerned in actual administration. It is unfortunate, perhaps, that it is inadequately documented and lacks a bibliography. The reader is left with a large volume by an anonymous, and apparently self-appointed, group of zealous students, and without reference to the sources of information. The book itself is clear evidence of the competence of its writers and the reader is assured of the authenticity of their resources. We rather agree, however, that such a survey should have been undertaken by an officially appointed or approved body, and not anonymously. Its appeal is mainly to the local authorities and their officers, who are accustomed to the English practice of signed reports by responsible persons. But in any event, here is a book which provides the reader and student with a most valuable, instructive and comprehensive presentation of the facts.

For the reason just mentioned, and for other obvious reasons, including finance, we fear the numerous recommendations and proposals made throughout the report, many of them acutely controversial, are less likely of acceptance. The public will naturally consider the suggestions regarding the medical profession as a matter primarily for its members, through the General Medical Council and the British Medical Association; midwives, nurses and dentists have also quite recently received much Parliamentary attention; nutrition and physical education are, it is to be hoped, fairly on the way to reform; the various suggestions for the improvement of health insurance have already been before a Royal Commission; and some of the more abstruse medical problems await further knowledge and experience.

We welcome the interest of the writers in the importance of medical research. Certainly, there is always need of more knowledge. Yet in a single generation we have witnessed, at any rate since 1911, a great awakening and an ever-extending appreciation of that need. The fundamental difficulty is lack of researchers, for true research can only be done by those who have the talents and experience which especially fits them for it. Often, the indirect approach is the more effective; the human body is immeasurably complex and all sciences affect the issue, which is rarely medical only. Physics, statistics, biology, geology, may be as material as physiology or pathology, and the relation of the sciences to each other and to the whole is highly relevant to the acquisition of more knowledge. Facility and opportunity—ways and means and money—are rapidly becoming more available. New and further knowledge cannot be gained by pressure or administrative organization. Even now much scientific knowledge awaits application rather than elucidation. Nor is there any doubt that it is common knowledge among responsible officers in the health services that health and ill-health bear intimate relation to social condition, economics and psychology, and this is now more appreciated than formerly.

Organo-metallic Compounds

Die Chemie der metall-organischen Verbindungen

Von Prof. Dr. Erich Krause und Prof. Dr. Aristid von Grosse. Pp. xvi + 926. (Berlin: Gebrüder Borntraeger, 1937.) 55.20 gold marks.

FROM the time of their discovery, the organo-metallic compounds have aroused particular chemical interest. The manner in which they were first encountered was dramatic. Edward Frankland, working in Bunsen's laboratory in 1849, was attempting to isolate the radical methyl by heating methyl iodide with zinc in a sealed tube. "After discharging the gases" he says ("Sketches from the Life of Sir Edward Frankland", p. 186), "I cut off the upper part of the tube in order to try the action of water upon the solid residue. Upon pouring a few drops of water upon this residue, a greenish-blue flame, several feet long, shot out of the tube, causing great excitement in the laboratory. Bunsen, who had suffered from arsenical poisoning during his researches on cacodyl, suggested that the spontaneously inflammable body might be that terrible compound formed by arsenic present in the zinc as an impurity, and that I might be already irrecoverably poisoned."

Fortunately Bunsen was wrong. The inflammable compound was not cacodyl but zinc methyl, and Frankland survived the incident by more than fifty years. The discovery of the alkyl compounds of zinc was quickly followed by that of similar derivatives of mercury, tin and antimony, and consideration of these substances led Frankland to make his great contribution to chemical theory—the law of valency.

At the beginning of the present century, two events gave a powerful stimulus to the investigation of organo-metallic compounds. These were

Grignard's discovery in 1900 of the organo-magnesium halides, and that of Ehrlich in 1907 of salvarsan. The extraordinary value of the Grignard compounds as synthetical reagents led to their exploitation in all possible directions and brought notable advances in many fields of organic chemistry, whilst Ehrlich's discovery laid the foundation of the new science of chemotherapy, and by inspiring the search for new therapeutic agents led to an active investigation of the organic derivatives not only of arsenic but also of mercury and antimony. Of some 12,000 known organo-metallic compounds, about 8,000 are derivatives of arsenic.

The most abundantly utilized organo-metallic compound is lead tetraethyl ('Ethyl'), on account of its 'antiknock' properties discovered by Midgeley in 1922. More than 70 per cent of the petrol consumed in the United States for automobile propulsion in 1936 had received an addition of lead tetraethyl, and the annual consumption of this compound in the U.S.A. alone amounted to some 20,000 tons. In Germany, however, iron pentacarbonyl ('Motalin') is chiefly employed as an antiknock.

Of the purely scientific applications of organo-metallic compounds probably the most striking is that made in Paneth's work on the thermal decomposition of the alkyl compounds of lead and bismuth, by which it was shown that the radicals methyl and ethyl are capable of independent though brief existence.

The book under review is a treatise of more than 900 pages. Organo-metallic compounds are defined as containing a metal linked by a principal valency to the carbon of a hydrocarbon radical. Co-ordination compounds are thus excluded, but arsenic and tellurium are counted as metals and the alkyl compounds of oxygen, sulphur and selenium, and of the halogens, nitrogen and phosphorus are shortly described for comparison.

The derivatives of the four elements the organic compounds of which have been most extensively investigated—magnesium, mercury, arsenic and antimony—are treated in considerable detail (for example 143 pages are devoted to arsenic compounds) but are not dealt with exhaustively, since this is naturally impracticable within the limits of a single volume (and the authors suggest that it is the less necessary since excellent monographs dealing with these elements are already available.) They claim, however, that of the remaining metals, all known compounds are included so far as they appear in the literature abstracted in the *Chemisches Centralblatt* down to January 1, 1936.

Physical data are fully recorded, but the authors deplore that the only properties which have been hitherto at all extensively determined are boiling points, melting points and densities. They point out that the alkyl compounds of the elements, providing a series of mostly normal liquids, free from disturbing effects of association and co-ordination, form material of exceptional value for the study of the variation of the combining properties of the elements over wide regions of the periodic table, and they stress the desirability of obtaining more complete data derived from the newer methods of investigation (for example, Raman spectra, at present available only for limited groups) in order to enable a general comparison of the more fundamental properties of the links which the elements form with alkyl groups.

A chapter is devoted to theoretical considerations on the organo-metallic compounds. Of the ninety known elements, only about forty form alkyl derivatives. The transition elements lack the power of combining with hydrocarbon radicals, for of the forty-two elements of this category only two—platinum and chromium—have been definitely found to yield alkyl or aryl derivatives. The authors correlate this with the fact that the transition elements, unlike other elements, have their valency electrons distributed between two principal quantum groups. In titanium, for example, which forms no organo-metallic derivatives, two of the four valency electrons are in the M- and two in the N-shell. To explain the incapacity of such elements to combine with hydrocarbon radicals, the authors suggest that when the valency electrons are in two principal quantum groups, those with the lower principal quantum number yield antibonding molecular orbitals. This explanation is conceivable, but scarcely probable. The transition elements differ from other elements in having d-electrons among their valency electrons, and it may be that the character of the d-wave functions is such that they do not combine with s-wave functions to give bonding orbitals of the necessary strength. In any event the explanation is likely to be more subtle than that suggested.

The descriptive parts of the book are well and clearly arranged, and the experimental aspects of the subject receive special attention. Detailed directions are given for the preparation of representatives of the chief types of organo-metallic compounds, and a number of devices are described that have been found useful in the manipulation of substances which, like so many members of this class, are specially sensitive to atmospheric oxidation.

This treatise is to be commended as a book of reference which should prove most valuable to all workers in the field with which it is concerned.

W. H. M.

Descriptive Zoology

Handbuch der Zoologie:
eine Naturgeschichte der Stamme des Tierreiches. Gegründet von Prof. Dr. Willy Kukenthal. Herausgebenen von Dr. Thilo Krumbach. (Berlin und Leipzig: Walter de Gruyter und Co., 1937.)

(1) Band 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lief. 10, Teil 5. Pp. 7–134. 18 gold marks.

(2) Band 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lief. 9, Teil 2. Pp. 289–384. 12 gold marks. Band 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lief. 11. Pp. 385–496. 16 gold marks.

(3) Band 5, Hälfte 2: Tunicata. Lief. 6. Pp. 545–672. 18 gold marks.

(4) Band 6, Hälfte 1: Acrania (Cephalochorda) = Cyclostoma, Ichthya. Bearbeitet von Dr. Victor Pietschmann. Lief. 5. Pp. 449–560. 14 gold marks.

(5) Band 7, Hälfte 1: Sauropside, Allgemeines; Reptilia; Aves. Lief. 3. Pp. 225–320. 14 gold marks.

(1) THIS well-known general "Handbuch der Zoologie" revives the term Vermes, which has practically ceased to be used in English texts. The Vermes are divided into three groups, the Amera, Polymera and Oligomera. The present part is the first of the section of the book to treat of the Oligomera. This group includes three classes: (1) Tentaculata, that is, the Phoronidea, Bryozoa and Brachiopoda; (2) Sagittoidea (Chaetognatha); and (3) Brachiotremata, that is, the Pterobranchia and Enteropneusta. The first sixty pages contain an introduction to the Oligomera, including a bibliography of general works. The next four pages are an introduction to the Tentaculata in particular, and the last sixty-four pages furnish a complete and most useful account of the Phoronidea up to the first few items of the special bibliography of that group. The whole part contains 150 well-produced figures, a good number of which are original. A curious error has crept in on p. 123. No. 24, *Phoronis pacifica* is correctly stated to be Puget Sound and Humbolt Bay, but on the map point 24 is depicted on the east coast a little south of New York.

(2) Part 9 of this half of the second volume contains 116 illustrations. The first eleven pages conclude the account of the Solifugidæ by A. Kästner and are mainly concerned with the distribution, classification and literature of the group. Ten families in all are recognized and defined, and a useful key for separating them is provided. The bulk of the part is concerned with A. Kästner's account of the Opiliones, up to their geographical distribution.

The first nine pages of Part 11 carry on from Part 9 and conclude the Opiliones. It contains little more than a review of the families and subfamilies, among which the more than 1,400 species of the order are divided, and the list of the relevant literature. The remaining hundred and three pages commence the account of the Araneæ, or true spiders, by U. Gerhart and A. Kästner. It deals in detail with the general morphology, anatomy and histology of the group up to the beginning of the female reproductive organs—the reproductive system being the last to be considered. The part is illustrated with 133 figures, a number of which are original.

(3) In Part 6 of the second half of the fifth volume Dr. Johan Huus deals with the Ascidiaceæ or simple Ascidians. It contains 123 figures, mostly, with the exception of the distributional maps which are original, chosen from the works of previous writers. It completes the account of the structure, physiology and ecology of the sub-class and also a large part of the systematic review of the genera, but does not include the bibliography.

(4) The first hundred and two pages of the first part of volume 6 complete the account of the Cyclostoma by Dr. V. Pietschman. It has thus taken five hundred and fifty pages and 531 figures altogether to deal with this group. Without in any way suggesting that it is an uninteresting or unimportant group, it would seem that such treatment exceeds in length and detail what is usually expected of a "Handbuch". In itself it forms quite a substantial volume, and the various parts together cost 68 gold marks. It is obviously impossible to treat all the groups of the animal kingdom at this length. As it stands, it forms a veritable mine of information and has a most useful bibliography. The last ten pages commence the general account of the Ichthya or true fishes.

(5) The first eleven pages of this part conclude Proj. O. von Wettstein's account of the order Rhynchocephalia. It is naturally based on the genus *Sphenodon*, of which only one living species, *punctatus*, is recognized, although several varieties are described. Brief reference is made, however, to the allied fossil orders, Choristodera and Rhynchosauroidea. The whole account of the order occupies two hundred and thirty-five pages, is illustrated by 174 figures, and terminates with a most useful and full bibliography. The remainder of the part deals with the Crocodilia.

Economic Botany:

a Textbook of Useful Plants and Plant Products. By Albert F. Hill. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. x+592. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 24*s*.

IN this work, the author, who is research assistant in economic botany at Harvard University, deals in an interesting manner with the more important useful plants and plant products of the world from the point of view of their history, cultivation, preparation and utilization. He shows how the three great necessities of life—food, clothing and shelter—as well as a large number of other useful products, are supplied in great measure by plants. Economic plants have been intimately bound up with human existence and have not only played an important part in the everyday life of mankind but have also had a profound influence on the course of history and civilization. Spice plants and the early spice trade afford evidence of this.

The volume consists essentially of four main sections: industrial plants and plant products; drug plants and drugs; food plants; and food adjuncts. Under the first of these are fibres, forest products and resources, tans and dyes, rubbers, gums and resins, essential oils, fatty oils and waxes, sugars, starches and cellulose products. Food plants include cereals, legumes, nuts, vegetables, fruits, spices and beverage plants. Insecticides such as pyrethrum, derris and cube (*Lonchocarpus*), which have assumed increasing importance in recent years, are also dealt with. In all, about eight hundred species are referred to, greater stress being laid on those plants that are of particular importance in the United States. There are numerous photographs in the text, and a full index and bibliography of more important works are given.

Introduction to Theoretical Seismology

By J. B. Macelwane and F. W. Sohon. Part 1: Geodynamics. By J. B. Macelwane. Pp. x+366. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 30*s*. net.

AS the author remarks, "the forces producing earthquakes, the character and structure of the rocks affected, and the permanent displacements occurring in them are geological phenomena". They form the subject of seismology proper, and have been well described in Heck's recent work on "Earthquakes" (see NATURE, March 27, 1937, p. 529). The subsequent course of the waves so produced and the physical properties of the media through which they pass form a distinct branch of science to which the present volume is devoted. Depending to some extent on older works, such as Galitzin's "Vorlesungen über Seismometrie", this book is a summary of lectures delivered by the author. With its companion volume on "Seismometry", by F. W. Sohon, it forms a text-book that will be of great value to students of geophysics.

In the first seven chapters, dealing with stresses and strains in elastic solids and the course of seismic waves through the earth, the treatment is almost entirely mathematical. The last four chapters are, however, of interest to the general reader. They describe the paths of seismic rays, the interpretation of seismograms, and, especially, the methods by which the positions of epicentres and the depths of foci are determined. Many useful tables are given, such as those of the velocities of waves in the different layers of the crust, the positions of important seismological stations, and the notation used in denoting the various phases that appear on a seismogram.

C. D.

Tables Annuelles Internationales de Constantes et Données Numériques:

International Annual Tables of Constants and Numerical Data. 14: Combustion and Detonation of Gases. By Prof. P. Lafitte. Vols. 11–12 (Years 1931–1936), Section 70. Pp. iii+28. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1937.) 16 francs.

THE summary of constants and data relating to the combustion and detonation of gases contained in vols. 7, 8 and 10 of the "Tables Annuelles Internationales de Constantes et Données Numériques" has been brought up to date by Prof. Lafitte in vol. 14, which covers the years 1931–36. This period is noteworthy for many important advances in the subject, inspired to a large extent by Semenoff's development of the chain-reaction theory. Chain mechanisms of hydrocarbon combustion have been suggested by Egerton, Norrish and Lewis, and new phenomena indicative of chain processes have been discovered in relation to ignition, the limits of inflammability and detonation; in addition, there has been a general revision and extension of existing data.

Prof. Lafitte has used excellent judgment in assembling and summarizing the results of this large body of new information. The numerical data are tabulated or are given in the form of curves reproduced on a legible scale, and each of the ten sections into which the volume is divided is accompanied by a comprehensive bibliography. D. M. N.

Contes Lazes

Par Georges Dumézil. (Université de Paris: Travaux et mémoires de l'Institut d'Ethnologie, Tome 27.) Pp. xii+134. (Paris: Institut d'Ethnologie, 1937.) 56.25 francs.

THIS collection of folk-tales from the Caucasus has a double interest. To that of the folk-lore content is added that of the linguistic material. The volume contains a collection of tales related to the author in Constantinople by a young Georgian, a native of Lazistan, in his own language. The themes, for the most part, are familiar, but the tales are told with a delightful naiveté. Some, as the author points out, probably have a literary origin. From the scientific point of view the chief value of the collection lies in the linguistic analysis of the little-known language of Lazistan. The author provides an interline, as well as a running, translation and a grammatical commentary.

Scientific Work of the Drifting North Polar Station*

By P. Shirshov and E. Fedorov

EXACTLY a year ago we were preparing for the press an article on the plans we had made for our scientific work on the drifting icefloe. This article was published after the aeroplanes had landed us at the North Pole. It is pleasant to note that everything we had planned to do before we set out on our expedition has been done. Reality brought us much of the unexpected. In particular, the drift turned out to be more rapid than we had anticipated. In consequence, we were able to carry out observations at a considerably greater number of points than was originally planned. Over a distance of 15°—from the Pole to the 75th parallel—we carried out all the work we had set out to do. From February 1, after our icefloe had split, we were compelled to cease hydrological work, because the winch, which was kept about a kilometre from our tent, was carried away.

Owing to the rapidity of the drift, we were compelled to make more frequent observations than had been planned. To cope with the work was only possible because our colleagues—Papanin and Krenkel—relieved us of all domestic duties, which they took entirely upon themselves. Naturally, work like the measurement of the depths, rotatory and other observations, was carried out by the joint efforts of the four of us. Meteorological observations were carried out by Fedorov and Krenkel.

Every observation we made during the drift had to have an exact position. Therefore we endeavoured to determine our longitude and latitude as often and as carefully as possible. For these determinations we had to measure the height of the luminaries above the horizon. During the 274 days of the drift we took 534 series of measurements, from which we calculated our positions at 143 points. These points served as the basis for the entry of our course on the map. Up to the end of September, for astronomical determinations we made observations of the sun and sometimes of the moon. Later, when the oncoming darkness permitted us to see the stars, we always used the latter for our observations. Cloudy weather sometimes left us without a position for six or seven days at a stretch, but happily this did not often occur.

The study of the movement of the ice covering the surface of the Arctic Ocean was one of the most interesting subjects of our work. During the 274 days, we went from lat. 89° 26′ N. and long. 78° W. to lat. 70° 48′ N. and long. 19° 48′ W., covering 1,134 miles (1,800 kilometres) to the south-south-west (more precisely, a course of 197°) reckoning by the shortest line. The numerous zig-zags and loops, especially in the early days, actually lengthened our course, bringing it up to approximately 2,500 kilometres. Consequently, the average speed of drift of the icefloe was 9·1 kilometres or 5·6 miles a day. Though this was the average speed of our movement, actually the movement varied greatly. There were periods when for two or three days we remained on the same spot, and others when we drifted 23 miles (37 kilometres) per day.

The rapidity of the movement increased as we drew farther to the south. It became especially rapid towards the end of the drift, in January and February. For example, from the Pole to lat. 85° N. (from May to October) the average rate of movement was 2·7 miles a day. From lat. 85° to 80° N. (from October to January) the speed of the drift increased to 4·6 miles a day. In January the average speed had already risen to 11·5 miles, and in February to 12·3 miles a day.

What causes the movement of the ice in the region of the polar basin investigated by us ? A preliminary examination of our observations shows that the ice drifts by the action of the wind blowing in a given spot ; yet at the same time it has a continuous movement (directed in general to the south) which is independent of the local wind. Thus, in calm periods the ice moves to the south. A wind blowing from the north will speed up this movement. Southern winds will retard or even overcome it, and drive the ice to the north. The speed of the ice movement independent of the local wind was about a mile a day near the Pole. Farther to the south it gradually increased, reaching 5–7 miles per day between the 75th and 70th parallels.

On this systematic movement is superimposed the drift caused by the wind blowing in the given spot. The wind is powerless to draw the ice in the direction in which it is blowing. Preventing this is the law by which a body moving on the surface of the earth in the northern hemisphere is inclined to deviate to the right of the direction of its original movement. The ice, obeying this law, deviates to the right of the direction of the wind at an angle of about 40°. The speed of movement of the ice naturally depends on the velocity of the wind. It is interesting to note that their interaction—the "power of the wind to drive the ice"—was not uniform during the whole of our course. Near the Pole the wind drove the ice with a speed equal approximately to one- to two-hundredths of the velocity of the blowing wind. At the end of the drift the action of the wind increased in effectiveness.

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* Received through the Soviet Union Year Book Press Service, 623–624 Grand Buildings, Trafalgar Square, W.C 2.

What causes the movement of the ice southwards independently of the local wind ? It seems simplest to assume the existence in the Arctic Ocean of a surface current which draws the ice. However, the rotatory observations, which will be dealt with in detail later, reveal the opposite. It is not the water which draws the ice, but the moving ice which draws after it the upper layers of the water. Evidently the general weather regime in the polar basin results in the prevalence of northerly and north-westerly winds (again we are calculating the direction in relation to the Greenwich meridian). These winds, predominating over a vast stretch, create a general flow of the ice towards the Greenland Sea.

Observations of currents arising in surface layers of the sea from the action of the drift of the ice were carried out by means of simultaneously lowering two rotators to different depths. The observations were made in series of five to six layers. Forty series of this kind were made. It appears that the ice draws only the uppermost surface layer of water. For example, with an ice-drift having a speed of 0·1–0·15 metre per second, the drift current is obvious at depths of 25–35 metres, and only on rare occasions does it affect the water down to 50 metres. The speed of the current decreases quickly with increasing depths. Whereas at a depth of 5 metres (two metres from the lower surface of the ice) the speed of the current fluctuates from 65 to 100 per cent of the speed of the drift, at a depth of 20 metres the speed of the current does not generally exceed 20–30 per cent of the speed of the ice-drift.

The drift current in the upper layers of the water sets in very quickly after the ice drift has begun, but it ceases as rapidly when the ice drift stops. A rapid and prolonged drift of the ice in any one direction draws after it a considerable quantity of water from the surface layer. An inflow of water follows from adjoining regions to replace it. A reverse current sets in to compensate for the movement of the surface waters from the given region. More often the reverse current is observable immediately underneath the surface layer of water drawn by the drift, that is, at a depth of 50–75 metres. However, during prolonged and rapid drifts, the reverse current embraces a considerably thicker layer, 35–125 metres.

In contrast to the drift current of the surface layer, the reverse current sets in after an appreciable lapse of time following the start of the drift of the ice—usually 12–36 hours. It reaches its maximum speed even later still, not infrequently only after the drift of the ice, which set the masses of water into motion, has ceased. Not infrequently, too, the reverse current continues for a long time, sometimes for several days, after the ice drift has stopped. For example, after a rapid drift to the south-east during August 10–13, the reverse current was observed at a depth of 75 metres up to August 19, that is, five days after the drift had ceased.

Measurements of depth were carried out by the help of a specially constructed deep-water hand-worked winch, equipped with a brake of the Lucas type. Altogether thirty-three observations were made, of which fourteen were at depths of more than 3,000 metres.

Starting from the Pole, up to lat. 86° 40′ our icefloe drifted over a deep hollow with an extremely sloping bottom of a depth of 4,300–4,400 metres. The greatest depth here appeared to be 4,395 metres (position lat. 88° 41′ N., long. 10° W.). Then the bottom commenced to rise—unevenly, with big jumps in depths, varying from 300 to 500 metres over a distance of 30 miles. In this region (up to the 84th parallel) the depths varied from 3,500 to 4,050 metres. At lat. 83° 56′ N., long. 0° 47′ E., we discovered a submarine elevation. The depth here was 2,380 metres. Farther on, from lat. 83° 30′ N. to 81° 50′ N., we again came to a depth of more than 3,000 metres. The greatest depth in this region exceeded 4,160 metres (lat. 81° 53′, long. 6° W.). The whole of the cable then on the drum was paid out but failed to reach the bottom. The existence of great depths in this region is of special interest in view of their proximity to Greenland. It was generally supposed that the depths here were those of the continental slope ; actually there were deep hollows situated only forty miles from the North East Foreland.

The next measurement (at lat. 81° N., long. 6° 50′ W.) was carried out on the so-called Nansen threshold. The depth here was 1,420 metres. We know that it used to be supposed that here, between Spitsbergen and the North East Foreland, the sea bed rose to within a thousand metres of the surface, thus dividing the Arctic Ocean from the Greenland Sea. However, we maintain that the depth here is no less than 1,300–1,400 metres, and that, quite probably, the depths in the central parts of the Nansen threshold reach 2,000 metres.

In the Greenland Sea the icefloe drifted over the coastal platform. Here the depths were 160–250 metres, reaching 320 metres in one spot only.

Samples of the bed were taken at eight northern soundings with the aid of a scoop. The ground in the deep hollow of the polar basin is composed of oceanic silt of a reddish-brown colour. Under this layer of silt is grey silt. We have brought samples of these deposits with us for further analysis.

The thirty-eight hydrological soundings made by us during the period of the drift represent the two hydrological sections, from the 89th parallel to Greenland, and in the Greenland Sea to the 76th parallel.

During his drift in the *Fram*, Nansen discovered under a comparatively thin layer of cold Arctic water a powerful layer of water of Atlantic origin with positive temperatures. In 1935 the same water was encountered to the north-west of Severnaya Zemlya (Northern Land) by the Ushakov High Latitude Expedition in the *Sadko*. Lastly, the expedition in the *Krasin* in the same year, 1935, also discovered water with a positive temperature to the north of Herald Island. But all these instances relate to the borders of the polar basin, and it might have been presumed that the Atlantic water penetrating to the Arctic Ocean was pressed by the deflective action of the earth's rotation to the right, towards the Eurasian mainland. However, our investigations have shown that the Atlantic water flowing into the Arctic Ocean between Greenland and Spitsbergen in a powerful current reaches the Pole, apparently spreading extensively through the greater part of the polar basin.

At all the soundings, under the comparatively thin layer of cold Arctic water with negative temperatures common to polar seas, a layer was found with positive temperatures and of considerably greater density than the water of the surface layers.

At soundings taken to the north of the 86th parallel, the upper negative isotherm is at 250 metres, the lower at 750 metres. Thus the thickness of the layer of water with positive temperatures in the region near the Pole reaches 500 metres. The maximum temperature in this region is 0·77° C. (at a depth of 400 metres). Farther on, to the south, between the 86th and 85th parallels, the negative isotherms separate—the upper rising to a depth of 200 metres and the lower dropping somewhat deeper—to 750 metres. Thus the thickness of the layer of Atlantic water here increases. There is an increase also in the temperature of the water: plus 1° C. at a depth of 400 metres, and 0·88° at a depth of 250 metres. Farther to the south the layer of Atlantic water becomes more powerful, and the maximum temperature rose to 1·72° C. (at a depth of 250–300 metres).

At the 81st parallel we came out to the edge of the current of Atlantic water. The isotherms converged sharply as we drew nearer to the North East Foreland of Greenland.

The deep layers were filled with water of temperatures and salinity common to oceanic depths. In the layer at the bottom we observed somewhat higher temperatures—common to all deep oceanic hollows. At a depth of 4,390 metres the temperature of the water reached − 0·63° C. The cause of this rise in the temperature of the water of the bottom layer lies in the warmth flowing from the earth's crust, and also in the bacterial processes of decomposition of organic remains which have sunk to great depths. The heat generated during these processes may cause the rise in the temperature of the water.

With twenty-two hydrological soundings samples of plankton were taken at different depths. As we know, Nansen advanced the theory that the ocean was very poor in organic life in high latitudes. He believed the cause of this to be that under conditions of an ocean completely covered with fields of solid ice even in summer, plant plankton cannot develop owing to the absence of light, and as plant plankton, in the last resort, is the basic nourishment of the entire animal population of the sea, then naturally the higher animals, too, particularly sea animals, could not exist here. But this hypothesis has turned out to be incorrect. During the course of an entire month (August) our observations showed that under the solid ice, in the upper layers of the sea, an intensive development took place of microscopic sea-weed, constituting that 'florescence' of plankton, observable in the 'biological' spring in seas of more southern latitudes. This 'florescence' begins at the end of the short polar summer when all the snow has melted from the surface of the ice, which has also perceptibly suffered from the thaw. Evidently, at that time, the intensity of light penetrating to the water through the melting ice is sufficient for the development of seaweed.

The quantity of plant plankton was estimated by the quantity of chlorophyll, which was determined by a spectrocolorimeter. If plant plankton was able to develop here, then naturally it was possible for animal life to exist; and certainly from all depths of the ocean—even from a depth of 3,000 metres—the plankton net brought up examples of different species of animal plankton.

If plankton exists, it is also possible for the higher animals to exist, and at the 88th parallel we saw a hare, a polar bear with two cubs, not to mention seagulls, which visited our camp on more than one occasion. The hypothesis that no life exists near the Pole must therefore be assumed to be wrong.

Measurements of the force of gravity were made by us at twenty-two points, situated between the

89th and 74th parallels. At present, we have provisionally calculated thirteen of these gravitational points. The last points it was impossible to calculate, as the increasing rapidity of the drift towards the end compelled us to carry out all observations much more frequently and to postpone their working up. The difference between our results and the values given for the same points by the international formula is as follows. At the 89th parallel the observations of the force of gravity practically coincided with the theoretical values. From the 88th to the 84th parallel stretches a field of positive anomaly. Here our measurements give a value greater by approximately 60 mgm. than was supposed. From the 84th to the 83rd parallel is observed a sharp decline in the measured value. At the 83rd parallel the anomaly already has a negative significance of approximately — 30 mgm. Evidently this jump is closely connected with the relief of the bed. Here, as it happens, a rise to the shallow waters at the coasts of Greenland commences.

The object of our magnetic measurements was to elucidate the geographical distribution of the elements of terrestrial magnetism over the course of the drift : inclination, declination and horizontal intensity. For this we made our measurements with the help of a magnetic theodolite. During our stay on the ice floe, we made fifty-five series of determinations of inclinations and horizontal intensity, and thirty-six measurements of declinations. The measurements were taken right up to lat. 84° N. Farther on, the icefloe began to rotate so rapidly that it was impossible to use the variometers. It became necessary to take more frequent measurements in order, so far as possible, to weaken the effect of the magnetic disturbances. The measurements show that over the entire stretch of our drift there were no considerable magnetic anomalies.

With the setting in of the darkness at the beginning of October, we began to make hourly visual observations of the northern lights, and continued these until February 9.

Meteorological observations were carried out by us four times a day. We measured the temperature of the air, pressure (by two aneroids), humidity (in the summer by psychrometer; from August, during the periods of frosts, by a hair hygrometer of the Kuznetsov type), direction and velocity of the wind. At first all the four daily measurements of wind velocity were carried out by an anemometer. Later, when one of our anemometers went out of action, we used the remaining one only once a day, and the other three times determined the velocity of the wind visually. Up to the middle of October we have an unbroken record of wind velocity taken by the anemograph. The barograph and thermograph kept on functioning the whole time.

The rapid drift of the ice permitted us to spend only four summer months in the region of the cold polar cap, the investigation of which is of so great an interest to meteorology. It can now be said with certitude that the weather in this region is considerably calmer than on the borders of the Arctic Ocean. For example, we never observed any very strong winds there, though we did not find the steady anticyclonic regime supposed to exist in that region. Our observations were communicated to the mainland daily.

The foregoing is a provisional account of the results of our scientific work. Immediately on our return home we shall begin to work up our material, so as to give a complete account of the investigations carried out by our expedition to the North Pole.

Oil from Coal*

THE report of the Sub-committee on Oil from Coal of the Committee of Imperial Defence serves a useful purpose, although nothing new is disclosed. Unless unexpected discoveries of petroleum should result from the exploratory work conducted by oil companies as an outcome of the recent Petroleum Act, Great Britain has only one alternative to importing practically the whole of its oil supplies : that is, the large-scale conversion of coal into oil by hydrogenation or synthesis, processes which are still very costly in both capital and operation. Oil and motor spirit are produced in small proportions as by-products from the carbonization industries, but such sources are not capable of indefinite expansion, since their industrial stability is dependent upon adequate markets for the main products—coke of various kinds or gas. They were, however, stimulated by the guaranteed preference at the rate of 4*d*. a gallon for ten years which has operated in favour of home-produced motor spirit since the Act of 1934. Although only 4*d*. per gallon is guaranteed by this Act, the actual preference which has been in operation since 1934 has been 8*d*., but this involves a shortening of the period during which the guarantee is effective. The report recommends that the *guarantee* should be increased to 8*d*. a gallon and remain in operation until 1950, and that it should be extended to include diesel oil used in motor vehicles.

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* Committee of Imperial Defence. Sub-Committee on Oil from Coal: Report (Cmd. 5665) Pp. 71 (London: H.M. Stationery Office, 1938.) 1*s* 3*d*. net.

It might be feared that this extension would involve a loss of revenue, but the consumption of oil and motor spirit is increasing so rapidly that any expansion of the various industries producing oil from coal would probably, at most, only provide for the increase, and could take place without reducing the present imports.

The Committee includes in its report a very welcome discussion of the position in time of war, and this probably forms its most valuable contribution. Much confusion has arisen in the past from the statements of parties interested in particular processes, or from well-meaning individuals who have based their deductions on incomplete knowledge. Even should carbonization processes expand to a degree wildly in excess of anything at present appearing commercially practicable, the supplies of motor spirit forthcoming would form only a small fraction of those needed in times of national emergency. The only methods which can be looked to as potential sources of large supplies of oil are hydrogenation and the Fischer or similar synthetic processes, where oil is the main product and is independent of the markets for coke and gas.

At present, only about 7 per cent of the motor spirit consumed in Great Britain is home-produced, and the home production of fuel oil, lubricating oil, etc., is negligible. An enormous expansion, involving the erection of many large plants, with consequent heavy capital expenditure, would thus be required to meet even peace-time demands. If such plants were put into operation, the consequent decrease in imported oil would eventually result in a considerable diminution of our sea transport facilities and make the possibility of import during war much more difficult. Moreover, large oil production plants would be extremely vulnerable to air attacks; and the man-power and supplies of coal needed for their operation, although an advantage in times of peace, might not be easy to provide when the fighting and munitions supply services were demanding all the men available. An interesting comparison is made between the capital cost of a plant with a yearly output of 150,000 tons of motor spirit (about £8,000,000) and the thirty-two tankers which could be built for the same sum, which, even if making only five voyages yearly, could carry 1,800,000 tons, or twelve times the output of the hydrogenation plant.

For these and other reasons, the Committee confirms the opinions already formed by those who have studied the subject impartially, that "in general a policy of depending on imported supplies with adequate storage is the most reliable and economical means of providing for an emergency".

Although in general agreement with the remarks of the Committee concerning low-temperature carbonization, the writer thinks it a pity that evidence in this field should have been taken only from the Low Temperature Distillers' Association of Great Britain, Ltd. In a subject which is still so experimental as low-temperature carbonization, an association of this character cannot be altogether representative, for, since it is not likely to welcome newcomers to introduce additional competition, much valuable data must be withheld from it. The Committee has, however, doubtless been in close touch with the Government Departments concerned in the matter.

C. H. LANDER.

Archæological Discovery in Britain, 1933-38

IN arranging an exhibition at the Institute of Archæology of the University of London to illustrate the achievement of field archæology in Great Britain and Northern Ireland during the five years 1933–38, the promoters have provided a conspectus of results which is continuous with those of the two exhibitions of a similar character held in 1929 and 1932, the latter in conjunction with the International Congress of Pre- and Protohistoric Sciences, which met in London in that year. The inevitable comparison demonstrates the very considerable advance made by archæological studies in the interval, and its direction.

The most striking feature in such a comparison is the increase in size of the present exhibition. This is not merely a matter of the total of exhibits, but also extends to the number of sites represented. For this the more efficient organization now possible is in part responsible; but unquestionably the decisive factors have been the growing activities of archæologists, and in no small degree an increased and more widely spread interest among a public which is prepared to support archæological excavation, financially and otherwise. For this part credit must be allowed to the Office of Works, which in the exercise of its statutory duties has stimulated local authorities, local museums, local societies and a local public to preserve their ancient monuments, or where that has been impossible, to obtain from them such information relating to the past as they can be made to render up by skilled investigation before the evidence is obliterated. Among the more salient instances of such interest, of which the results are to be seen here, is the Old Jewry Wall site at Leicester, and the Belgic and Romano-British site at Colchester, whence comes the notable evidence of the factory of 'Colchester' ware, or local Samian.

Dr. R. E. Mortimer Wheeler, director of the Institute, in a short but illuminating introduction to the catalogue of the exhibition, regards it as demonstrating the extension of archæological fieldwork to provinces other than the Romano-British studies which, following the pre-War Haverfield tradition, dominated the early post-War years. This, no doubt, is true in some measure, but needs qualification. What is especially notable is not so much the change in the orientation of archæological studies as the increase in the number of professional or highly trained archæologists, whose interests and services are now available for investigation in the wider field, which previously was not so much neglected as for a variety of reasons left to the investigator who, though experienced and frequently of advanced technical skill, was not professionally trained. The effect of this change in the qualification of personnel is to be seen on all sides. Without risking invidious distinction, mention may be made of instructive examples in the mesolithic exhibits from Sussex, in which there is profound knowledge and trained experience behind the arrangement and classification of the finds from the pit-dwelling site at Selmeston, unique at present in British scientific investigation, and of the Tardenoisian industry from Horsham, for both of which Dr. J. G. D. Clark is responsible. The work undertaken by Mr. Alexander Keiller and the Morven Institute of Archæological Research at Avebury lends further support to the contention, as also does the material drawn from bronze and early iron age sites in Sussex, Gloucester and Wales.

It is a further mark of the trained habit of mind that help from other sciences is being sought in an increasing degree to give objectivity to the findings of the archæologist. The evidence of geology and palæontology on broad lines has always served the excavator; but to this are now added intensive investigations in geology, climatology, palæobotany, which call for the employment of laboratory methods. Prof. F. E. Zeuner, the distinguished authority on prehistoric chronology, who is now attached to the staff of the Institute, stages an exhibit of the methods of geochronology, in which he shows how mechanical and chemical analysis of soils and gravels can be made to show changes of climate and geological conditions, and demonstrates the tree-ring method of time measurement, which has been used extensively in American archæology. Two interesting and instructive examples of the use of analysis and experiment in field work appear among the exhibits from archæological sites. The first comes from Wales and establishes the earliest recorded use of coal as fuel in Britain in a bronze age cremated urn burial from the Simonston Cairn, near Bridgend, Glamorgan, excavated by Sir Cyril and Lady Fox. The second is included in material, also from Wales, excavated by Mr. B. N. St. J. O'Neil from Fridd Faldwyn Camp, Montgomery. It is an example of vitrification, which is compared with similar vitrified rock from a hill-fort in Bute, and also with vitrified material experimentally produced by Mr. Wallace Thorneycroft, who has thus solved a puzzle of long standing among Scottish archæologists.

Before leaving the subject of archæological technique, attention may be directed to the nucleus of a collection of photographs taken from the air for which Major G. W. G. Allen is responsible. Such photographs are now familiar as an instrument of survey and discovery; but the technique of ground photography is less widely appreciated. Enlarged photographs arranged by Mr. M. B. Cookson illustrate the varied points of technical detail recorded by skilled manipulation of the camera. Technical considerations apart, the photographs of interments of the defenders of Maiden Castle, Dorchester, are intensely impressive; while those of the recently reported investigation of the methods of construction of Hadrian's Wall are of special interest at the moment.

Finally, as an example of more or less straightforward excavation, carried out with a patience that is unlimited, which are the fundamentals of archæological method, reference may be made to Mr. A. Leslie Armstrong's excavation of the Pin Hole Cave, Creswell Crags, Derbyshire, in which twelve years' work has penetrated through twenty feet of deposits and has brought to light relics of three phases of Mousterian, separated by two glacial phases or events, of Solutrean and of Aurignacian, the last including an engraving of a man masked for a ceremonial dance unique in Britain.

It may seem that in directing attention to the more salient features of the exhibition, which mark progress and direction in British archæology, too little has been said of individual exhibits. This is not due to any lack of interest. While there is no section which does not repay study, those which cover the early iron age and more particularly the period immediately before the Roman invasion, open up a field which a few years ago was unmapped. All sections alike in quality and number of exhibits testify not only to the skill of the investigators, but also to the value of this branch of scientific research in Britain as a source of material for the advancement of knowledge of man's cultural development and history.

Dr. Wheeler points out that recent development in archæological studies implies an elaboration of technique rather than a change of heart, while the position of General Pitt-Rivers as the founder of scientific archæology remains unchallenged. So long as this obtains, there is the less need for Dr. Wheeler's admonition to the archæologist to bear in mind that he is not merely a mechanic, but is also a student of humanity. If there be any danger, Dr. Wheeler's own excavations of Verulamium and Maiden Castle, which hold an outstanding position in the exhibition, spur his colleagues to emulation and guide them along the right path.

Obituary Notice

Sir Harcourt Butler, G.C.S.I., G.C.I.E.

BY the death of Sir Harcourt Butler, termed one of the greatest administrators in India of his day, which took place on March 2 at the age of sixty-eight years, oriental studies in the University of London have lost one of their strongest supporters.

Spencer Harcourt Butler was the second son of Mr. Spencer Percival Butler, conveyancing counsel to the Office of Works, a nephew of Dr. H. M. Butler, Master of Trinity College, Cambridge, and a brother of Sir Montagu Butler, now Master of Pembroke College, Cambridge. Born on August 1, 1869, Harcourt Butler was educated at Harrow and Balliol College, Oxford. He passed into the Indian Civil Service in 1888 and went to the United Provinces of Agra and Oudh, where he remained and served with conspicuous success until 1907, when he was chosen by Lord Minto to act as secretary of the Foreign Department, an office which brought him into close personal touch with the native princes. In 1910, Butler was appointed to the newly created post of education member in charge of sanitation, local self-government, archæology and other minor branches of public works. Butler took up the administration of these heterogeneous activities with vigour.

In 1915, Sir Harcourt (as he had become three years before) was transferred to Rangoon as Lieutenant-Governor of Burma. One of his early achievements was to raise a substantial sum for the provision of a teaching university in Rangoon to take the place of the colleges previously affiliated to Calcutta. In 1917 he returned to his old Province to take office as lieutenant-governor; but in 1923 he returned to Burma to become Governor under the new system inaugurated in 1919.

Butler's activities during this second term of office in Burma have met with criticism in two directions. He had already shown enthusiasm for education both in Rangoon and previously in India, where he had encouraged the foundation of universities at Benares for Hindus and at Aligarh for Moslems; while in his time in Oudh the University of Lucknow had been created and the University of Allahabad had been reconstructed. On his return to Rangoon, he found that his scheme for a university was languishing. He brought forward fresh legislation, and schemes were framed for raising money. Both measures met with much opposition and even aroused some personal animosity.

In another direction, Butler's actions have been regarded as not in the best interests of those he intended to serve. This was the abolition of slavery and human sacrifice in the land of the savage Nagas known as the Triangle, the then unadministered territory bordering on the Hukwang Valley. Butler was successful in stamping out these practises; but while they are repugnant to civilized ideas and not permissible under British administration, the anthropologist has to recognize that the abolition of slavery, at least without adequate substitute, economically has had a damaging effect in forcing land out of cultivation and reacting adversely on the morale of the tribes.

On leaving Rangoon in 1927, Butler was appointed chairman of the Indian States Committee to report on the relationship between the Paramount Power and the States. The report issued in 1929 proved a standard of reference on the question of federation in the Round Table Conference which followed.

On his return to England, among numerous other activities Butler accepted in 1931 the chairmanship of the Governing Body of the School of Oriental Studies, and took a prominent part in the arrangements for the new quarters of the School in Bloomsbury, now approaching completion. Among the numerous honours bestowed upon Sir Harcourt Butler were honorary doctorates from the University of Oxford and several of the Indian universities.

WE regret to announce the following deaths:

Mr. E. A. S. Fawcett, C.B., chief engineer to the Ministry of Health from 1921 until 1930, on April 1, aged sixty-nine years.

Mr. Edward Meyrick, F.R.S., assistant master at Marlborough College from 1887 until 1914, an authority on Australian Lepidoptera, on April 1.

Mr. T. H. Digges La Touche, formerly of the Geological Survey of India, on March 30, aged eighty-two years.

News and Views

An Extra-galactic Star Cluster

IT is reported by the New York correspondent of *The Times* that Dr. Harlow Shapley has announced the discovery of a great cluster of stars in the southern constellation Sculptor. The discovery was accidental, the cluster being photographed with the 60-inch reflector at the Harvard Southern Station at Mazelspoort, near Bloemfontein, South Africa, on a very clear night with a highly sensitive plate. If the median absolute magnitude of the stars photographed be assumed to be $-1\cdot5$, the apparent magnitude being about $+18$, it follows that the distance of the cluster is about 250,000 light-years. This places it well beyond the limits of our galactic system, the distance being more than double that of the Magellanic Clouds, and adds another to the known systems that are relatively near to our galactic system. The angular diameter of the cluster is greater than 1° and the linear diameter is estimated to be about 6,500 light-years, which indicates a size comparable with the Small Magellanic Cloud. The cluster is oval-shaped, unlike the clusters in our galactic system, which are globular. It is stated that there are about 10,000 stars in the cluster between the brightest stars and the dimmest that have yet been counted. The Magellanic Clouds are rich in stars of very high luminosity. The Sculptor cluster would undoubtedly have been discovered earlier, if it had contained such stars. It is probable that, when further photographs are available, Cepheid variables will be discovered in it and the study of their light variations will enable a more accurate determination of the distance of the cluster to be made.

Bequests for Research in Marine Biology

MR. EDWARD THOMAS BROWNE, a governor of the Marine Biological Association, who died on December 10, 1937, was for many years the leading authority in Great Britain on medusæ and other cœlenterates. Under his will, a number of valuable bequests are made to different bodies for the benefit of scientific research. The residue of his estate, estimated to amount to some £50,000, goes to the Royal Society to form a fund for the promotion of marine expeditions or individual research on marine biology. In addition, £6,725, together with scientific books, instruments and apparatus, are left to the Marine Biological Association for special purposes in connexion with the Plymouth Laboratory, £15,000 to Queen's College, Oxford, for a research fellowship and a scholarship in biology, and £5,000 to University College, London, for a postgraduate research studentship in zoology, in memory of his wife. After graduating at Oxford, Mr. Browne took up the serious study of zoology under the late Prof. W. F. R. Weldon at University College, London, in 1891, and remained at the College as a research worker until 1909. His summers were spent at different marine laboratories, Port Erin, Plymouth, Millport and at other places suitable for his work, including Valencia, Falmouth and the Scilly Isles. A monograph on the British medusæ is nearly completed, and provision is made in his will for its publication. He examined and reported on the medusæ from many foreign collections, especially from expeditions, including those from the Maldive and Laccadive Archipelago, the Gulf of Manaar, the Indian Ocean, the Suez Canal, the Scottish Antarctic Expedition, the British National Antarctic Expedition, the Falkland Islands, Norway and Spitsbergen. Browne was a very thorough and careful worker, with a complete knowledge of the literature of the groups in which he specialized. He gave great assistance both financially and, as a member of their respective councils, in the administration of the scientific societies in which he was interested, including the Royal Microscopical Society and the Quekett Club.

Soviet Awards for North Polar Expedition

ON p. 629 of this issue we print an account of the preliminary scientific results obtained by the Russian men of science who occupied the drifting north polar station. The Riga correspondent of *The Times* states that the following awards have been made to members of the expedition: M. Ivan Papanin, already a 'Hero of the Soviet Union' and a member of the Order of Lenin, has received the second class of that order and a present of 30,000 roubles, and has been appointed first deputy chief of arctic navigation (of which Prof. Otto Schmidt is chief). MM. Krenkel, Shirshoff and Fedoroff have been decorated with the Order of Lenin, awarded the title of 'Hero of the Soviet Union', and also received 30,000 roubles each. The captains of the *Taimyr*, *Murman* and *Murmanets*, and M. Ostaltseff, who conducted the relief expedition on board the *Taimyr*, and the airman, M. Vlasoff, have been decorated with the Order of Lenin and received 10,000 roubles each; and 118 others who took part in organizing the expedition to the North Pole and the rescue of the ice-floe party have been awarded various other decorations and sums of money.

Bronze Age Cairns in Glamorganshire

Two cairns of the bronze age, adjoining the village of Coity, near Bridgend, Glamorganshire, excavated by Sir Cyril Fox, director of the National Museum of Wales, and Lady Fox have made notable additions to the records of British archæology. The Simondston Cairn affords evidence of the earliest known use of coal as fuel in the British Isles. In the second, the Pond Cairn, was found a pit containing the remains of vegetation and grains of wheat and barley, believed to be the first food grains of the bronze age recorded in southern Britain. The excavations were described before the Society of Antiquaries of London by Sir Cyril Fox on March 31. The Simondston Cairn is of the normal highland Early Bronze Age type and contains burials of two adults and a child, dating from about 1600 B.C. In the southern rim of the cairn were five cremation burials of about a generation later. It was in one of these that the traces of coal were identified. The nearest outcrop of coal is about a mile and a half away. The second cairn, Pond Cairn, lies half a mile away from Simondston and is on a lower level. It is of a very unusual type both as regards its structure and the ritual acts involved in the construction. Near the centre was a rock-cut pit, probably dedicatory, which was filled with stones and contained the scattered burnt bones of a child. The primary burial was an urn of about 1300 B.C. which was covered with a heap of stones and a vertical-sided turf stack. A basin with a projection, phallic in plan, and lined with charcoal, fronted the urn. Around the turf stack was a continuous cairn ring, sixty feet in diameter, with an inner wall face and outer kerb. The space between the ring and the stack was scattered over with charcoal, and had been trodden hard, presumably in some ceremonial movement. Later the inner face of the ring was broken and the pit, to which reference is made above, was dug. It was covered with a pile of stones, linking the ring with the stack. The Pond Cairn is comparable with examples in Devon. With the secondary deposits at Simondston it probably represents an intrusion across the Severn Sea into the Glamorgan plain.

Roman Dorchester

Resumed excavation on behalf of the Dorset Archæological Society on the site at Colliton Park, Dorchester, which has been purchased by the County Council for the erection of a shire hall, has already produced several discoveries (*The Times*, March 3). It will be remembered that last year, when excavation began, a large Roman town house was discovered belonging to the Roman city of Durnovaria which underlies the modern town. This has been completely excavated and is to be preserved intact by the County Council. Trial trenches have now revealed that four important Roman buildings underlie the area upon which the shire hall is to be erected. These it is hoped to examine. A well-made path of cobble flints leading to the door of the house has been brought to light. It overlies an earlier wooden cookhouse, furnished with an oven. A large pit was also found. This was circular in plan and lined with blocks of stone. It is fourteen feet in diameter and sixteen feet deep. A passage to the west leads to the Roman town wall. Excavations will be continued for a further period of at least three months.

Jungfraujoch Research Party

At the end of this month Mr. G. Seligman, author of "Snow Structure and Ski Fields", will take a party of scientific workers to the Jungfraujoch Research Institute in Switzerland to undertake scientific research work on glaciers. This will be the first British expedition ever to spend its whole time studying glaciological problems, and it will form a continuation of Mr. Seligman's previous researches on the nature of snow. The party will spend five months at the Institute, at a height of more than 11,000 feet, and will consist of: Mr. T. P. Hughes, of the Physical-Chemical Laboratory, Cambridge—physicist; Mr. M. F. Perutz, of the Crystallographic Laboratory, Cambridge—crystallographer; Mr. A. E. Benfield, of the Department of Geodesy and Geophysics, Cambridge, and Mr. E. A. Ferguson, of the Department of Geography, Cambridge—assistants. The chief problem to be investigated will be the transition of firn into glacier ice, but other problems, particularly those which may have some bearing on the main question, will be investigated, notably the movement of glaciers, the formation of ice-bands and the connexion, if any, between those in the névé regions and those near the snout of the glacier. In addition, Mr. Hughes will carry out certain experiments on the friction of solid bodies on ice, in connexion with his work at the Physical-Chemical Laboratory, Cambridge. Mr. Seligman has been granted a Leverhulme Research Fellowship for the purpose of this research, and the expedition is also supported by the Royal Geographical Society, the Ski Club of Great Britain and the Alpine Ski Club.

Changing Conceptions of Education

At a public meeting of the Derbyshire County Association of the National Union of Teachers on March 26, Mr. A. E. Henshall, education secretary of the Union, spoke on present-day teachers' aims and attitudes as contrasted with those of their predecessors. The attitudes established by the notorious payment-by-results system persisted long after its abolition, but to-day there is fairly general acceptance of the view that the teacher is concerned before everything else with the welfare of the individual child, considered as a person destined in due course to contribute to the welfare of the community as a citizen of a democratic State. It follows, at least in theory, that teachers of children in all stages in every kind of school—infants, junior, senior, central, secondary—are united in a single task and owe it to themselves and their charges that they should co-operate as fellow workers in a unitary service. To promote such co-operation by providing convenient occasions for getting together and comparing notes is an important function of the local associations of the National Union. Mr. Henshall stressed the pioneer role of the new senior schools and warned their teachers against sacrificing their comparative freedom in a misguided effort to rival the secondary schools. With equal emphasis he insisted on the importance of the junior schools, the teachers of which should be regarded as having a status not inferior to that of senior school teachers.

Social Services of the League of Nations

In an article entitled "The Non-Political Value of the League" contributed to the *Quarterly Review* for

January, Capt. A. L. Kennedy gives an admirable survey of the services rendered by the League of Nations technical organizations in non-political fields. He stresses the value of the resettlement of populations in Greece under the League Commission as a contribution to European peace and indicates the need for dealing with questions of refugees and minorities which still persists. In regard to opium, the co-operation established at Geneva has resulted in a central office which maintains supervision over a complete branch of economic activity, from the import of the raw material to the consumption of the manufactured article and in checking its transport from one country to another. This achievement has, however, set the League the even harder task of suppressing the illegitimate traffic which still flourishes to a serious extent and also the task of controlling the raw material. Again, the League has provided a central body for collating and directing measures against the traffic in women and children, and it has every claim to be regarded as the world's ministry of health, not only co-ordinating health work in different countries, as well as research and standardization but also, as in the Singapore Epidemiological Intelligence Bureau, providing an intelligence service for the prevention of epidemics. Capt. Kennedy writes appreciatively of services rendered to China before the onslaught of Japan occurred as well as to the reconstruction work in Austria, the work of the Mandates Commission and of the International Labour Office and the Permanent Court of International Justice. This well-balanced assembly of facts leaves no room for doubt that if the failure to use the League in the political sphere led to its abandonment, we should require an exactly similar organization to carry on its present non-political activities if both nations and individuals are not to be deprived of services which have given and are giving them relief from want and suffering, higher moral and material standards and opportunities of a useful life.

Scientific Research in New Zealand

THE eleventh annual report of the Department of Scientific and Industrial Research, New Zealand, covers the year 1936–37, and, in addition to the secretary's report and the reports of the research committees of the Council, includes the reports of the Dominion Laboratory, the Geological Survey Branch, the Meteorological Branch and the Dominion, Apia and Magnetic Observatories. The Minister's covering statement refers to the establishment of a Bureau of Social Science Research, the work of which will include the co-ordination of the activities of research bodies or individuals in this field and the undertaking of investigations to assist the Government by providing the factual bases for social policy measures. Outstanding developments of the year were the reorganization of plant research under the Plant Research Bureau and the steps taken to establish an Animal Research Bureau. The Plant Diseases Division of the former Bureau has made good progress in the study of virus diseases of farm crops, particularly tobacco, and has also completed comparative trials of new organic mercury dusts. Diseases of tomatoes and potatoes, etc., have also been investigated, and the Entomological Division of the Bureau has obtained satisfactory results in the biological control of the white butterfly, although new lines of attack for the control of the diamond black moth have been necessary. The Dairy Research Institute has made further progress in its study of the control of gas-producing organisms which cause openness in cheese, and has continued its studies of the elimination of the feed taint in butter and cream from certain districts.

THE Wheat Research Institute has continued to expand its long-range work on wheat breeding, while the Leather Research Laboratory has given special attention to methods of assessing the quality of leather as a guide to improvements. A particular group of chemical constituents has been studied in relation to the wearing-value of leather. An extensive programme of fruit research has included an attack on the problem of the mouldy core of apples and the control of internal cork of apples, while the soil and land utilization survey has been continued to give a fairly complete picture of the agricultural resources of the Hawke's Bay province. Other features of the year have been the establishment of the Standards Institute, which has already done much to promote the adoption of standards and establish committees and sub-committees covering a wide range of subjects. Evidence is already available of the benefits of this work to the Dominion. Research associations have been developed during the year in connexion with the tobacco, wool manufacturing and footwear manufacturing industries, and a feature of staff appointments during the year has been the recruitment of New Zealand science graduates who had migrated overseas. Of the total expenditure of £131,957 of the Department, £71,233 is on research investigations, £13,268 of which is derived from industries and £13,243 from sales and miscellaneous recoveries. Expenditure on the Dominion Laboratory was £17,261 and on the Meteorological Office £12,069.

The Ontario Research Foundation

THE report of the Ontario Research Foundation for 1936 refers to the increased work carried out for industry. Two new laboratories for research on paints and on air-conditioning are now running smoothly. In the former, investigations on weathering tests and chemical analysis of white house paints, weathering of structural metal paints, etc., are in progress, while the latter is investigating the 'summer' comfort requirements in regard to temperature and humidity of people in Toronto. The work of the Textiles Division has been concerned with the development of a textile oil for use in processing woollen materials as well as with the development of a process for high-resistance tusser silk for electrical insulation purposes, and with processes for the reduction of shrinkage in textile materials. The Division of Engineering and Metallurgy has continued its studies on the effect of heat treatment on chilled cast-iron and on the forgeability of metals. The Division of Biochemistry has been concerned with the development of a new system of combination vegetable tannage for sale and transmission belting leather. A microscopic method for the early diagnosis of bovine mastitis has been worked out by the Division of Pathology and Bacteriology, while other work of the Foundation has been concerned with the deodorization and partial hydrogenation of cod liver oil without destroying the vitamin content, with the incidence of diseases of apples and related problems, and with a process for transferring pigments used in the paint industry from aqueous pastes to the oil phase.

Desiccation in Africa

A supplement to the *Journal of the Royal African Society* of January entitled "The Man-made Desert in Africa: Erosion and Drought" by Prof. E. P. Stebbing offers yet another warning that in many parts of the world drifting sand and eroding soil are beginning seriously to clog the wheels of administrative machinery. Erosion is a matter in which African Governments interfere unwillingly, for effective control often means uprooting social, agricultural and religious customs upon which tribal life, which British Governments strive to preserve, is based. In this paper, Stebbing regards erosion primarily from the point of view of its effect on water supplies, and believes that with increasing erosion, a falling water-table and decreasing water supplies, the character of the rainfall deteriorates, wet years becoming less, and droughts more frequent, and of longer duration. When deterioration has reached what Stebbing terms the "intermittent rainfall stage", where continuous agriculture is scarcely feasible, man has his last chance to change his methods and prevent the final encroachment of the desert. Much of Africa seems to have entered upon this critical stage of deterioration, and some parts have passed it irrevocably. Stebbing emphasizes that now "it is for the Administration to act". The immediate needs for Africa's conservation are more money and more officers trained to the work. Given these, administrations might put into operation soil conservation programmes which, if carried out, would turn the scales, at or before the intermittent rainfall stage, against the desert's encroachment. The trouble is that we cannot tell, until we have tried them out, whether plans for soil conservation are compatible with plans for the harmonious social development of whites and blacks.

Grass Seed Production

Three new bulletins have been issued in the Herbage Publication Series by the Imperial Bureau of Plant Genetics, Aberystwyth. Bulletin 19, "Production of Grass Seed" (price 5*s*.), is edited by R. O. Whyte and consists of an international exchange of opinions and experiences on the technique of producing seed of graminaceous herbage and forage plants. The countries represented are Scotland, Northern Ireland, New Zealand, the United States, Germany and Sweden, the names and addresses of the contributors being supplied in each case. Bulletin 20, "Insect and other Pests injurious to the Production of Seed in Herbage and Forage Crops" (price 2*s*. 6*d*.), has been prepared by H. F. Barnes. This paper is essentially a summary of the available information concerning some of these pests, but although growers should find this most useful, they are nevertheless advised to consult the advisory entomologist in their particular area as to the best method for safeguarding their crops, as it is impossible to secure really satisfactory results without due attention to local conditions. Bulletin 21, "The Influence of Climatic Conditions on Type Composition", by Nils Sylvén (price 1*s*.), gives an account of experiments in Sweden on the changes induced in herbage plants grown for seed outside their proper growing districts. It is evident that there is considerable danger of loss of valuable characters if this process is continued. For satisfactory results, seed must be obtained direct from the breeding station or its vicinity, and care taken to keep seed from the original source scrupulously apart from that grown in a different locality, or much of the value of the selection work will be lost.

Education in the Indian Villages

A paper by Capt. J. W. Petavel before the Economics Society of Osmania University on September 24 last year emphasizes the value of educative employment in the economic system of the Indian village, and particularly that of the educational colony in Indian rural education. One of the greatest possibilities to be explored, however, is that of the use of educational colonies for town children and adolescents, and these should be for the benefit of poor middle-class people as well as for the working classes and should include secondary as well as primary education. Stress is laid in this system on productive work, and the scheme of factory colonies outlined is also advocated as a contribution to improved world relations. Both in the rural and in the factory colonies one of the primary needs is the co-operation of scientific men and other professional workers in leadership and on a part-time basis in teaching and other capacities. Moreover, the colony organization offers one of the best opportunities of dealing with India's root problem of increasing the productivity of the land to yield more food for her growing population. The establishment of a standing committee for unemployment and poverty problems, to plan and assist research in the directions indicated by the success of the Swiss labour colony of Witzwil, is also urged.

Report of the University of Leeds

The University of Leeds report for 1936–37 records as the outstanding event of the year a gift of £200,000 by Mr. Frank Parkinson. It is significant that the report gives prominence to Mr. Parkinson's expressed belief "that the university can render the highest service to the community by keeping the realities of life and the need of breadth of vision in human affairs before its students" and refers to an expression of the same belief by Lord Nuffield. Among other endowments were an anonymous gift of £20,000 and a legacy of £25,000 for founding a chair of psychology. The subject of employment of graduates is dealt with at greater length than is usual in these annual reports. In the technological departments, no difficulty was found in obtaining employment immediately after, and even before, graduation, To meet the situation created by the time-lag between graduation and employment in the teaching profession the Appointments Board exerted itself to find temporary summer employments. The usefulness of this Board is said to have greatly increased during the last few years, the number of vacant appointments notified to it having risen from 380 in 1932 to 3,500 in 1937. Appreciative reference is made to the report on employment of graduates published by the National Union of Students. Schemes for medical examination of students at their own option and for physical instruction were under consideration during the year and are now in process of realization.

Quantitative Economics

IN a paper on econometric researches, appearing in the series of publications dealing with economic problems edited by Dr. R. Gilrat (No. 412; Hermann and Cie., 6 Rue de la Sorbonne, 6, Paris, 1936), Prof. R. Ray deals with the demand for goods for direct consumption. Results obtained in this question of demand, whether by experimental methods or by the application of statistical methods to observations, afford a strong presumption in favour of the quantitative investigation of economic phenomena. Prof. Ray discusses the theories of Cournot, Dupint and Marshall, who considered demands as the function of a single variable, as well as the theories of Walras and the mathematical school. His own investigations on products for direct consumption suggest that for certain products or services, coefficients of elasticity can be used to characterize the demand. In considering the elasticity of demand, it is essential to analyse the part which the law of substitution plays, and accordingly it is desirable to limit the investigations to products which lend themselves less readily than others to substitution, or to investigate a group of products which are readily substituted one for another in meeting the same need. The method of multiple correlation offers interesting possibilities, and Prof. Ray concludes that the demand for goods or services investigated so far is nearly always inelastic.

Effects of Dry Rot in Ships

THE presidential address of Dr. John Ramsbottom to the Essex Field Club dealt with dry rot in ships. Its text appears in the *Essex Naturalist* (25, 231; 1937), and provides an interesting account of the struggle of naval builders with wood-rotting fungi. A historical survey from the sixteenth century onwards traces the use of various kinds and qualities of timber, and shows how prone they were to rotting within the vessel, and above the water-line. The diarist Pepys made some contributions towards an understanding of the problem, but it was largely the work of James Sowerby, the author of "English Fungi", which first directed attention to the real cause. He figured twenty-three species of "Fungi found in the Dockyards and Ships of Great Britain from Deptford to Plymouth 1812". *Merulius lachrymans* was included in the list, and there can be little doubt that it was one of the chief agents of decay. Many substances were used to impregnate timber in an effort to control the rot; but it was not until the appearance of ironclad ships that dry rot ceased to trouble the Royal Navy.

The Rabbit Problem

IN certain localities, as is well known, the prevalence of rabbits has become of some importance in horticulture, agriculture and forestry. In order to deal with this nuisance effectively and humanely, the University of London Animal Welfare Society (ULAWS) has published a pamphlet, entitled "Instructions for Dealing with Rabbits", compiled by Capt. C. W. Hume, in which the chief methods of rabbit destruction are fully described. In addition, a list of some relatively rabbit-proof plants and details of rabbit-proof fencing are given. Sir Frederick Hobday, in a foreword, commends the pamphlet, a copy of which will be sent free on receipt of a stamped envelope measuring 6 in. by 9 in. by ULAWS, 42 Torrington Square, London, W.C.1.

Cambridge Dissertations for Degrees

A BOOK of "Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge" during the academic year 1936–37 has been issued (Published by Authority: The University Press, Cambridge, 1937.) Each summary has been approved by the examiners or by the student's supervisor, and gives a good idea of the matter of a dissertation. Copies of the dissertations are deposited in the University Library (Ph.D. degrees) or in the University Registry (M.Sc. and M.Litt. degrees).

Reference Standards Laboratory

AFTER a delay of many years, the establishment of a laboratory for the maintenance in Australia of standards of length, mass, electrical units, etc., has been approved by the Commonwealth Government. It will probably be placed at Canberra, the estimated cost of the building being £80,000. The administration will be in the hands of the Council for Scientific and Industrial Research, which will maintain intimate contact with the National Physical Laboratory at Teddington in general accordance with a plan drawn up some ten years ago.

National Academy of the Lincei

A SUPPLEMENTARY number of the *Atti della Reale Accademia Nazionale dei Lincei* (1937) contains an account of the formal annual meeting held in Rome on June 6, 1937, in the presence of H.M. the King of Italy, to whom tribute was also paid for the first time as Emperor of Abyssinia. Among the chief awards announced by the President, V. Rossi, are those of the Bocconi Prize for cancer research to Prof. F. Pentimalli and the Cannizzaro Prize in chemistry to Prof. L. Ruzicka, Zurich. The following were elected as members during the preceding year: A. Ghigi, D. de Blasi, P. G. Goidanich, L. Castiglioni, P. Ducati, A. Maiuri, P. de Francisci, F. Flora, as national members, and A. Carrelli, G. Polvani, F. Ercole, as corresponding members. The centenary of the death of the Italian poet, Giacomo Leopardi, was commemorated by an address given by G. Gentile.

Royal Academy of Belgium: Prize Awards

The following prize awards have been announced by the Royal Academy of Belgium: the Théophile Cluge Prize to Dr. J. J. Bouckaert for his work on physiology; the Agathon De Potter Prize for astronomy to S. Arend, for mathematics to F. Bureau, for physics to J. Géhéniau, for chemistry to Prof. W. Mund, for mineralogy to E. Polinard, for biology to Z. M. Bacq and to L. Lison; the Schepkens Prize to J. Beirnaert for his work on genetics and the improvement of the oil palm; the Wetrems Prize to L. Coppens for his work on fire-damp.

Announcements

Dr. L. J. Spencer, formerly keeper of minerals in the British Museum (Natural History), has been elected a corresponding member of the American Museum of Natural History, New York.

At the general meeting at Indianapolis of the American Society of Plant Physiologists, Prof. Henry H. Dixon, of Trinity College, Dublin, was elected an honorary corresponding member of the Society.

Sir Walter Langdon-Brown and Prof. W. J. Dilling have been nominated by the Privy Council members of the council of the Pharmaceutical Society of Great Britain, in succession to Sir Humphry Rolleston and Prof. J. A. Gunn, who have retired. Sir Malcolm Delevingne will continue as the third member nominated by the Privy Council.

A committee has been appointed under the chairmanship of Mr. John Forster with two representatives of the Medical Research Council, Sir David Munro and Mr. Bradford Hill, two representatives of the London Passenger Transport Board, and two representatives of the Transport and General Workers Union to investigate the conditions of work and their effect on health of the London omnibus workers.

At the annual general meeting of the Ray Society on March 24 the following officers were re-elected: *President*, Sir Sidney F. Harmer; *Treasurer*, Prof. F. E. Weiss; *Secretary*, Dr. W. T. Calman. Prof. F. Balfour-Browne was elected a vice-president, and Dr. J. Ramsbottom and Mr. J. L. Chaworth-Musters new members of the council. It was announced that a translation by the late Sir Arthur Hort of the "Critica Botanica" of Linnæus will shortly be published and that among other works in preparation is one on the distribution and ecology of British spiders by Dr. W. S. Bristowe.

Dr. Heinrich von Fischer, professor of meteorology at Vienna, has been made an honorary member of the German Meteorological Society and has been awarded the Silver Hillmann Medal by the Air Minister of the Reich.

The twenty-fourth Annual Conference of the National Association for the Prevention of Tuberculosis will be held at the British Medical Association House, Tavistock Square, W.C.1, on June 30–July 2.

The Royal Sanitary Institute will hold a further course of instruction in disinfestation of houses and furniture from the bed-bug, beginning on May 16. Further information can be obtained from the Secretary, 90 Buckingham Palace Road, S.W.1.

The All-India Population and Family Hygiene Conference will be held at Bombay on April 16–19 instead of in January as originally announced. Further information can be obtained from the Honorary Secretary, 8 Ormiston Road, Apollo Bunder, Bombay.

The third International Congress for Microbiology will be held at the Waldorf-Astoria Hotel, New York City, on September 2–9, 1939, under the auspices of the International Association of Microbiologists and the presidency of Dr. T. M. Rivers, Rockefeller Institute for Medical Research, New York. Further information can be obtained from the General Secretary, Dr. M. H. Dawson, College of Physicians and Surgeons, 620 West 168th Street, New York, or from Dr. R. St. John-Brooks, Lister Institute, Chelsea Bridge Road, London, S.W.1.

The International Federation for Documentation will hold its fourteenth International Conference on Documentation under the presidency of Sir William Bragg at Lady Margaret Hall, Oxford, on September 21–25. Members of the Conference will visit the Science Museum, London, on September 26. Advantage will be taken of the meeting being in England to hold joint sessions on the mornings of September 24–25 with the Association of Special Libraries and Information Bureaux. Further information can be obtained from the Secretary, Miss M. Gosset, The Science Library, South Kensington, London, S.W.7.

Gustav Fock, Leipzig, has issued an important catalogue listing close on 4,000 items, of which, in addition to journals and works of general zoology, the most extensive series deal with the physiology and biology of animals, psychology, zoogeography, and animals of economic importance. From Antiquariaat Junk, Den Haag (Holland), comes a list of 2,014 items concerning the one group Vermes.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 650.

Correspondents are invited to attach similar summaries to their communications.

Resonance Transmutations of Carbon by Protons

During the investigation of the capture radiation of light elements bombarded by protons, we have found for carbon the following results. The intensity of capture radiation was measured for different proton energies by the number of coincidences produced in a pair of Geiger-Muller counters. The coincidences were caused by electrons released from an aluminium plate by the incident γ-radiation. The quantum energy of this radiation was determined by finding the range of the electrons in millimetres of aluminium absorber placed between the counters. The intensity of γ-ray emission at different bombarding voltages is shown by Curve 1 of Fig. 1. Two resonances are clearly observed at 400 and 500 kv. approximately. With a bombarding proton energy of 560 kv., corresponding to the second peak of this curve, we find the γ-ray energy to be 7·4 Mv., as deduced from the end-point at 11 mm. of aluminium (Curve 1, Fig. 2). This is in marked disagreement with the value of the γ-ray energy to be expected from the reaction

$$^{12}C + {}^{1}H = {}^{13}N + h\nu \quad . \quad . \quad . \quad . \quad (1)$$

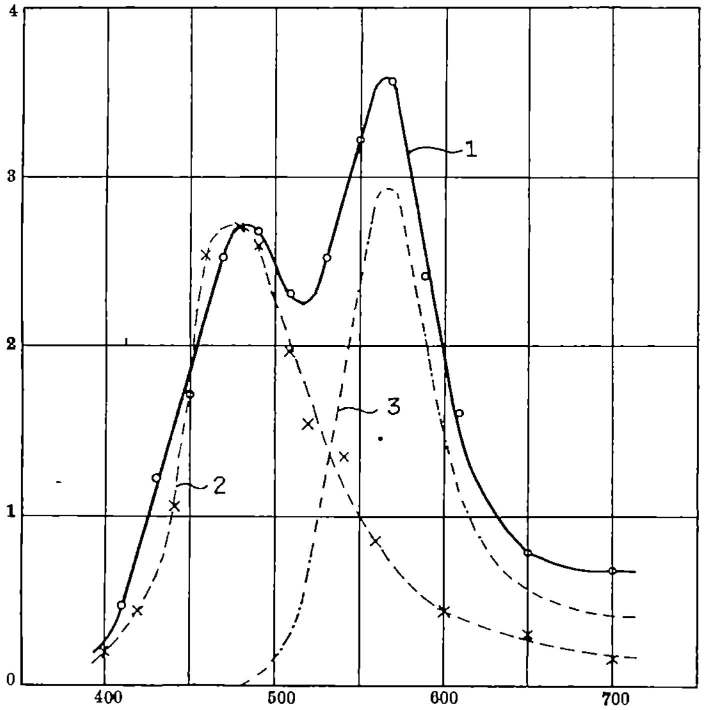

Fig. 1.

Resonance curves for ^{12}C and ^{13}C.

However, if we consider the reaction

$$^{13}C + {}^{1}H = {}^{14}N + h\nu, \quad . \quad . \quad . \quad . \quad (2)$$

it is found by calculation, using accepted mass values and taking into account the energy of the incident protons, that the γ-ray energy is 8·2 Mv. for this process. This reaction has not previously been observed, and the following experiments confirm that the resonance peak of Fig. 1 at 560 kv. must be ascribed to the rarer isotope ^{13}C and not to ^{12}C.

The quantum energy of the capture γ-radiation was again measured with the energy of the incident protons changed from 560 kv. to 470 kv. Curve 2 of Fig. 2 shows the new absorption measurements in aluminium, and the γ-ray energy deduced is 2·6 Mv. For comparison the absorption measurements obtained under the same conditions with the γ-rays of thorium C″ are shown by the crosses of Fig. 2. Using the accepted mass values in equation (1), we find that for protons of energy 470 kv. the γ-ray emitted should have an energy of 2·37 Mv., in good agreement with our experimental value of 2·6 Mv. The above results suggest that the peak in the γ-ray excitation curve at 470 kv. must be attributed to the formation of the radioactive ^{13}N, whilst the peak at 560 kv. must be attributed to the formation of stable ^{14}N.

It is strange to notice that Hafstad and Tuve[1], in a measurement of the amount of radioactivity excited at different proton energies, obtained some evidence for two resonances at 400 kv. and 480 kv. The association, however, of the two resonances found by these workers with the resonances which we find in the capture γ-excitation is not possible on account of the above measurements of the energies of the γ-rays and our proposed interpretation. In view of this coincidence, however, we have repeated Hafstad and Tuve's measurements of the excitation of radioactivity at different proton energies. Our results, shown in Curve 2 of Fig. 1, give no evidence of the second resonance found by Hafstad and Tuve. This curve for ^{12}C was obtained by bombarding the same target with protons for a fixed interval of time and measuring the subsequent positron emission with a thin-walled Geiger-Müller counter. It has been reduced to make the best fit to Curve 1 for the capture γ-radiation. We note that only the first peak at 470 kv. in the γ-ray excitation curve can be associated with the radioactivity. The ^{13}C resonance curve can be found by subtracting Curve 2 from Curve 1 and is shown as Curve 3 of Fig. 1, with a threshold value for resonance at about 500 kv. It is interesting to note that ^{13}C has such a large cross-section for proton capture that its yield is of the same order as that of ^{12}C, though it is about 1 per cent abundant in natural carbon.

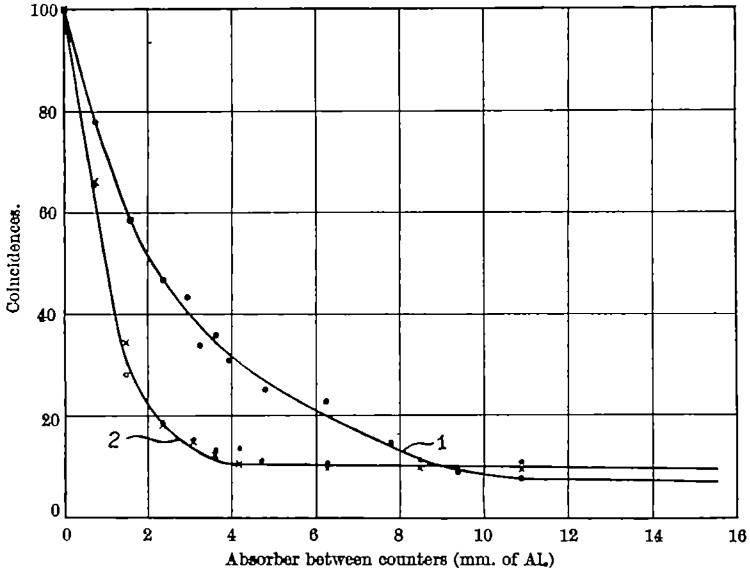

Fig. 2.

Curve 1. ^{13}C capture radiation ; Curve 2. ^{12}C capture radiation (circles) ; thorium C″ radiation (crosses).

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S. C. Curran.
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March 14.

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[1] Hafstad and Tuve, *Phys. Rev.*, **48**, 306 (1935).

The λ-Phenomenon of Liquid Helium and the Bose-Einstein Degeneracy

In a recent paper[1] Fröhlich has tried to interpret the λ-phenomenon of liquid helium as an order–disorder transition between n holes and n helium atoms in a body-centred cubic lattice of $2n$ places. He remarks that a body-centred cubic lattice may be considered as consisting of two shifted diamond lattices, and he assumes that below the λ-point the helium atoms prefer the places of one of the two diamond lattices. The transition is treated on the lines of the Bragg-Williams-Bethe theory as a phase transition of second order in close analogy to the transition observed with β-brass. Jones and Allen in a recent communication to Nature[2] also referred to this idea. In both these papers, use is made of the fact, established by the present author, that with the absorbed abnormally great molecular volume of liquid helium (caused by the zero motion[3]) the diamond-configuration has the lowest potential energy among all regular lattice structures[4].

In this note, I should like first to show that the mechanism proposed by Fröhlich cannot be maintained and then to direct attention to an entirely different interpretation of this strange phenomenon.

(1) According to Frohlich, a diamond lattice of He atoms, when partly formed, should offer, to any other He atom, a preference for being attached at those points which belong to the same diamond lattice, that is, the binding energy at a diamond point should be greater than anywhere else. It is, however, easy to see that just those points, which according to Fröhlich should become less favoured for low temperatures, have an appreciably greater binding energy. It is true these holes have four nearest neighbours at exactly the same distance (3·08 A.), as the lattice points of the diamond lattice have, but in addition they possess six second neighbours at the distance of 3·57 A. which the diamond lattice points do not possess, and these second neighbours contribute considerably to the binding energy just at the hole-places (about 50 per cent to the potential energy). Therefore, actually no such co-operative phenomenon will appear as supposed by Fröhlich. The atoms would rather frequent the holes as much as the proper diamond lattice points, and this would signify that we have a body-centred lattice of $2n$ places for n atoms, every place being occupied with the probability $\frac{1}{2}$ only—even at the absolute zero. In this configuration every atom has on the average four nearest neighbours at a distance of 3·08 A., as in the diamond configuration, but in addition there are here on the average three second neighbours at the distance of 3·57 A. In the diamond lattice there are twelve second neighbours but at a distance of 5·04 A., where there is almost no Van der Waals field. It might be mentioned, by the way, that a face-centred lattice of $2n$ places for n atoms (on the average 6 first neighbours at a distance of 3·17 A.) has been found to have a still little lower energy than the configuration just discussed of the co-ordination number 4.

Complete numerical details cannot be given here ; in any event it can be shown by such energetic discussions that a static spatial model of liquid He II of whatever regular configuration is certainly not possible. This has been previously suggested in consideration of the great zero point amplitude calculated for He[4]. The determination of the most favourable co-ordination numbers of the first and second neighbours, however, maintains a good physical meaning : it may be considered as a rough Hartree calculus which yields the self-consistent field and the corresponding probability distribution of the atoms belonging to the minimum of energy.

(2) It seems, therefore, reasonable to imagine a model in which each He atom moves in a self-consistent periodic field formed by the other atoms. The different states of the atoms may be described by eigen functions of a similar type to the electronic eigen functions which appear in Bloch's theory of metals ; and, as in Bloch's theory, the energy of the lowest states will roughly be represented by a quadratic function of the wave number K,

$$E = \frac{\hbar^2}{2m^*} K^2,$$

the effective mass m^* being of the order of magnitude of the mass of the atoms. But in the present case we are obliged to apply Bose-Einstein statistics instead of Fermi statistics.

(3) In his well-known papers, Einstein has already discussed a peculiar condensation phenomenon of the 'Bose-Einstein' gas; but in the course of time the degeneracy of the Bose-Einstein gas has rather got the reputation of having only a purely imaginary existence. Thus it is perhaps not generally known that this condensation phenomenon actually represents a discontinuity of the derivative of the specific heat (phase transition of third order). In the accompanying figure the specific heat (C_v) of an *ideal* Bose-Einstein gas is represented as a function of T/T_0 where

$$T_0 = \frac{h^2}{2\pi m^* k}\left(\frac{n}{2{,}615}\right)^{2/3}.$$

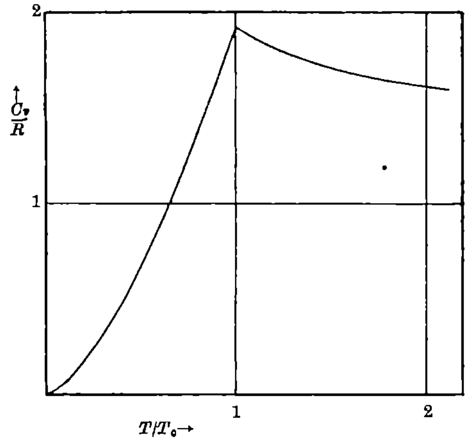
With m^* = the mass of a He atom and with the mol. volume $\frac{N_l}{n} = 27 \cdot 6$ cm.³ one obtains $T_0 = 3 \cdot 09°$. For $T \leqslant T_0$ the specific heat is given by

$$C_v = 1 \cdot 92\, R\, (T/T_0)^{3/2}$$

and for $T \geqslant T_0$ by

$$C_v = \frac{3}{2}\, \mathrm{R}\left[1 + 0 \cdot 231\left(\frac{T_0}{T}\right)^{3/2} + 0 \cdot 046\left(\frac{T_0}{T}\right)^{3} + \ldots\right]$$

The entropy at the transition point T_0 amounts to $1 \cdot 28\, R$ independently of T_0.



SPECIFIC HEAT OF AN IDEAL BOSE-EINSTEIN GAS.

(4) Though actually the λ-point of helium resembles rather a phase transition of second order, it seems difficult not to imagine a connexion with the condensation phenomenon of the Bose-Einstein statistics. The experimental values of the temperature of the λ-point (2·19°) and of its entropy ($\sim 0 \cdot 8\, R$) seem to be in favour of this conception. On the other hand, it is obvious that a model which is so far away from reality that it simplifies liquid helium to an ideal gas, cannot, for high temperatures, yield but the value $C_v = 3/2\, R$, and also for low temperatures the ideal Bose-Einstein gas must, of course, give too great a specific heat, since it does not account for the gradual 'freezing in' of the Debye frequencies.

According to our conception the quantum states of liquid helium would have to correspond, so to speak, to both the states of the electrons and to the Debye vibrational states of the lattice in the theory of metals. It would, of course, be necessary to incorporate this feature into the theory before it can be expected to furnish quantitative insight into the properties of liquid helium.

The conception here proposed might also throw a light on the peculiar transport phenomena observed with He II (enormous conductivity of heat[5], extremely small viscosity[6] and also the strange fountain phenomenon recently discovered by Allen and Jones[2]).

A detailed discussion of these questions will be published in the *Journal de Physique*.

F. LONDON.

Institut Henri Poincaré,
Paris.
March 5.

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[1] Frohlich, H., *Physica*, **4**, 639 (1937).

[2] Allen, J. F., and Jones, H., NATURE, **141**, 243 (1938).

[3] Simon, F., NATURE, **133**, 529 (1934).

[4] London, F., *Proc. Roy. Soc.*, A, **153**, 576 (1936).

[5] Rollin, *Physica*, **2**, 557 (1935); Keesom, W. H., and Keesom, H. P., *Physica*, **3**, 359 (1936); Allen, J. F., Peierls, R., and Zaki Uddin, M., NATURE, **140**, 62 (1937).

[6] Burton, E. F., NATURE, **135**, 265 (1935); Kapitza, P., NATURE, **141**, 74 (1938); Allen, J. F. and Misener, A. D., NATURE, **141**, 75 (1938).

Cross-Sections of the Deuteron for the Electric and Magnetic Nuclear Photo-effect

THE cross-section for the scattering of slow neutrons by protons leads to the assumption of a ^1S level in the deuteron nucleus, with an energy of about 100,000 volts[1]. Fermi[2] showed that the capture of thermal neutrons by protons can be understood qualitatively as a magnetic dipole transition from a ^1S level to the fundamental ^3S level of the deuteron. The amount of the capture cross-section would still depend on the sign of the ^1S level. For a virtual ^1S level, the mean life of neutrons in water (not paraffin) should be $\tau = 2 \cdot 9 \times 10^{-24}$ sec. For a real level $\tau = 6 \cdot 3 \times 10^{-4}$ sec. The values for a virtual level are in good agreement with the recently obtained experimental value[3], $\tau = 2 \cdot 7 \times 10^{-4}$. The evidence obtained by the scattering of thermal neutrons by ortho- and para-hydrogen indicates as well a virtual level[4].

The photo-disintegration of the deuteron by γ-rays may take place by two transitions: the magnetic photo-effect is the inverse of the capture, a ^3S–^1S transition, it leads to uniform angular distribution of the neutrons and protons. The photo-electric effect is due to a ^3S–^3P transition, and consequently the number of protons or neutrons emitted per unit solid angle should be proportional to the sine² of the angle between the incident γ-ray and the photo-particles. The relative contribution of the two photo-effects depends on the sign of the ^1S level. For 2·6 Mev. γ-rays the ratio of the number of neutrons or protons observed in the direction of the incident γ-ray to the number observed at 90° is expected to be

$$I_0/I_{90} = 0 \cdot 29 \text{ for a virtual level}^5.$$
$$= 0 \cdot 13 \text{ for a real level.}$$

Chadwick, Feather and Bretscher[6] observed the angular distribution of 65 photo-protons obtained by the γ-rays of thorium-C′ in a cloud chamber. The total angular distribution seems to show a contribution of the magnetic effect, which is still lower than the one expected for a real level.

I have measured the number of photo-neutrons emitted by a sphere of heavy water (diameter = 10 mm.) in the direction of the γ-rays and at 90° to this direction. As a source 450 mc. of mesothorium were used, the neutrons were detected by the artificial radioactivity of 3 gm. of dysprosium oxide, placed at 33 cm. distance from the heavy water in a paraffin cone of 10° opening. The number of kicks observed at 90° ± 20° to the γ-rays was 700 ± 42, and only 47 ± 40 were observed in the corresponding time at 0° ± 20°. For a pure sine[5] distribution one should expect for the given geometrical conditions at 0°, 5 per cent of the intensity observed at 90°. This result confirms the observation of Chadwick, Feather and Bretscher; the magnetic photo-effect will scarcely yield more than 5 per cent of the photo-electrical intensity observed at 90°, instead of 29 per cent expected. The cross-section of the deuteron for the total photo-effect for 2·64 Mev. γ-rays was obtained by counting the total number of neutrons slowed down in a large tank filled with water, after the method developed by Amaldi and Fermi[7] and Amaldi, Hafstad and Tuve[8]. The total cross-section is found to be $9 \pm 0{\cdot}8 \times 10^{-28}$ cm.^{2}. The cross-section for the electric effect is therefore 9×10^{-28} cm.^{2}, in good agreement with theoretical expectation. An upper limit of 6×10^{-29} cm.^{2} can be indicated for the magnetic effect; this value is much lower than that derived from the capture cross-section of protons for thermal neutrons.

I thank Prof. Urbain for the generous gift of 3 gm. dysprosium oxide and "La société de produits chimiques des terres rares", who kindly lent me the mesothorium source.

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Paris.
Feb. 19.

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[1] Wigner, *Phys. Rev.*, **51**, 106 (1937).

[2] Fermi, E., *Ric. Sc.*, 7, 2 (1936).

[3] Frisch, Halban, Koch, Nature, **170**, 895 (1937).

[4] Dunning, Manley, Hoge, and Brickwedde, *Phys. Rev.*, **52**, 1076 (1937); Halpern, Esteiman, Simson and Stern, *Phys. Rev.*, **52**, 142 (1937); Schwinger and Teller, *Phys. Rev.*, **52**, 286 (1937).

[5] See Bethe and Bacher, *Rev. Modern Physics*, 8 (1936). For the number given here the scattering cross-section was assumed to be 18×10^{-24} cm.^{2} for 'free protons' and slow neutrons, and the difference of the magnetic moments of proton and neutron 4·2 nuclear magnetons.

[6] Chadwick, Feather and Bretscher, *Proc. Roy. Soc.*, A, **154**, 366 (1937); see also Richardson, R., and Emo, L., *Phys. Rev.*, **53**, 234 (1938).

[7] Amaldi, Fermi, *Phys. Rev.*, **50**, 899 (1936).

[8] Amaldi, Hafstad and Tuve, *Phys. Rev.*, 51, 896 (1937).

Wilson Chamber Study of the Neutro-Electric Effect

In our previous letter describing the results of our Wilson chamber study of the neutro-electric effect[1], we stated that we had found the paired tracks of a proton and an electron in such numbers as would be expected from our counter experiments (assuming the validity of the conservation laws for the energy and momentum).

Since then, we have taken photographs of 10,538 proton tracks; of these 6,448 were taken by using D—D neutrons, and the remaining 4,090 were taken with Li—D neutrons. In each case we found three paired tracks. This is about one sixth of what is expected. Though it is not impossible that they are due to accidental coincidence of the two independent tracks, the fact that we could find no paired track in which the electron starts from the end of the proton track seems to indicate that they are true pairs.

The smaller effect compared with our former result might be explained partly by the fact that the photographs were much clearer in the present case than in the former, and the accuracy of discriminating whether or not the tracks were true pairs was raised considerably, and partly to the statistical fluctuation. No definite conclusion can be drawn from our present result. One may only say that the neutro-electric effect cannot be explained in terms of the direct interaction of the neutron with the atom satisfying the conservation laws, if our previous cross-section determination is not in error by a factor of about 6.

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Feb. 26.

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[1] Nature, **141**, 323 (1938).

High-Pressure Afterglow in Nitrogen

A most remarkable afterglow in nitrogen has been observed at pressures higher than 10 mm. This afterglow has certain properties which would scarcely be looked for in an afterglow at high pressures. The most striking of these is the relatively strong excitation of the Vegard-Kaplan intercombination bands, which originate on the $A^3\Sigma$-metastable state of nitrogen. Their intensity relative to the usually strong second-positive bands is as high as the intensity in the night-sky afterglow which I reported several years ago[1]. The remarkable nature of this phenomenon will be realized when it is pointed out that the weak night-sky glow was produced at pressures of approximately 0·01 mm. by means of a very feeble exciting discharge, while this strong new glow is produced at about 1,000 times that pressure by means of a very strong exciting discharge. In fact, the relative intensity of these bands has been increasing steadily with pressure in the range so far studied. This is an anomalous result in view of the metastability of the $A^3\Sigma$ level. Moreover, the high-pressure afterglow is more intense and has a longer life than similar glows at lower pressures.

There is present on these afterglow plates a strong line at a wave-length of approximately 3470 A., which has not yet been identified. Its behaviour, as the tube cleans up and the nitrogen becomes purer, is now being studied. It is important, too, that a relatively strong unidentified line or band has been reported by both Dufay[2] and Gauzit[3] in the light of the night sky at a wave-length of 3471 A. The presence of this line in the new high-pressure afterglow, in companionship with the Vegard-Kaplan bands, which are strong in the light of the night sky, suggests that it may be the hitherto unobserved atomic nitrogen line $^2P - {}^4S$, the predicted position of which is also 3470 A. If this be true, then the auroral transition $^2P - {}^2D$ should be much stronger in the afterglow, as well as in the light of the night sky, than 3470 A. The approximate position of the components of the $^2P - {}^2D$ transition is at 1·0373 μ, and until it is observed in the present experiments or in the light of the night sky, the above proposed identification of the 3470 line as the trans-auroral transition $^2P - {}^4S$ should be considered tentative. It may be pointed out, however, that the infra-red lines at 1·0373 μ would be the nitrogen analogue of the well-known auroral green line.

Added weight is given to the identification of the 3470 line as the unknown atomic nitrogen line, rather than as the second-positive band at 3469, by the fact that the second-positive bands, which are usually stronger than 3469, are either absent or weaker in the light of the night sky. A discovery of this significance for the physics of the upper atmosphere must be carefully considered, and a programme of exhaustive investigation of the 3470 line is now under way. Until further study, therefore, the identification must be given as a tentative one, attractive as the above arguments may sound.

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[1] Kaplan, *Phys. Rev.*, 48, 800 (1935).

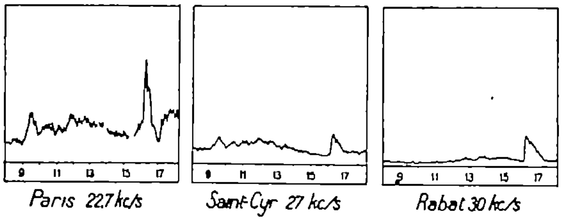
[2] Dufay, *J. Phys.*, VII, 5, 523 (1934).

[3] Gaunt, *J. Phys.*, VII, 5, 527 (1934).

Effect of Catastrophic Ionospheric Disturbances on Low-Frequency Radio Waves

K. G. Budden and J. A. Ratcliffe[1] have described an effect of catastrophic ionospheric disturbances on low-frequency radio waves (16 kc./s.), but this action did not show an increase in atmospherics.

This last statement agrees with our observations. It is certain that an increase in atmospherics seldom appears on a frequency of 12 kc./s. This has been known for several years. A recent observation shows that, on a frequency of 17 kc./s., increase had already disappeared.



Increases noticed at Paris (22 kc./s.), St. Cyr (27 kc./s.) and Rabat (30 kc./s.) on November 6, 1936 (date of the anomally published by K. G. Budden and J. A. Ratcliffe), are shown on the accompanying figure.

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Feb. 19.

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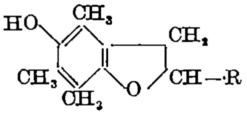
[1] NATURE, 140, 1060–1061 (1937).

Vitamin E: Structure of β-Tocopherol

IN a recent publication[1] we indicated that β-tocopherol, $C_{28}H_{48}O_2$, might be a coumaran or chroman derivative bearing a long side chain in the heterocyclic nucleus.

With the view of testing this hypothesis, we have synthesized 5-hydroxy-2 : 4 : 6 : 7-tetramethylcoumaran (I), m.p. 124–125°, starting from pseudocumoquinol and allyl bromide, and also 5-hydroxy-4 : 6 : 7-trimethyl-2-*n*-heptadecylcoumaran (II), m.p. 95–95·5°, isomeric with β-tocopherol, from pseudocumoquinone and ethylsodiostearoylacetate followed by partial hydrogenation of the intermediate coumarone.



I R = CH_3

II R = $C_{17}H_{35}$

Both the synthetic coumarans are very similar to β-tocopherol in absorption spectrum and reducing properties.

Substance	Wave-length		ε mol	
	Max.	Min.	Max.	Min.
β-tocopherol . . .	295mμ	260mμ	3577	520
'Heptadecylcoumaran' . .	297mμ	258mμ	3993	624
'Methylcoumaran' . .	296mμ	270mμ	3840	1305

When thermal decomposition is attempted, synthetic 5-hydroxy-4 : 6 : 7-trimethyl-2-*n*-heptadecylcoumaran distils at 370° without charring, giving a mixture from which a trace of a quinol is obtained, m.p. 185–190° (subl.) (cf. thermal decomposition of tocopherols, *loc. cit.*).

These results together with the surface film measurements of Dr. Danielli, recorded below, give support to the view that β-tocopherol is a coumaran derivative. The detailed configuration of the side chain, and the distribution of CH_3-groups in the ring system remain to be determined. Side methyl estimations of β-tocopherol indicate the presence of six or seven $CH_3(C)$. Two or possibly three of these can be attached to the aromatic nucleus; the remaining three to five can be accounted for by formulating the side chain and the heterocyclic nucleus as a 'dihydrophytyl'-like structure; such a structure would explain also the oily nature of the vitamin and the ready production of quinols on thermal decomposition. This hypothesis is supported by results of oxidation: two oily fatty acids, C_{17-18} and C_{11-12}, are obtained, giving crystalline phenylphenacylesters.

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March 10.

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[1] Bergel, Todd and Work, *J. Chem. Soc.*, 253 (1938).

Both β-tocopherol allophanate and 5-hydroxy-4 : 6 : 7-trimethyl-2-*n*-heptadecylcoumarone spread on *N*/100 hydrochloric acid to give stable films. The limiting area of the first compound is 30 sq. A. and that of the coumarone is 26 sq. A. *p*-Hexadecylcyclohexanol has a limiting area of 30 sq. A. and the lactone of γ-hydroxystearic acid an area of 29 sq. A. It may therefore be concluded that the first two compounds mentioned are analogous in structure and that in cross-section β-tocopherol cannot have a ring system more than one ring in thickness measured perpendicular to the side chain. The ring system cannot be analogous to a phenanthrene or sterol skeleton.

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March 10.

Function of Carbon Dioxide in the Metabolism of Heterotrophic Cells

In recent years the indispensability of small quantities of carbon dioxide for the growth of very diverse heterotrophic cells has been amply demonstrated. For a fairly recent survey of literature, reference may be made to the paper of Gladstone, Fildes and Richardson[1]. Until now, however, no explanation has been given for this unexpected phenomenon.

Two possibilities present themselves. In the first place, the fact that very common types of bacteria, yeasts and fungi proliferate in a given medium if traces of carbon dioxide are present, but do not do so in its absence, may mean that carbon dioxide is the starting point for the synthesis of some essential cell constituent. This implies, of course, that carbon dioxide will be chemically converted, or in other words reduced, by the heterotrophic cells of the inoculum. Although it seems improbable that this power is a universal property of the numerous heterotrophic organisms for which the indispensability of carbon dioxide has already been demonstrated, the possibility cannot be at once rejected in view of the results obtained in the recent studies of Woods[2], Wood and Werkman[3], Barker[4] and others.

It may, however, suffice to state here that all attempts made so far to obtain experimental evidence in favour of this assumption have been unsuccessful.

A second possible explanation for the necessity of carbon dioxide for the growth of heterotrophic cells might be sought in a demonstration that this compound is essential for the functioning of the energy-yielding reactions normally occurring in the cells of the inoculum. Since only aerobic organisms have been studied, this would mean that the ultimate removal of carbon dioxide from the cells interferes with the respiration process. This would imply that carbon dioxide is not only essential for the proliferation of heterotrophic cells, but also for the respiration of a suspension of preformed 'resting cells'.

After experiments to test this hypothesis had already been started, I found that a similar suggestion had been made by Krebs[5], who, however, did not offer experimental support for his assumption that carbon dioxide might act as a hydrogen carrier in the respiration of *B. coli*.

I have now succeeded in proving that carbon dioxide is, indeed, essential in the normal functioning of the oxidation-reduction catalysts in various heterotrophic cells, in so far at least that complete removal of carbon dioxide leads to an inhibition of methylene blue reduction. It was found that this reduction under the usual conditions is fully prevented if the medium is rigorously freed from the last traces of carbon dioxide previous to the test. For this purpose, some solid caustic potash was placed in the side bulb of a Thunberg-Keilin tube, and the tubes were shaken, keeping them at a temperature of 0° C. to prevent reduction before the removal of the carbon dioxide was completed. After some hours the tubes were incubated in a water bath at 37° C. in order to test whether or not reduction of the dye would occur. Using *B. coli* or *B. prodigiosum* as test organisms, no reduction took place although the experiment was continued for 24 hours; control tubes submitted to a similar pre-treatment, with calcium chloride instead of caustic potash in the side bulb, readily reduced the methylene blue.

With organisms like *Saccharomyces ellipsoideus* (Chambertin yeast), *Aspergillus niger* or *Prototheca* species which ordinarily contain large quantities of reserve carbohydrates—easily leading to carbon dioxide production in the cells—no absolute inhibition of methylene blue reduction could be obtained, but the time necessary for the reduction was considerably prolonged, showing that here the same condition prevails.

I am much indebted to Prof. A. J. Kluyver at Delft (Holland) for his kind help in guiding me with many suggestions during the investigation.

J. W. Hes.

Service des Fermentations,
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Paris.
March 14.

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[1] *Brit. J. Exp. Path.*, 16, 335 (1935).

[2] *Biochem J*, 30, 515 (1936).

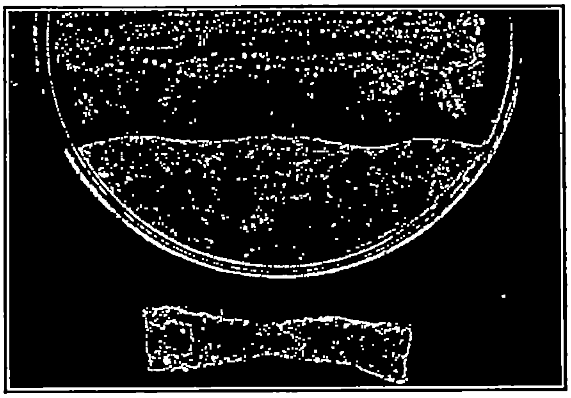
[3] *Biochem. J.*, 30, 48 (1936).

[4] *Archiv f Mikrobiol.*, 7, 404 (1936)

[5] *Biochem. J.*, 31, 2095 (1937).

Dissolving Action of Micro-Organisms on Milk-Wool

Milk-wool is now becoming of universal interest, and samples are being shown now and then of textile products containing 50 or even 100 per cent of this material. It appears to us, however, that due consideration should be given to the question, whether these products can withstand the biological agencies provided by Nature in the form of organisms able to assimilate and mineralize protein substances of the class to which casein belongs.



Above: Milk-wool plate Dissolving action of micro-organisms.
Below: Piece of 100 per cent milk-wool textile.
Left: two holes, caused by sterile pieces of clarified milk-wool agar Right: piece of same agar, non-inoculated, as control (no change).

These considerations have induced us to investigate the possibility of isolating casein-splitting organisms, which are also capable of attacking the formol-hardened casein, milk-wool.

It was found that nearly all casein-splitting micro-organisms, isolated from soil or manure, or gathered by infection from the ordinary atmosphere, are able to attack the wool. They belong to all classes: bacteria, moulds, actinomyces, many of which show a very strong dissolving action when grown on water-agar plates containing the usual inorganic salts and finely divided milk-wool threads. These organisms invariably act by an exo-enzyme, and so a fairly large zone is developed around the places of their growth, where every thread of milk-wool is dissolved and the milky white agar has become completely transparent. Pieces of agar from this zone, when applied to a piece of textile material of 50 per cent milk-wool, were able to destroy all the milk-wool beneath them, leaving the 50 per cent of genuine wool unattacked. The 100 per cent milk-wool textile was completely dissolved, resulting in a hole after two days, as the accompanying illustration shows. The enzyme was inactivated by boiling.

The direct action of the micro-organisms, when applied to pieces of textile material, lying on agar-plates, which contained only inorganic salts, was equally deleterious.

The experiments are being continued in several directions.

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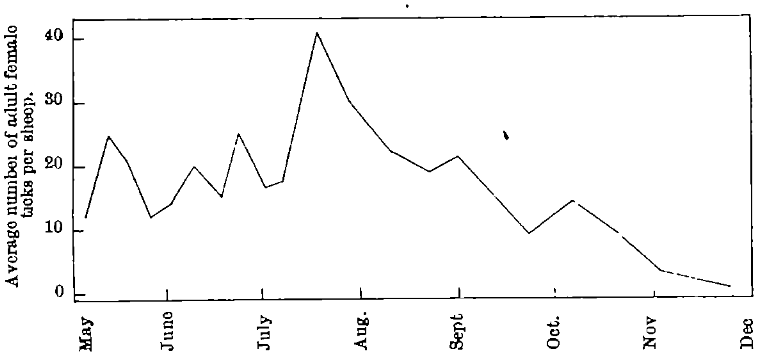
March 3.

Activity of the Sheep Tick

THE activity of the sheep or grass tick, *Ixodes ricinus* L., in Great Britain has been reported by various workers[1,2,3] to be confined to two periods of the year: (*a*) spring activity, extending from March until early June, (*b*) autumn activity, from late August until the end of September. Outside these periods, ticks are said to be scarce during the summer months and completely inactive in winter.

In the spring of 1937, an investigation was commenced by us upon the incidence of *Ixodes ricinus* in the Deeside area, and it has been found that its activity differs very widely from that reported in other parts of the country.

The accompanying graph, showing the seasonal activity upon one hill-grazing, is representative of data obtained from several holdings. In making the tick counts upon the sheep, only the adult females upon the head and neck and on the bare skin beneath the forelegs were counted. This method, which is also in use by other observers, enables one worker to examine large numbers of sheep and allows some comparison to be made with the results obtained by other workers.



SEASONAL ACTIVITY OF TICKS IN NORTH-EAST SCOTLAND

From observations made upon hares previous to the sheep being placed upon the hill, the ticks had already begun their activity in this district during the first week in April. The sheep were attacked as soon as they grazed upon the hill and the infestation progressively increased to a peak in the month of July, after which there was a gradual decrease. When the sheep were removed from the hill on November 25 there was still an average infestation of 0·5 ticks per sheep.

During the month of December the worst snowstorm for many years swept the country, and we assumed the ticks would become inactive for the remainder of the winter.

On January 12, 1938, two stags were shot which had ticks attached, one a fully engorged female, which, from its appearance, had become attached about ten days previously, when the hills were still covered with snow. This female commenced egg-laying on February 5.

On January 27, a flock of sheep upon a tick-infested pasture on another hill were found to have an average of 1·5 adult female ticks attached to the head and neck and the bare skin beneath the legs, in addition to large numbers of males, nymphs and larvæ. Five deer, which were shot on this date, were found to be carrying a total of 42 adult female and 25 male ticks. The flock of sheep was again examined on February 9 and had an average of 1·2 female ticks attached.

From these observations it appears that tick activity is continuous throughout the year in north-east Scotland, the seasonal incidence being greatest during the summer and lowest in winter.

Further work upon this problem, aided by a grant from the Agricultural Research Council, is proceeding, and detailed results will be published elsewhere.

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Marischal College,
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March 1.

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Tube Formation in *Pomatoceros triqueter* (L.)

AMONG the scientific effects of the late Frank A. Potts was found the following account of tube formation in the serpulid worm *Pomatoceros triqueter*, a subject on which he had been working intermittently for some time.

The apparently homogeneous keeled tube is seen in longitudinal section to be composed of successive rings of calcium carbonate. The substance of the tube is of a mucoid nature in which small crystals of aragonite are deposited. Each successive ring is formed by the peristomial collar which arises from the ventral wall. As the animal lies on its back, the ventral surface with the collar is uppermost.

When the animal is removed from its tube it will live for an indefinite period, and in normal sea water will form one or two calcareous rings. If instead of normal sea water artificial sea water (Dittmar's formula) is used, the worms live almost as well as in normal sea water and produce rings with equal facility. If the animals are taken out of their tubes and placed in artificial calcium-free sea water, they will live for a number of days and are apparently normal, but they do not produce calcareous rings. Animals which have been kept like this in calcium-free sea water, if transferred back to normal sea water, produce calcareous rings. If animals removed from their tubes are placed in artificial sea water in which there is half the amount of calcium chloride required by Dittmar's formula, that is, about 210 mgm. instead of 420 mgm. calcium per litre, they will form rings at roughly the same rate of deposition as when the normal amount of calcium chloride is present. From preliminary experiments, it appears that the amount of calcium can be further reduced without inhibiting the production of calcium carbonate.

The above experiments show an independence of food in the calcium carbonate forming activities. If worms which have been feeding are at once removed to calcium-free sea water, they are unable to form the calcareous rings. There are no organs in *Pomatoceros* which might act as special stores of calcium. If the blood be considered as a possible store of calcium, it may be mentioned that the frequent severe hæmorrhage which occurs on removing the worm from its tube does not interfere with the immediate production of calcareous rings. The evidence so far collected points to the sea water as the source of the calcium required for tube building.

In Nature the production of the calcareous tube begins in March and goes on until August or September. The length of life of *Pomatoceros* is from two to three years at least. The animal begins its tube building activities in the spring presumably about the time it begins to feed, and it builds its tube continuously until the autumn.

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Feb. 28.

Relation between Structure of Pine Leaves and their Position on the Tree

The quantitative anatomical method has recently acquired an increasing importance in determining the face, the form, or even the variety of various cultivated plants. It has also been applied in the study of the leaf of the pine (*Pinus silvestris* L.)[1,2,3]. Unfortunately, however, scarcely any of the investigators have considered the position on the tree to which are attached the leaves taken for study. Whereas, so early as 1904, Zalensky[4] discovered the law which has, in the Russian literature, acquired the name of 'Zalensky's law' (Maximov[5]), but which, unfortunately, remained unknown in western Europe and was considerably later rediscovered by a number of investigators[6]. Zalensky, studying monocotyledonous and dicotyledonous plants on a very extensive and variegated material, showed that the higher up on the tree the leaf grows (or the nearer to the end of the branch) the greater the xeromorphic properties it acquires; that is, the epidermis and mesophyll cells are smaller, the conducting strand is thicker, the cuticle and wax coating are thicker, the stomata are greater in number and smaller, the palisade tissue is more clearly defined. It was to be expected that a similar law would be found for Gymnospermæ, except that, in connexion with the peculiar structure of the leaf in conifers, it would take a slightly different form.

An investigation of the leaves of several pines by stages confirmed this supposition. It was shown that the higher up on the tree (or closer to the end of the branch) the leaf grows, the longer, broader, and thicker it is; the central cylinder is wider and thicker, the conducting bundles are larger, the resin canals are greater in number and larger, the epidermis is thicker. The difference between the upper and lower stages of hundred-year-old pines in the length and breadth of the leaves, in the thickness of the conducting tissue, in the number of resin canals, reaches 25 per cent[7].

Thus, in every quantitative anatomical study of the leaves of *Pinus*, it is necessary to choose material for comparison from the same regions on the tree, which have grown under similar conditions. Failure to observe this rule may completely destroy the value of the results of the investigation.

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Blood Groups of the Noluas of Bengal

The Noluas are a group of people who collect reeds and manufacture different types of basket from it. They live in four districts of Bengal—Jessore, Khulna, Faridpur and Nadia. Their total strength is 1,704-884 males and 820 females. They are a short-statured, mesocephalic and mesorrhine people.

I examined the blood of 100 adult male Noluas of four districts, 25 from each. All the samples were examined carefully with fresh standard serum. The following are the data which I obtained: group *O*, 16 per cent; group *A*, 38 per cent; group *B*, 33 per cent; group *AB*, 13 per cent.

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Feb. 16.

"Clay"

In Nature of April 2, Dr. A. B. Searle refers at some length to a discourse on clay which I gave at the Royal Institution a few months ago. Dr. Searle is too generous to me in his account of our present knowledge of clay structure. The application of the X-ray methods to this difficult but most interesting problem was, in the first place, based on the silicate investigations at Manchester, and has been made by many workers, especially by Pauling and his collaborators in the United States, and by Nagelschmidt and others in Germany and Great Britain. My discourse was a brief summary and comment on the work done and doing by others than myself.

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April 2.

A Shortened Method of Estimation of Mental Factors by Regression

A type of problem of estimation with which one meets in the theory of mental factors is this: a team of n tests z_i ($i = 1, 2, \ldots, n$) has been analysed into r common factors $f_{0\alpha}$ ($\alpha = 1, 2, \ldots r$) and n specifics f_{1i}, all of which are normalized and uncorrelated, but otherwise unknown. The observed test-scores (in standard measure) can then, in matrix notation, be represented as follows.

$$z = M_0 f_0 + M_1 f_1,$$

where the column vectors z, f_0 and f_1 indicate the tests, the common factors and the specifics respectively. The matrices M_0 and M_1 whose elements are the loadings of the tests with the hypothetical factors, are regarded as known. When it is desired to estimate the common factors in terms of the test-scores, the usual regression method leads to the formula:

$$\hat{f}_0 = M'_0(M_0 M'_0 + M_1^2)^{-1} z, \quad \ldots \quad (1)$$

where $\hat{f}_0$ is the estimate of f_0.

If the number of tests, n, is large, the evaluation of this expression is very laborious, since it involves calculating the reciprocal of the n-rowed matrix $M_0 M'_0 + M_1^2$. However, according to L. L. Thurstone, the number of common factors, r, is in most practical cases much smaller than the number of tests; in these circumstances it is more convenient to use the formula:

$$\hat{f}_0 = (I + M'_0 M_1^{-2} M_0)^{-1} M'_0 M_1^{-2} z, \quad \ldots \quad (2)$$

in which now only the reciprocal of an r-rowed matrix is required.

Formula (2) is an extension to multiple factor analysis of a formula which Prof. C. Spearman has derived for the estimation of the 'general factor' g in the theory of two factors.

A more detailed account of this will be given elsewhere.

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Feb. 10.

Points from Foregoing Letters

In an investigation of the capture γ-radiation produced by protons in carbon, P. I. Dee, S. C. Curran and V. Petržílka find that there are two resonances. One of these, at 400 kv., is due to ^{12}C, the other, at 500 kv., is due to ^{13}C. The energies of the capture γ-radiations have been measured, giving for ^{12}C the value 2·6 Mv. and for ^{13}C the value 7·4 Mv. These values agree with those to be expected from the known mass values.

From energetics considerations, Dr. F. London concludes that a spatial model of liquid helium II such as that proposed by Frölich to explain the λ-transition point is not possible. The author describes, instead, a kinetic model in which each helium atom moves in a self-consistent periodic field formed by the other atoms. He calculates the specific heat of such a system by applying Bose-Einstein statistics on the very rough simplifying assumption of 'ideal gas' conditions. The author considers that his view may throw light on the large heat conductivity and the small viscosity of helium II.

The cross-section for the total nuclear photo-effect of the deuteron for 2·64 Mev. γ-rays has been determined by Dr. H. v. Halban, jun. The relative contributions of the electric and magnetic effects were separated by counting the number of photo-neutrons projected in the direction of the incident γ-ray and at 90° to this direction. The cross-section found for the magnetic effect is lower than would be expected from the capture cross-section of protons for thermal neutrons.

Among some 10,000 proton tracks obtained by using D—D and Li—D neutrons and photographed in a Wilson chamber, S. Kikuchi and H. Aoki have found only six pairs, a smaller proportion than formerly noticed, and only one sixth of the expected number on the basis of the 'neutro-electric effect.'

An unusual intense nitrogen afterglow has been produced by Prof. J. Kaplan at pressures higher than 10 mm. Its spectrum is rich in bands of the Vegard–Kaplan intercombination system and contains a strong line at 3470 A. which is tentatively identified as the hitherto unobserved trans-auroral line $^2P - {}^4S$. There is a fairly strong line at this wave-length in the light of the night sky. A search is now being made for the $^2P - {}^2D$ lines in the high-pressure glow. These should lie around 1·0373 μ and would be the nitrogen analogues of the well-known green auroral line.

Further investigations towards elucidating the structure of the anti-sterility vitamin E are reported by Dr. F. Bergel, A. Jacob, A. R. Todd and T. S. Work. From the fact that a synthetic coumaran derivative behaves similarly to β-tocopherol upon thermal decomposition and from surface film measurements carried out by Dr. J. F. Danielli, they conclude that β-tocopherol is a coumaran derivative.

Dr. J. W. Hes finds that the complete removal of carbon dioxide interferes with the oxidation-reduction power (as shown by the methylene blue reaction) in the case of heterotrophic cells, that is, bacteria and other low organisms which cannot synthesize proteins and carbohydrates from inorganic constituents. This explains the indispensability of carbon dioxide for the growth of such organisms.

Prof. Jan Smit and B. van der Heide report on experiments showing that milk-wool, made from milk-casein, is readily attacked by many kinds of micro-organisms, which may thus affect durability of textile products made from that substance. The dissolving action was likewise shown by sterile pieces of the milk-wool agar, on which the organisms were grown, and taken from places where the wool had been dissolved by an exo-enzyme. The enzyme was destroyed by heating the agar.

A study of the formation of the calcareous tube of the serpulid worm *Pomatoceros triqueter* by the late Frank A. Potts, reported by J. D. Robertson and Dr. C. F. A. Pantin, has shown that the source of calcium for the tube is probably the sea water. Tube building in this polychæte extends from March to September.

Research Items

'Bone Age' Man

The Abbé Breuil in *Antiquity* of March argues for a much more extensive use of bone in the earlier phases of the Palæolithic period than is at present conceded by archæologists. In the Later Palæolithic period, the technique of bone is already far advanced, and the implements must have had more ancient prototypes; but in fact the only Middle Palæolithic examples known of bone-working by means of attrition and scraping are few in number—rib-bones sharpened by rubbing, occasional awls similarly sharpened, and two large spear-points of the Upper Mousterian from Castillo and La Quina, to which might be added the anvil blocks and trimming tools discovered by Dr. H. Martin. Further, stone suitable for implements does not occur everywhere, and the technique of its working is a process of long development. Therefore some authorities postulate an age of bone and wood. Man in the dawn of the industrial phase would naturally take the remains of animals killed by him, horns, antlers and bones, to use against them. The long bones would make excellent clubs, while others in their natural state could be used for pricking and piercing, or as planes and hammers, either in the natural state or when broken by a pebble. Bones, however, gnawed by carnivores or rodents show marks suggesting human workmanship, which are apt to deceive the archæologist. The bone claimed to have been worked by Piltdown man is an instance in point. Evidence for the use of slightly modified parts of his victim by early man is afforded in the cave of Castillo (Santandar, Spain) and Choukoutien (Peking). The evidence of the horns of ruminants and deer antlers, of skulls or parts of skulls, of jaw bones and long bones, of shoulder, iliac and trunk bones from both sources suggest the belief, at least, that at some ancient epoch the use of bones may have been of more importance than the use of stone.

Ainu Marriage Ceremonial

In an account of a traditional oration or song intoned or sung at an Ainu marriage which Dr. N. Gordon Munro collected from an Ainu learned in the lore of his people (*Man*, March 1938) he records the order of ceremonial in which the song was introduced. The song itself belongs to a class *Yai-kuru-e-karapa*, meaning personal speech-making, a term used only of an address on a felicitous occasion, but never for a funeral oration or at any other sad event. At a wedding, it is delivered by the father of the bride. On the occasion here recorded the song indicated that the daughter was an only child, and there is a hint of anxiety now relieved by the prospect of her children continuing the line. The bridegroom has been approved, more particularly as to his line of descent. Ainu society was matrilineal and rigidly exogamous, the evidence of descent of each group from an eponymous ancestress being furnished by a secret girdle, which no man dare examine and which it was taboo even to mention. It is a cord conventionally taken to signify a particular ancestral source, according to its length and consequently the number of times it is folded to make a girdle. Elderly women, who treasure their esoteric knowledge, decide whether the girdle of the man's mother bears testimony to a descent other than that of the girl. All preliminaries ended and marriage gifts exchanged (there is no bride-price), and the most revered and trusted Kamui Fuchi—spirit ancestress of all Ainu who comes to light in the hearth-fire—having been solicited, all is in order. The bridegroom has sent to the home of the bride material for the sacred brew, which takes a week to make from millet with ritual precautions. When the guests have assembled for the feast, the father makes a speech or recitative in poetic form, which preludes the ancient rite of handing the cup of the sacred brew to the bridegroom, who drinks half and gives the remainder to his bride. Should she refuse it there is no marriage. The bride takes the cup and raises it to the level of her forehead, swings it gently thrice to right and left, drinks, and then performs the characteristic feminine gesture of *rai-mik*, in which the forefinger of the right hand is drawn from that of the left hand up the arm and across the upper lip.

Influence of Circulation on Size of Blood Vessels

By means of an indirectly illuminating microscope and a moist, warm chamber it is possible to study development of the vascular system in a living chick blastoderm still on its yolk for a period of seven days. This method was chosen by A. F. W. Hughes (*J. Anat.*, 72, Oct. 1937) to investigate the influence of the rate of circulation of the blood upon the diameter of the blood vessels. The rate of flow in the arteries and veins of the area vasculosa was determined by measuring the speed of the corpuscles in the margins of the vessels, and is termed the 'marginal velocity'. In the first ten hours the increase in diameter of the vessels may be 40 per cent per hour and the marginal velocity 4 mm. per sec. During the third and fourth days the marginal velocity drops to 1·2 mm. per sec. and the increase in diameter to 5 per cent per hour. Thus there is a correlation between marginal velocity and rate of increase in diameter of the vessels; the relationship, however, is not a simple mathematical one. In arteries, the mitotic rate of the endothelium is sufficient to account for the increase of diameter. When the veins are increasing rapidly in diameter, however, the mitotic rate of the endothelium is only sufficient to account for about one fifth of the increase in diameter. Since no noticeable increase in cell size is discernible, it is suggested that the remaining four fifths of the cells are supplied by the immigration of cells from the adjacent mesenchyme.

Crabs of America

Miss Mary J. Rathbun completes her series of handbooks on American crabs in a fourth volume, "The Oxystomatous and Allied Crabs of America" (United States National Museum. Bulletin 166. 1937). The former volumes have dealt with grapsoid crabs (Bulletin 97), spider crabs (Bulletin 129) and cancroid crabs (Bulletin 152). All these works are based on an enormous amount of material and the whole is exceedingly valuable. Carcinologists are fortunate in having this complete work by one of the greatest authorities on the subject. The present volume includes Gymnopleura, Oxystomata and

Dromiacea; also the Haplocarcinidea, the position of which in the Brachyura is uncertain, and one single example of *Geryon* (Brachygnatha) omitted previously from the volume on Grapsoids. The Dromiacea are still regarded as belonging to the Brachyura in spite of the fact that the larvæ differ entirely from any brachyuran zoea. The Oxystomata are the largest group represented and occupy the greater part of the volume (pp. 75–258). In this sub-tribe are many very interesting forms, some of peculiar shape, some so exactly resembling the pebbles in which they live that it is difficult, if not impossible, to detect them in their natural surroundings. The Calappidæ with their large chelæ which cover the ventral surface are also included here. The 86 plates, mainly from photographs, are good and clear.

Indian Brackish Water Fauna

N. Kesava Panikkar and R. Gopala Aiyar (*Proc. Ind. Acad. Sci.*, 6, Nov. 1937) have investigated the fauna of the brackish waters in the neighbourhood of Madras, particularly in regard to its relation to its habitat. The temperature of the water varies during the year from 25·0° C. to 29·6° C., its *p*H from 8·48 to 9·15, its salinity from 16·91 to 30·44 per mille. The change from marine to brackish water conditions is somewhat abrupt. Ninety-two species of invertebrates, eighty belonging to typically marine groups, are recorded, and this excludes Protozoa and Rotifera. The majority of the fifty-four fishes recorded are more or less permanent inhabitants; seven freshwater species and a few casual or seasonal migrants comprise the remainder. The fauna on the whole is typically marine. The animals are discussed from the point of view of their ecology and adaptation to their environment, which is described in detail. The vertical and regional distribution of the organisms is described, and there is a discussion of the general problems of the biology of animals in brackish water in the light of the facts brought forward.

Osmotic Values of Plant Tissue under Snow

During the British East Greenland Expedition of 1935–36 under the leadership of Dr. L. R. Wager, Dr. and Mrs. H. G. Wager carried out observations throughout the year upon the osmotic values of typical plants in Kangerdlugssuak, East Greenland. The osmotic values were determined by a plasmolytic method using sections or stripped portions of the epidermis and cane sugar solutions. Some of the species examined showed a sharp rise in osmotic value in late autumn, probably associated with the falling temperature both directly and indirectly, through the fact that the soil water was thus rendered unavailable. The most interesting result is the fact that five plants—two species of *Salix*, *Empetrum*, *Viscaria* and *Cassiope*—show a marked fall in osmotic value during the winter, whilst buried under the snow. The authors suggest that this is probably associated with a change in the water balance. Under the snow the air is continually saturated with water vapour and the water shortage in autumn, very clearly shown in some species by the shrunken protoplasts when examined in oil, no longer exists, the cells slowly saturate with water and the osmotic pressure falls. Comparison between the osmotic values of some of the same plants grown throughout the seasons in Dublin suggest, however, that the group of factors determining the seasonal changes of osmotic pressure is very complex.

Disease of Australian Pines

A progress report for 1936–37 entitled "Needle Fusion of Species of *Pinus* in Southern New South Wales" by W. V. Ludbrook has been issued (Melbourne, 1937) discussing the disease known as 'needle fusion', 'fused needle', or 'curly needle', which is confined to Australasia, being important chiefly in Queensland, Tasmania and the coastal plantations of New South Wales. Investigations appear to show that it is severe only when the soil conditions are unsuitable to the trees planted, a case which has other parallels elsewhere with introduced exotics. There is no evidence that it is infectious, though the cause of the disease is still unknown. It is said that the commercial value of severely affected trees is permanently destroyed. Diseased trees exhibit varying degrees of stunting, die-back and needle abnormality, but are rarely, if ever, killed by the disease. The symptoms commonly appear 3–7 years after the trees have been planted. The majority of the species of *Pinus* commonly grown for afforestation in Australia are susceptible, *P. pinaster* being the chief exception. *P. caribea* appears to be relatively resistant. It is said that there is little or no chance that the disease will cause appreciable loss in plantations where the soil and climatic conditions are satisfactory. In Queensland, climatic conditions are very different from those where the investigations were made, so that the conclusions arrived at may not be applicable.

Fusarium culmorum on Wheat

The fungus *Fusarium culmorum* has been described as the cause of various diseases of wheat, but modern investigations do not incriminate it strongly. G. Samuel and F. J. Greaney have, in fact, isolated it from healthy, high-yielding crops in three localities in the south of England (*Trans. Brit. Mycol. Soc.*, 21, Pts. 1 and 2, 114–117; 1937). One crop obtained the gold cup at the Bakers' Exhibition in London, yet in spite of this undoubted hall-mark, its roots and stems harboured *F. culmorum*. Very numerous isolates of the fungus were all mildly pathogenic under greenhouse conditions, and there would appear to be other evidence that the fungus really does cause damage in the northern parts of Great Britain. Such findings emphasize the need for greater development of the ecological side of plant pathology. A close alliance of laboratory studies and field estimations over a wide area is absolutely necessary for the correct evaluation of any host-fungus relationship.

Oceanic Sedimentation

From the stratification of the bottom samples collected during the *Meteor* Expedition, Schott, in 1935, calculated the average rate of deep-sea sedimentation at 1 cm. per 1,000 years. This estimate was based on the reasonable assumption that 20,000 years have elapsed since the climate was considerably colder than at present. In an interesting study of the problems raised by such rapid sedimentation, Ph. H. Kuenen (*Amer. J. Sci.*, Dec. 1937) points out that Schott's estimate appears to imply a total thickness of deep-sea sediments amounting to about 17 km. This, in turn, implies denudation of the continents of about 40 km., which is evidently far too high to be acceptable. Two modifying factors have to be considered, however, namely, compaction of the sediments, and the steady production of eruptive rocks throughout geological time. Appropriate estimates of the effects of these factors then bring Schott's figures into close agreement with the results of other denudational statistics. It is concluded that the thickness of deep-sea deposits may be of the order 5–6 km. The bearing of such a thickness on isostasy, temperature at the lower surface of the oceanic crust, seismic propagation, the thickness of the continents, and the mechanism of continental drift is discussed. Kuenen shows that if South America drifted westwards for 3,000 km., the piled up oozes would, after complete isostatic compensation, form a mass equivalent to a plateau 200 km. broad at sea-level. Actually, the continental slope is there one of the steepest in the world and is fronted by deep-sea troughs. Evidently the problem of oceanic sedimentation is involved with others which cannot yet be easily solved.

Origins of Magmas

IN a stimulating paper on "The Origin of the Pacific Magma Types in the Volcanic Inner-arc of the Soenda Mountain System" (*De Ingenieur in Ned.-Indie*, No. 1 ; 1938), R. W. van Bemmelen reaches some petrogenetic conclusions of far-reaching importance. He points out that three different ways of magma generation may now be distinguished : (1) differentiation of a parental magma (primary or juvenile magmas) ; (2) magmatization of pre-existing crustal rocks by ascending emanations from the substratum (palingenetic magmas, now becoming more familiar as rheomorphic magmas) ; and (3) hybridization or contamination of juvenile or palingenetic magmas by assimilation of foreign material (syntectic or mixed magmas). On the basis of geological field observations, together with petrological and petrochemical investigations, in the area under review, the author comes to the conclusion that there are few direct indications of (1), whereas (2) and (3) are of great importance for the origin of calc-alkali or Pacific magma types. The observations strongly point to the possibility that at least part of the various types of Pacific igneous rocks are *not* the product of gravitational crystallization differentiation of a gabbroic parent magma, as has been commonly assumed, but that they are the result of the ascent of magmatic emanations, containing mainly silicon, aluminium and alkalis, whereby the sialic crustal rocks became locally magmatized. A valuable feature of the paper is the review which it contains of the recent literature relevant to the subject of magma formation.

Impact Stresses

IN a paper read before the Scottish Section of the Institution of Mechanical Engineers at Glasgow on March 3, it was demonstrated that stresses caused by impact loads may and do differ materially from those calculated on the assumption of statical equivalence. The subject of the research—described by Mr. R. N. Arnold under the title "Impact Stresses in a Freely Supported Beam"—was a portion of railway rail, 8 ft. span, and the bending stresses induced were found to be 20 per cent higher than those calculated on this assumption. The beam was subjected to impact loads by dropping weights of magnitude up to 470 lb. from different heights and at intervals of 4 in. along its length ; records of its deflections were made by means of a scratch extensometer, the construction of which is described. These show the occurrence of 'sub-impacts'—the weight, in some cases, striking the rail five times in what appeared to be a single impact. At the centre of the beam the deflections are seen to be initially positive, but at distances of 16 in. and more from the centre they prove to be initially negative and to become positive as the impact proceeds, thus showing a distinct divergence from the conditions of static bending. The analysis of the results obtained in this way and also by the use of thin pieces of paper inserted between the rail and the falling weight leads to the conclusions that impact effects, even in comparatively simple settings, are in general much more complicated than is supposed, and that while the ordinary methods give fair approximations for deflections, the errors which they introduce in the bending moments and stresses are excessive. This research had particular reference to the impact loads to which railway rails are subject due to such causes as non-circular wheels, rail irregularities, joints and crossings and to the trouble experienced with fatigue cracks. These grow internally in the head of the rail and are especially dangerous because their existence may be quite unsuspected until fracture occurs. Similar internal fissures have been produced by prolonged repetitions of a rolling load on a rail, and wheel impact load rather than bending moment has been indicated as the stress-determining factor. The results of the present series of tests are held to have exhibited the complexity of impact effects and the probability that the actual loads may be much more severe than are predicted by the usual approximate theories.

State of the Outer Planets

DR. HAROLD JEFFREYS has recently published a note on the state of the outer planets (*Mon. Not. Roy. Astro. Soc.*, 98, 3 ; Jan. 1938) in which he corrects certain misinterpretations of his previous papers on the cold conditions prevailing on the outer planets. His paper is largely suggested by Mr. B. M. Peek's paper (*Mon. Not. Roy. Astro. Soc.*, June 1937), where doubts are expressed regarding the deep atmosphere and thick layer of ice on Jupiter. In Dr. Jeffreys's second paper (*Mon. Not. Roy. Astro. Soc.* **84** ; 1924), he pointed out that an explanation of the observed radiation of Jupiter and Saturn—appreciably larger than it was possible to explain by solar radiation—would be possible if the planets possessed 1,300 times as much uranium per unit surface as is present on the earth. This, however, was not suggested as a serious explanation, as some appear to have thought. Another alternative explanation was departure from black-body radiation, made some two years later, but he does not consider that this is the correct one. He now suggests that if the surface temperature of Jupiter is about 150° absolute and we allow for solar radiation, the planet would have had time to lose 5,000 calories per gram—not an unreasonable amount. With suitable internal conditions the original heat may explain the difference between the observed and calculated radiations. Dealing with the thick ice layer, he does not consider that this implies cold interior conditions, because if the temperature gradient fell below some degrees per kilometre, convection would cease, cooling would be negligible, and a high central temperature would be possible. Dr. Jeffreys also attaches some importance to Wildt's suggestion that the ice would be in the form of Bridgman's high-pressure modification, Ice vi, which can exist at fairly high temperatures.

Teaching of Technical Optics

THE teaching of optics may be divided into four sections; (1) physical optics; (2) optical computation and design; (3) ophthalmic optics; (4) practical optics—glass grinding and polishing.

Physical Optics. The first of these sections is included to a greater or less extent in the teaching of physics in nearly all schools, universities and technical colleges. As 'light' it is included among the subjects that may be offered in the school certificate and matriculation examinations. To more advanced stages it is treated in the courses for the science degree and for the honours examinations in physics at the universities. All these courses are so well known that they need be no further described.

Optical Computation and Design. The second section is an exceedingly important one, as upon the ability to carry this out depends our future progress in the construction of new forms of instruments for surveying, astronomy, gunnery (including such things as range-finding and air defence), photography and microscopy. The actual number of men required for these computations is not large—indeed it is exceedingly small in comparison with the numbers of engineers or chemists for which there is a demand; their importance, however, is not to be measured by their numbers but by the value to the nation of the work they do. The demand for such men has only gradually arisen in (say) the last fifty years. Until then, lenses both for the microscope and for photography had to a large extent been devised and produced by methods of trial and error by practical men, who had only a general acquaintance with optical principles; their calculations were mostly concerned with first-order quantities, and their corrections were the result of their own long experience of the results of changing one or other of the surfaces. This experience in the hands of such men as Andrew Ross and Tom Powell resulted in the production of lenses of excellent performance, but each lens had to be individually tested and adjusted. Then such computers as Schroeder, Hasselkus, Conrady, Booth, Aldis and Dennis Taylor in Great Britain, and Abbe, Rudolf, Goerz and others abroad, showed that there were great possibilities of improvement in the design of lens systems by the application of the theoretical work of Coddington, Seidel and others, and by the systematic computation of the paths of rays through a lens system. As a result, such firms as Zeiss now employ men who spend their whole time in the computation of lenses for optical instruments of all kinds.

The sudden large demand for optical instruments caused by the Great War and by the closure of the foreign supply of such instruments, made it imperative that special courses of training should be provided. Courses were already in existence at the Northampton Institute, set up first by Dr. C. V. Drysdale and later carried on under S. D. Chalmers and since his death in 1919 by H. H. Emsley, but these classes were sparsely attended and did not carry their students very far. A special Department of Technical Optics was therefore established at the Imperial College of Science under Prof. Frederick J. Cheshire with Prof. A. E. Conrady in the chair of optical designing and computing and with L. C. Martin as lecturer. Somewhat later, Prof. A. F. C. Pollard was appointed to the chair of mechanical design of optical instruments. In the first few sessions, the demand for trained computers made the classes abnormally large, but since then they have averaged an output of some half-dozen a year. They cannot expect to be larger, as the number of firms requiring such men is necessarily small; for example, in Great Britain there are only four firms making microscopes—Baker, Beck, Swift and Watson, and four making photographic lenses—Cooke, Dallmeyer, Ross and Taylor, Taylor and Hobson. To these must of course be added firms making surveying, navigating and astronomical instruments, and the army and navy have their own staffs for the design of the special instruments required for warfare; but when allowance is made for all these the total numbers still remain comparatively small, though nevertheless of exceeding importance.

The course at the Imperial College is a two-year one, usually taken as by post-graduates. It includes the theory, design and testing of the fundamental optical systems from both the optical and the mechanical points of view with practical work in all branches. Since their establishment, more than six hundred students have entered for these courses and must have proved of very great value to the industry. The research work of the College, which has been carried on both by students who have continued on after the completion of their course and by the members of the staff, has covered a wide field. Of great importance were Conrady's investigations into the tolerances allowable in an optical system (published in the *Monthly Notices of the Royal Astronomical Society* and later embodied in his "Applied Optics and Optical Design"). Other papers, on ultra-violet transmission of materials and the ultra-violet microscope, the electron microscope, on colour vision and colorimetry and on similar subjects amount in all to more than a hundred and fifty—no inconsiderable output for one department in a comparatively short period.

Some small amount of similar work has been done at both the Northampton Polytechnic Institute, London, E.C.1, and the School of Technology in Manchester, but more in the way of individual work by advanced students and by research than as systematic training, as it has not been worth while to run special classes for the small number of students who wished to attend in any one year.

Ophthalmic Optics. In the third section of optical teaching, ophthalmic optics, there are much larger numbers of students. For these, special examinations were set up by the British Optical Association in 1895 and by the Spectacle Makers Company a year or two later. Before entering for the examinations of the former body, students must have passed a matriculation examination or its equivalent; for the latter they have to sit for a preliminary examination in similar subjects. For the certificates of both bodies the students have to pass in elementary optics; the general structure and functioning of the eye; practical sight testing for the prescription of spectacles; and in workshop practice—lens finishing and mounting and frame making and bending. In order to ensure satisfactory training for the examination, the B.O.A. has 'recognized' certain schools which have been inspected to ascertain that their equipment, staffing, and courses are satisfactory. These schools are mostly in the technical institutes in such towns as Manchester, Edinburgh, Glasgow, Bradford, Cardiff, etc. The largest classes are those at the Northampton Institute, London, where last session more than two hundred and thirty attended organized courses in addition to some sixty who took special courses or individual classes in optics. In Manchester in the same session twelve students were taking full-time courses and about forty were taking part-time courses for these examinations. In the other schools the numbers are of the order of a dozen students in the session. In addition to the optical training in these schools, arrangements are made in all cases for the students to attend some form of hospital course in order to enable them to recognize diseases of the eye, to ensure that patients so suffering shall be sent to obtain proper treatment.

Practical Optics. The fourth section of optical training, practical optics, is provided to a limited extent at all the 'recognized' schools, since it is included in the training of the sight-testing optician, who is expected to be able to grind, polish and edge a lens for a spectacle frame; but it is also arranged as an independent course both at the Northampton Institute and at the Manchester School of Technology. These special courses are planned for workers in optical factories; the students attend on three evenings a week for instruction in drawing, in optical calculations, and in actual lens- and prism-grinding and polishing. The industry so far does not seem to have appreciated the potential value of these classes, as there were less than ten students at either of the schools last session. In spite of the large use of machinery for the grinding and polishing of lenses and prisms, the very exact workmanship required in some cases (roof-prisms, for example, have to be worked to an angle which is correct within two seconds of arc) still necessitates hand finishing; for this and similar work, as well as to enable the men to use the machines in a more intelligent and less 'rule-of-thumb' manner, such classes should surely be of very great value.

Inauguration of the German State Council for Research

In March of last year, the foundation of a new State Council for Research ("Reichsforschungsrat") was announced in Germany by the Minister of Education, Herr Rust. Within ten weeks the fourteen departments of the research organization were formed. In December last a handsomely printed quarto publication describing the Council and its purposes was issued with No. 23 for the year 1937 of the Official Gazette of the German Ministry of Learning, Training and National Education (Amstblatt der Reichs-Ministeriums fur Wissenschaft, Erziehung und Volksbildung). It is entitled "A Celebration of German Learning" (Ein Ehrentag der deutschen Wissenschaft, 25 Mai 1937).

The publication sets out the system on which research is to be organized and the principles on which it is conducted in the Third Reich. It is illustrated with scenes of the inaugural ceremony and with large portraits of the Fuhrer, the Minister of Education, the president of the new Council, Artillery-General Professor Dr. K. Becker, his acting deputy, the vice-president, Dr. O. Wacker, and the directors of the various departments. Fourteen of these departments, all of a definitely technical character, have been established. The speeches of Herr Rust and of Prof. Becker are set out in large type and are followed by detailed records of the career of each director of a department.

In his address, Herr Rust directed attention to his ready action and indicated the need for the establishment of the Council. "The Council," he said, "is initiated at a moment when the German people is preparing, in a manner hitherto unprecedented and by an unexampled expenditure of its utmost effort, to win its rightful foundations of existence, independent of its environment. . . . Not long ago many of us felt that learning (*Wissenschaft*) was too aloof from the great decisions of our time to co-operate in the great struggle of the German people. But the course of German history has itself brought this idyllic attitude to an end and with it has ended also certain idyllic forms of scientific work. The Nazi Revolution summoned science to the decisive battle."

Herr Rust then turned to the question of the freedom of science and of learning: "Complete freedom of opinion and judgment," he said, "are not marks of a truly free science, but rather of an estrangement of the spirit from the eternal forces of Nature and of history. . . . Freedom is assured to science neither by its abstractness nor by its independence of current events. . . . It is rather the hopes of the German people and of the Nazi State in the share of science in the Four Year Plan . . . that give proof of the recognition of the freedom of science.

"If the Nazi State calls on German science to co-operate in the Four Year Plan, it is not because it anticipates the findings of science but because the first task of science will be to give us those materials which Nature has denied us. Such a task can only be accomplished by free science. For science is unfree if her findings be dictated by an unscientific force, but she is free if she sovereignly masters those problems which are posed to her by life. . . . With the foundation of this Council no new principle of scientific behaviour is introduced. . . . What is new is the determinate and planned co-operation of technology and of science for the self-sufficiency of the German economy."

The president of the Council, General Becker, spoke of the reduction in number of the independent centres of research in Germany with the object of concentrating research on more immediate ends. He then turned to consider the way in which the new Council would further the unification of research on methods of preparing raw materials and on their employment. Here, he pointed out, a special position was occupied by the Kaiser Wilhelm Gesellschaft zur Förderung der Wissenschaften.

"The status of the Kaiser Wilhelm Gesellschaft," he said, "will not be disturbed by the new process of organization. Those in authority regard its maintenance as necessary not only because of the respect which it enjoys abroad but also for the purpose of linking research with industry. The necessary cooperation between the State Council for Research and the Kaiser Wilhelm Gesellschaft is for the present guaranteed; first, by the common supervision of both bodies by the Reichsminster (Herr Rust), secondly, by the appointment of the directors of two of the Kaiser Wilhelm Institutes as heads of Departments of the State Council for Research, and finally by my own membership of the Senate of the Kaiser Wilhelm Gesellschaft. Later it will be essential, by suitable measures, to bring the directors of all the Kaiser Wilhelm Institutes into closer relations with the State Council for Research. The Ministerial decree founding the Council," he added, "designates the furtherance of the Four Year Plan as one of the Council's most important tasks."

The careers of the heads of all departments of the new Council are set forth in the publication, those of the president and vice-president being stated as follows:

"*Artillery-General Professor Karl Becker*. Born 1879. From 1900 Artillery Officer. 1906–14 in the Military Technical Academy and active as referee in ballistics. 1914–16 on active service in charge of a 42 cm. battery and then until the end of the War ballistic expert of the Artillery Investigation Commission. From 1919, ballistic expert in the Armaments Office and from 1926 director of its Projectiles and Munitions Department. Since 1932, as director of the Munitions Office Investigation Committee, he has been responsible for the entire technical developments of the Army. In 1933 he became professor ordinarius of military technics, physics and ballistics at the Technische Hochschule in Berlin."

"*Staatsminister Dr. Otto Wacker*. Vice-president of the State Council of Research. Head of the office for Learning (*Wissenschaft*) in the Ministry of Learning, Training and National Education. Born 1899. During the War he was a 'front fighter' on the western front. After the War he studied architecture at the Technische Hochschule at Karlsruhe. Since 1925 he has studied German literature and history at Freiburg, where he took his doctorate. During the revolutionary period he became a district leader (*Kreisleiter*). He also wrote for the Baden journal *Der Führer*. In 1933 he became *Kultus* and Education Minister of Baden. With the nationalization of justice in 1934, he became Minister of Justice for Baden. He is also an SS Commander (*Oberführer*)."

The fourteen departments already organized by the Council are as follows: (1) Physics, including mathematics, astronomy and meteorology; (2) Chemistry and physical chemistry, under the direction of General Becker himself; (3) Power materials; (4) Organic industrial materials, artificial products, rubber, textiles, fats, cellulose; (5) Non-ferrous metals; (6) Geology, including mineralogy and geophysics; (7) Agriculture and general biology, including zoology and botany; (8) Forestry and timber research; (9) Military science and technics, under General Becker himself; (10) Electro-technics; (11) Mining and smelting; (12) Iron and steel; (13) Medicine, including race research and race biology; (14) Military medicine.

Medical Research in Canada

Medical Research Committee

A COMMITTEE to study the organization of medical research in Canada has been appointed by the National Research Council. This action was taken on the recommendation of a nationwide conference on medical research held in Ottawa recently, which was attended by representatives of all the medical schools, organizations and institutions concerned in medical research, including the provincial departments of health, the Department of Pensions and National Health, and the National Research Council. Sir Frederick Banting has been appointed chairman of the new committee. The president of the National Research Council, the deputy minister of the Department of Pensions and National Health, the president of the Canadian Medical Association, and the president of the Royal College of Physicians and Surgeons of Canada are to be *ex-officio* members of the committee. To complete the personnel of the committee invitations have been extended to twelve distinguished members of the medical profession who have a comprehensive knowledge of Canada's requirements in medical research.

It has been suggested by many members of the medical profession that the formation of this committee on medical research under the National Research Council might well be a first step towards the formation of a medical research council for Canada similar to that which exists in Great Britain. Commenting on this suggestion, Major-General McNaughton, president of the National Research Council, speaking at the conference, said that "the National Research Council is approaching the problem of organization of medical research at present as a preliminary measure only. When a purely medical research council becomes necessary, there will be no opposition whatever from the National Research Council. In fact, the National Research Council will give every assistance possible in order to help a movement that in the opinion of the Council is very important for the welfare of the people of Canada."

The immediate purpose of the committee is defined in the terms of reference, which are: (*a*) to receive suggestions for requirements in respect of medical research and in matters related thereto; (*b*) to consider by whom the investigations required can best be carried out and to make proposals accordingly; (*c*) to correlate the information when secured and to make it available to those concerned; (*d*) to do such other things as the committee may deem advisable to promote medical research in Canada.

The conference agreed that the scope of the new committee's activities should not be limited to particular subjects, but that it should be empowered to investigate the whole field of medical research in Canada. One of the first steps to be taken by the committee will be to make a survey of the work in progress at various centres to determine how the activities of the various institutions concerned may be developed to the best possible advantage.

A remarkable record of individual research achievements was revealed in the prepared statements presented at the conference, but the need of bringing the available information together through a central body which could then make it more readily accessible to all concerned was stressed by nearly every speaker. The new committee undertakes its task with the full support and under the direct leadership of the medical profession as a whole in Canada. Results of far-reaching importance are expected in the planning and co-ordination of medical research that will be possible through this new committee. Better dissemination of information regarding the multitude of projects that are being carried on by skilled workers in the hospitals and laboratories of the Dominion will greatly enhance the opportunities of the research workers to make their efforts count.

Progress in Road Research*

ONE of the interesting features of the report of the Road Research Board (director of research, Dr. R. E. Stradling) recently issued by the Department of Scientific and Industrial Research is that which concerns the method of studying the problem of skidding by means of texture prints. These are obtained by inking a portion of the actual road surface and rolling over it a perfectly smooth tyre which then impresses on a sheet of paper an exact record of this portion of the road surface. The object is to study the texture of the surface of a road in order to ascertain its relation to the skidding resistance of the road and to its wearing properties.

The importance of the method can be understood from the statement made in the report that the skidding characteristics of road surfaces are largely determined by the total area of contact between tyre and road and by the number of individual isolated areas of contact into which the total area is divided. In order that, when the road is wet, the liquid on it can escape as the tyre rolls over the road, these small areas of actual contact must be surrounded by channels of adequate size. If the channels are too small, these small areas of contact will, in effect, be merged into one another and the surface will behave as if quite smooth. "An examination of texture prints taken from roads known to be slippery has shown", says the report, "that on these the tyre makes contact with the road over almost the entire area of the ellipse of contact while the number of individual contacts in this area is small". On the other hand, where the sideway force coefficient is high, the proportionate area of actual contact is found to be less while the number of individual areas of contact is much higher. The same is regarded as true of tyre-tread patterns.

In two other directions, the road texture print is an aid to the study of surface problems. By their means the seasonal changes in the slipperiness of roads are being more closely investigated. These, it is believed, depend largely on changes of the surface texture. Then, again, apart from the question of slipperiness, a series of prints is of value in exhibiting the progressive wear of a road surface and of enabling this and other surface changes to be recorded and followed.

The motor-cycle and side-car equipment described in previous reports continues to be employed on skidding tests and is noted as having been employed on surfaces prepared of cast-iron blocks, ordinary wood blocks and special blocks. A sharp fall in the value of the sideway force coefficient as from dry to wet conditions is very noticeable in the results. The higher powered machine now available permits of tests at speeds from 30 to 50 miles an hour, and it would appear that while, on most surfaces, the coefficient tends to reach a steady value in this range, on some there are indications of a continued fall and therefore of increased risk of skidding.

Specimens of mud from surfaces giving low skid coefficients are being studied and their lubricating properties compared with those of water in order to determine to what extent this agency affects slipperiness. The report briefly discusses the question whether mud films on a road during a fog produce a specially slippery surface, and the conclusion tentatively reached is that, from the several points of view quoted, the tendency is towards increased slipperiness.

Tests of road roughness by the special vehicle designed for the purpose and capable of detecting and recording irregularities of more than one fifth of an inch and of integrating them, show a total irregularity, on the best roads, of 75–85 inches a mile. Main roads commonly give 100–250 inches, and very rough roads 500–800 inches a mile.

In investigations on the durability of road construction by means of the full-size lorry driven round a track of 55 ft. radius, experience indicates the desirability of correlating these trials more closely to actual road conditions. In conjunction with a traffic census, records of the periods of wetness and of dryness will afford valuable information. Instruments have been devised for this purpose, the method employed to detect whether the road is wet or dry depending on the fact that the electrical resistance of the film of moisture on the road, measured between two contact strips 3 ft. long and 18 inches apart, is of the order of one fifth megohm when the road is wet, and some 50 megohms when visibly dry.

Other lines of investigation include the impact forces to which traffic subjects a road, the causes of failure of embankments and cuttings in wet seasons, tests of road materials and experiments on the aggregate vibration method of concrete control. An extensive trial of this method is being made by the County Engineer of Surrey in the construction of the Mickleham By-Pass Road.

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* Department of Scientific and Industrial Research. Report of the Road Research Board, with the Report of the Director of Road Research, for the Year ended 31st March, 1937. Pp. viii+120. (London: H.M. Stationery Office, 1937.) 3s. net.

Water and the Plant

PROF. E. J. SALISBURY delivered the Masters Lectures of the Royal Horticultural Society in March of last year. He spoke on "The Plant and its Water Supply", and the text is now published in the Society's *Journal* (62, Pts. 10 and 11, Oct. and Nov. 1937). It provides a synopsis of present-day knowledge which should be in the hands of every teacher and research worker in botany.

Prof. Salisbury ministered to the modern necessity for defining what is meant by water, for he considered some of the botanical implications of heavy water. A plant does not have a uniform water requirement throughout its period of growth, and the work of B. N. and B. R. Singh was quoted to show that seedlings and plants about to flower have greater demands than at other stages. Soil conditions naturally play a large part in the supply of water, and the physical forces which are active therein were reviewed in a succinct manner. Recent work upon the extent of root systems, the suction pressures required to transfer water from the soil to the plant, the appearance of osmotic gradients within the root and shoot, the numbers and behaviour of stomata, and the occurrence of hydathodes and nectaries, was marshalled to provide a basis for estimation of a plant's balance of water.

Several external factors may affect these processes. The root system may be diminished by competition or lack of phosphate in the soil, and shoot development is dependent upon proper extension of the root. The intake of sufficient mineral matter and of the rarer essential elements is also conditional upon an adequate area of absorption. It is interesting to note that gold is now enumerated among the elements present in small quantities in the tissues of some plants. It is found in the ash of *Equisetum arvense*, but not in amount sufficient "either to justify its cultivation, or even compensate us for its presence". Plants may also take in some water through the leaves, and the recovery of wilted shoots during the night is probably due very largely to this agency.

The mechanics of water transfer along the stem was also passed under review by Prof. Salisbury. Rates and pressures of the transpiration stream were enumerated. Investigations by Keinholz and by McDougall seem to show that a woody tree is not a rigid system, for the trunk contracts slightly during the day, and recovers at night.

The numbers of stomata upon the leaf of a plant may vary with soil conditions, being crowded when the plant grows in a dry situation, and sparser under wet conditions. Some plants grow better in dry air, while others flourish more in a moist atmosphere. The rate of water loss also depends upon the difference in temperature between the leaf and the surrounding air, whilst wind, of course, increases transpiration.

One cannot escape the conclusion, on reading Prof. Salisbury's lecture, that botanical research owes a great deal to the simplest methods. Measurements of temperature, humidity, water contents and organic matter contents, leaf areas and root lengths, contribute to a very convincing philosophy of the water relations of a plant, and also provide much practical knowledge which can be used directly by the gardener.

Telegraphy and Telephony

Progress in the General Post Office

AT the Institution of Civil Engineers on January 11, Sir George Lee, engineer-in-chief to the Post Office, read an instructive paper on recent and future developments in telephony and telegraphy and on the conveyor and machine systems in postal work. The aim of the developments is reduction of costs or higher precision in transmission. The change in the increase in the number of telephones from 73,000 per annum in 1931, to 250,000 per annum in 1937, and the 50 per cent increase in the traffic in telegraphy due to the new tariffs, shows that such steps are desirable.

It was pointed out that by carrier-cables the speed of transmission in telephony has been increased from about 20,000 miles per second to six times that amount. The use of these cables also reduces the difficulties met with owing to the fact that waves of different frequencies travel with different velocities. It is fortunate that the ear is very accommodating both for electric wave 'echoes' and 'phase delay'. It is interesting to find that the beams of light which constitute a television picture, in order to be portrayed accurately and quickly, require, at the present time, a band width of 1,600,000 cycles, whilst commercial telephony only requires 2,400. Circuits for music require 9,000. Thus the new 'coaxial' cable is expected to carry 400 telephone conversations simultaneously, although it only provides one television channel.

Sir George referred to radio telephone communications by the use of ultra-short waves. Examples were given of commercial communications within the optical range, in the radio telephone system across the North Channel between Scotland and Northern Ireland. This is done by using two stations well above sea-level. A distance of approximately 36 miles is traversed, the path being entirely optical. As an example of a service working over a non-optical range, the radio telephone service between England and Guernsey was cited. It was attempted at first to cover a range of 105 miles, the optical range being only 45 miles. With this arrangement it was found that as late autumn changed into winter, the received energy was only about one thousandth of that received during the summer. A change in the stations selected reduced the distance to 85 miles; this worked satisfactorily, the working range being 1·73 times the optical distance.

Science News a Century Ago

Human Temperature in Different Climates

AT a meeting of the Academy of Sciences on April 9, 1838, reported in the *Gazette Médicale de Paris* of April 21, MM. Eydoux and Souleyet reported their observations on the men belonging to the crew of the *Bonite* of different ages and temperaments but always leading the same kind of life and engaged in much the same kind of occupations. Their observations were carried on every day at the same time (3 p.m.) from their arrival at Rio de Janeiro until their return to France. These observations, which amounted to more than a thousand, showed that human temperature rises and falls at the same time as the external temperature, though much less rapidly, as it is easy to imagine. It falls rather slowly on passing from a hot to a cold country, but after leaving a cold region for a tropical one it rises much more rapidly. This upward or downward movement is more or less marked according to the individual, but the extremes are fairly close to one another, and the average of the differences observed in the temperature of the human body for a difference of 40° C. in the temperature of the external air was only about a degree in the men under observation.

The Royal Astronomical Society

AT a meeting of the Royal Astronomical Society on April 13, 1838, several communications were made. The first of these was "On the Correction of the Mean Distance, Eccentricity, Epoch and Longitude of the Aphelion of the Orbit of Venus, by Errors of Heliocentric Longitude derived from the Cambridge Observations of the Years 1833, 1834 and 1835 and the Greenwich Observations of 1836". The author of this paper was the Rev. Robert Main (1808–78) who had become chief assistant at Greenwich in 1835 and was afterwards Radcliffe observer at Oxford.

Another paper, entitled "Times of Emerson of the first and second Satellites of Jupiter observed at Greenwich Hospital School, April 9, 1838", was by Edward Riddle (1788–1854) who was mathematical master at the School from 1821 until 1851. "These phenomena," said Riddle, "deserve notice and are here recorded, merely from their happening within so short a time of each other, and from their having been observed earlier in the evening than the superintendent of the *Nautical Almanac* anticipated that they could be seen with advantage in this neighbourhood."

German Scientific Periodicals

THE editor of the *Athenæum* had apparently asked a correspondent in Germany to give a review of the progress of art and science in that country, and accordingly a communication was sent from Dresden which was printed in the journal on April 14, 1838. "Your wishes", the writer began, "are easier expressed than complied with; however, I will do my best to give you a sketch of the intellectual world of Germany. . . . In no part of Europe is the number of periodicals devoted to science, art and literature, so great as in Germany. . . . In the scientific and medical journals, of which about eighty exist in Germany (forty-one being exclusively devoted to physiology and medicine) many subjects of importance are under consideration and discussion. Animal magnetism, somnambulism, and even the histories of people possessed with devils occupy many pens . . . the works on animal magnetism, which have lately appeared from the pens of Professor Hensler and Dr. Bork . . . are reviewed in Gersdorf's Repetorium and other journals. Dr. Bork asserts that during the last nine years he has cured no less than two thousand diseases through the influence of animal magnetism. In the writings of two other medical men, the greater number of illnesses, particularly of married people, are attributed to disharmony in the magnetic influences; and however absurd such opinions may be thought in England, it is beyond question that many educated Germans have faith in them. . . . Another therapeutic novelty . . . is the *cold water* system. . . . The press is continually producing works advocating cold water, internally and externally, as the grand remedy for all disorders."

. . . . .

"A periodical of somewhat higher pretensions than any of the preceding is the 'German Quarterly' just published by Cotta, of Stuttgart. . . . This work is to occupy new ground, and supply a void long felt to exist. A point of union was wanting in Germany, where new discoveries and their practical utility . . . could be immediately discussed and appreciated, by men of all parties, distinguished for science and general attainments. Germany may boast of a conscientious cultivation of the sciences and of its honorable acknowledgement of the merits of foreigners; but many first rate men have often been thrown back on themselves, or confined to a narrow circle, though capable of imparting valuable information to society, from the want of such a work. . . . No man can find time to hunt after all that he may desire to be informed of, if scattered abroad in numberless periodicals; and few public libraries, much less individuals, have even the means at command to purchase all that are published. And yet the basis of knowledge is wasted, and the capacity to appreciate it greater, in Germany than in the surrounding countries. The German Quarterly is intended to collect together whatever is best and most important in all branches of knowledge, that they may gain general appreciation and be brought home as far as possible to the business and bosoms of men in our everyday life. . . ."

A Life-Saving Rocket Apparatus

THE *Mechanics' Magazine* of April 14, 1838, quoting from the *Silurian*, said: "A Mr. Gyngell made experiments on the Green near Brecon, with some rockets of his invention for communicating with stranded vessels. He discharged several rockets of different weights. The rope was coiled on a cone formed of light rails of wood, and was carried out the distance of from 3 to 5 hundred yards according to the size of the rocket attached to it. . . . Mr. Boyers, of Swansea, in a letter on this subject that we inserted a few weeks since, remarks that if rockets could have been obtained at the time of the wreck of the Killarney steamer, a number of lives might have been saved and the survivors would have been delivered from their dreadful sufferings. . . . It is very seldom that an instance occurs of a vessel striking on a lee shore a greater distance than a quarter of a mile from the land. We need hardly point out the utility of the rocket in such cases, and we hope ere long no vessel will leave port without being provided with this simple and cheap apparatus."

University Events

Aberdeen.—The honorary degree of LL.D. was conferred on Dr. E. J. Butler, secretary to the Agricultural Research Council, and on Dr. G. Dahlberg, director of the Institute of Medical Genetics, Uppsala, among others, on March 30. The ordinary degree of D.Sc. was conferred on Dr. D. Robertson, for a thesis entitled "Studies on the Internal Parasites of Sheep in Scotland and the Importance of Nutrition in Regard to their Control."

Cambridge.—The adjudicators consider that the following essays submitted by candidates for the Smith's Prizes and Rayleigh Prizes are of distinction: F. Hoyle, of Emmanuel College, "Beta-Disintegration"; G. L. Clark, of Trinity College, "The Relativity Theory of Gravitation"; G. S. Rushbrooke, of St. John's College, "Strictly-regular Solutions"; A. L. Yoxall, of Sidney Sussex College, "Systems of Equivalence and their Applications to the Geometry of Algebraic Varieties". The Smith's Prizes are awarded to F. Hoyle, of Emmanuel College and A. L. Yoxall, of Sidney Sussex College. Rayleigh Prizes are awarded to G. L. Clark, of Trinity College and G. S. Rushbrooke, of St. John's College.

The General Board recommends: (*a*) that the following additional University teaching offices be established: A University lectureship in the Faculty of Economics and Politics; two University demonstratorships in the Department of Engineering; (*b*) that a third assistant directorship of research in colloid science be established and that the General Board be authorized to appoint Dr. H. W. Melville to this post for five years; (*c*) that a post of assistant in statistical research be established; (*d*) that three posts of assistant in research in medicine be established from July 1, and that appointments to these posts be made by the Appointments Committee of the Faculty of Medicine, with the approval of the General Board, each for a period not exceeding five years, or for so long as the Rockefeller Foundation continues the grant to the University for this purpose, whichever period is the shorter.

The Board of Research Studies has approved Dr. F. P. Bowden, of Gonville and Caius College, for the degree of Sc.D.

London.—Lieut.-Colonel H. E. Shortt has been appointed, as from April 1, to the University readership in medical parasitology tenable at the London School of Hygiene and Tropical Medicine. Since 1934 he has been director of the King Institute of Preventive Medicine, Madras.

Societies and Academies

Paris

Academy of Sciences, February 7 (*C.R.*, 206, 385–464).

Gaston Julia: The inversion of the linear operators of Hilbertian space.

Lucien Cayeux: The brechoid structure of chalk containing phosphates of the North of France, and its multiple origins.

Charles Achard, Augustin Boutaric and Mme. Madeleine Roy: Viscosimetric researches on serums and solutions of their proteins separated by the cold acetone method.

Pierre Lejay: Application of the inverted elastic pendulum to levelling the axes of astronomical instruments. This method possesses some advantages over the usual liquid level. It is much more rapid and rather more accurate.

Henri Eyraud: Some laws of errors in two dimensions.

Gustave Malécot: The Mendelian chances and the correlations of heredity.

Stanislas Golab: The function representing the distance of a variable point to a fixed ensemble.

Rodolphe Henri Germay: The decomposition into primary factors of certain uniform functions.

Dragoslav S. Mitrinivitch: Theorems relating to the differential equation of Riccati.

Robert Ballieu: Functions locally univalent in the unit-circle.

Chi-Tai Chuang: A criterion of quasi-normal family and on Schottky's theorem.

Joseph Peres and Lucien Malavard: Analogical realizations of flow with jet lines.

Pierre Clerget and Raymond Marchal: The working of injection motors and igniting by compression in a rarefied atmosphere. The motor, with double injection, was fitted with mechanical compressor giving an admission pressure of 760 mm. at a height of 2,700 metres. An aeroplane driven by this motor climbed to a height of 7,650 m. without the controls being affected.

Godofredo Garcia and Alfred Rosenblatt: Stokes's formula in the theory of gravity.

Gleb Wataghin: The theory of neutrinos.

Paul Ehrenfest: Two negatives of penetrating cosmic rays obtained in the Bellevue magnetic field (10,000–15,000 gauss) and on the existence of a heavy particle.

Mathieu Dobine: A possible method of determination of the true adsorption of the solvent and of the dissolved body in concentrated solutions.

Georges Carpéni: Electrometry and ultra-violet spectrography of rhodizonic acid. Remarks on titration with iodine.

Georges Wolf: A method of determining the metals of the alkaline earths. The method is based on the pressure of carbon dioxide obtained by heating a mixture of the three carbonates in a vacuum at temperatures between 630° C. and 840° C.

Fernando Gonzàlès Nuñez and Emilo Figueroa: Preparation and study of vanadyl bromide.

Mlle. Yvonne Garreau: Some addition compounds of pyrocatechol.

Mme. Elisabeth Jérémine: The lherzolites in the course of serpentinization in the Lorraine Vosges.

François Kraut and André Vatan: The origin of the clay rocks of the neighbourhood of Confolens (Charente) attributed to the siderolithic. These clays are not, as has been supposed hitherto, siderolithic sediments, but have been formed where they are found.

Arnold Bersier: The subsidence in the molassic pre-fosse of the Alps.

René Bernard: The observation of a new fluorescence phenomenon in the upper atmosphere. The presence and intensity variations of the radiation λ 5893 A. in the light of the sky at twilight.

Jacques Bardet, Arakel Tchakirian and Mlle. Raymonde Lagrange: The spectrographic search for traces of elements in sea water. Various precipitates were formed in sea water (60 litres) and examined spectroscopically. By this method all the elements detected by other workers, with the exception of nickel and tungsten, have been found, and arsenic and gallium, not previously notified, were added to the list. Gold was not found, and there seems reason to suppose that gold is irregularly distributed in sea water.

Tien Kiu : Atmospheric absorption and molecular diffusion according to the measurements of the Smithsonian Institution at Montezuma.

Philippe Hagene : The influence of the solvent and of the concentration on the velocity of penetration of thymol into the internal epidermal cells of the fleshy leaves of the onion bulb.

Roger Gautheret : Researches on the culture of fragments of tubercles of the carrot.

Maurice Bouchet, Antoine Jullien, Daniel Vincent and Mlle. Madeleine Vuillet : The diffusion of acetylcholine starting with the heart of *Helix pomatia*. In *Helix pomatia* a fraction of the intramyocardiac acetylcholine is diffusible into the surrounding medium : the concentration of the medium in this substance increases with the time, reaching a certain equilibrium after some hours. The quantity set free amounts to approximately one eighth of the total stock of acetylcholine.

Antoine Magnan, Charles Perrilliat-Botonet and Henry Girerd : Attempts at simultaneous cinematographic recording in three perpendicular directions, two by two, of the flow of air around a bird in flight.

Prague

Czech Academy of Sciences and Arts

May 28, 1937.

J. Milbauer : Colloidal and pure carbon. Colloidal carbon was prepared by the action of sulphuric acid on acetylene at 200° C. After centrifuging and washing, purest carbon was obtained, of a brownish black colour. Pure carbon was also obtained by using sugar instead of acetylene.

R. Rost : The minerals in burning waste heaps in the Kladno district.

A. Orlov : The first discovery of bauxites in Czechoslovakia.

E. Kodíček and J. Joachim : The quantity of vitamin C in the organs of rats affected by vitaminose B.

T. Buday : Geological conditions in the surroundings of Šahy, in southern Slovakia.

October 22, 1937.

K. Domin : *Lycopodium Issleri* Rouy in Czechoslovakia and the variability of the native *Lycopodium* of the section *Heterophylla* Spring.

B. Hejda and F. Procházka : Glutathione in the blood, and its significance in metabolism.

F. Němejc : Palæobotanical studies in travertine sediments near Gánoved and Horky (Poprad, Slovakia).

J. Wolf : The surface relief of human skin. (2) Stratum desquamans epidermis in man.

V. Špalek : The Miocene of Židlochovice, Moravia.

December 10, 1937.

J. Milbauer : A note on the action of permanganate with selenites.

J. Vachtl : A new discovery of carboniferous flora in the Slovakian Ore Mountains.

M. Hampl : The strain and bending of a spherical bottom, effected by uniform radial pressure.

V. Hovorka and V. Sýkora : The β-oxime of isatine, a new reagent for certain metals. (2) Determination of uranium by the β-oxime of isatin.

Washington, D.C.

National Academy of Sciences (*Proc.*, 24, 53–106, Feb. 15).

W. J. Robbins : Organisms requiring vitamin B_1. The fungi examined can be divided into four groups according as they require : (1) the vitamin ; (2) thiazole and pyrimidine (intermediates of the vitamin), or the vitamin ; (3) pyrimidine, both intermediates or the vitamin ; (4) thiazole, both intermediates or the vitamin. Some fungi are unaffected by any of these substances, and others are inhibited.

O. J. Eigsti : Cytological study of colchicine effects in the induction of polyploidy in plants. Solutions of 1 per cent colchicine and upwards are toxic, and even weaker solutions are toxic if treatment is prolonged. Weak solutions produce enlargement of meristematic tissue (root and stem). Individual cells are affected independently of their neighbours. Mitosis proceeds, but spindle and cell-plate formation are inhibited, producing nuclei with double or more times the number of chromosomes.

G. Evelyn Hutchinson : Chemical stratification and lake morphology. The distribution of alkalinity (bicarbonate ion, determined by titration with methyl orange as indicator) in a small lake suggests that the bottom water movements are confined to thin horizontal layers, as suggested by Alsterberg. Certain sudden rises in alkalinity appear to be initiated by temperature minima at the surface.

J. Bonner and D. Bonner : Ascorbic acid and the growth of plant embryos. Embryos of different varieties of peas differ markedly in the amount of ascorbic acid they are able to synthesize from sucrose and also in their response to added ascorbic acid. Varieties which synthesize most respond least (or not at all) to added ascorbic acid, and vice versa.

W. J. V. Osterhout : Potentials in *Halicystis* as affected by non-electrolytes. To study changes in potential difference caused by diluting sea water bathing cells of *Halicystis*, a non-electrolyte should be added to maintain the osmotic pressure of the sea water ; mannite seems to be most suitable.

G. W. Beadle, R. L. Anderson and Jane Maxwell : A comparison of the diffusible substances concerned with eye colour development in *Drosophila*, *Ephestia* and *Habrobracon*.

D. M. Whitaker : Effect of *p*H on the development of ultra-centrifuged *Fucus* eggs. Fertilized eggs centrifuged at 150,000 times gravity and at *p*H 7·9–8·1 formed rhizoids at the centrifugal ends ; at *p*H 5·8–6·1, rhizoids formed at the centripetal ends. The effects may be due to concentration and toxic over-concentration respectively of growth hormone by centrifuging.

Louise Wipf and D. C. Cooper : Chromosome numbers in nodules and roots of red clover, common vetch and garden pea. In each species, a tetraploid number (twice that of ordinary tissue) was found.

G. A. Miller : (1) Groups having a maximum set of independent generators of the same order. (2) Groups having a maximum number set of conjugate independent generators.

R. Courant : Existence of a minimal surface of least area bounded by prescribed Jordan arcs and prescribed surfaces.

F. Bernstein : The continuumproblem.

H. Lewy : Existence of a closed convex surface realizing a given Riemannian metric.

Forthcoming Events

Tuesday, April 12

Quekett Microscopical Club (at 11 Chandos Street, Cavendish Square, W.1), at 7.30.—Prof. F. J. Cole, F.R.S.: "Microscopic Science in Holland in the Seventeenth Century". (Open to the public.)

Wednesday, April 13

Society of Glass Technology (in the University, Sheffield), at 2.—Annual General Meeting.

Faraday Society, April 11–13. General Discussion on "Chemical Reactions involving Solids", to be held in the University of Bristol.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Engineer in the Roads Department of the Ministry of Transport—The Assistant Secretary, Establishment Department, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W C.2 (April 11).

Civilian Instructor (engineering) for the Royal Army Service Corps Training Centre, Aldershot—The Under-Secretary of State (C.5), War Office, London, S.W.1 (April 11).

Senior Technical Officer at the Air Ministry Headquarters, London—The Secretary, Air Ministry (S.2.d), Adastral House, Kingsway, W.C.2 (April 15).

Scientific Officer in the Air Ministry Research Pool—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (April 15).

Junior Scientific Officers at the Building Research Station, Garston—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (April 19).

Junior Scientific Officers at the National Physical Laboratory, Teddington, Middlesex—The Director (April 19).

Lecturer and Assistant Lecturer in Mechanical Engineering in the Belfast College of Technology—The Director of Education, Victoria Street, Belfast (April 23).

Civilian Education Officer (grade III) in the Royal Air Force Educational Service—The Secretary, Air Ministry (E.S.1.), Adastral House, Kingsway, London, W.C.2 (April 23).

Head of the Civil and Mechanical Engineering Department of the Northampton Polytechnic, St. John Street, London, E.C.1.—The Principal (April 25).

Assistant Lecturer in Statistics in the London School of Economics, Houghton Street, Aldwych, London, W.C.2—The Secretary (April 30).

Assistants (grades II and III) in the department of War Department Chemist—The Under-Secretary of State (C.5), War Office, Whitehall, London, S.W.1 (April 30).

Instructor in Domestic Engineering in the Education Department of the Straits Settlements—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1.

Lecturer (woman) in Hygiene and Biology in the Avery Hill Training College—The Education Officer (H.2/1), County Hall, London, S.E.1.

Assistants (grade III) in the Meterological Office—The Secretary (S.2.A), Air Ministry, Adastral House, Kingsway, W.C.2.

Director of the National Institute of Poultry Husbandry—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

Civil Engineer in the Public Works Department of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Museum (Natural History). John Murray Expedition, 1933-4. Scientific Reports, Vol. 5, No. 5: The Astacura and Palinura. By Dr. M. Ramadan. Pp. 123–146. 2*s*. 6*d*. Scientific Reports, Vol. 5, No. 6: Pycnogonida. By Dr. W. T. Calman. Pp. 147–166. 2*s*. 6*d*. (London: British Museum (Natural History).) [163

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1936-7. (Cmd. 5671.) Pp. 195+xiv. (London: H.M. Stationery Office.) 3*s*. net. [183

Report of the Rugby School Natural History Society for the Year 1937. Pp. 67+2 plates. (Rugby: George Over (Rugby), Ltd.) [213

Other Countries

South Australian Department of Mines. Mining Review for the Half-Year ended 30th June, 1937. (No. 66.) Pp. 111+4 plates. (Adelaide: Government Printer.) [153

Lunds Universitets Årsskrift. N.F., Avd 2, Bd. 33, Nr. 4: Kungl. Fysografiska Sällskapets Handlingar, N.F. Bd. 48, Nr. 4. Meddelande från Lunds Astronomiska Observatorium, Ser. 2, Nr. 90: On an Apparent Connection between Sunspot Frequency, Meteorite Frequency, and the Longitudes and Conjunctions of the Major Planets. By Nils Malmquist. Pp. 23. Lunds Universitets Årsskrift, N.F. Avd. 2, Bd. 34, Nr. 4: Kungl. Fysiografiska Sällskapets Handlingar, N.F. Bd. 49, Nr. 4. Meddelande från Lunds Astronomiska Observatorium, Ser. 2, Nr. 86: The Distributions of the Second Moment and of the Correlation Coefficient in Samples from Populations of Type A. By Carl Erik Quensel. Pp. 111. Lunds Universitets Årsskrift, N.F. Avd. 2, Bd. 34, Nr. 7: Kungl. Fysiografiska Sällskapets Handlingar, N.F. Bd. 49, Nr. 7. Meddelande från Lunds Astronomiska Observatorium, Ser. 2, Nr. 93: Positions of 75 Stars supposed to be Members of the Taurus Cluster. By Helge Nordstrom. Pp. 17. (Lund: C. W. K. Gleerup; Leipzig: Otto Harrassowitz.) 1 kr.

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, Nr. 91: Historical Notes and Papers, Nr. 12: On the Historical Origins of Atomism. By Per Collinder. Pp. 8. Ser. 2, Nr. 92: Invisible Companions of Parallax Stars revealed by means of Modern Trigonometric Parallax Observations. By Erik Holmberg. Pp. 23+1 plate. (Lund: C. W. K. Gleerup) [163

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 778: Geology and Ground-Water Resources of Webb County, Texas. By John T. Lonsdale and James R. Day. Pp. v+104+12 plates. 30 cents. Water-Supply Paper 796 C.: Flood in La Cañada Valley, California, January 1, 1934. By Harold C. Troxell and John Q. Peterson. Pp. iv+53–98+19 plates. 20 cents. Water-Supply Paper 797: Selected Bibliography on Erosion and Silt Movement. By Gordon R. Williams and others. Pp. 91. 15 cents. Water-Supply Paper 804: Surface Water Supply of the United States, 1936 Part 4: St. Lawrence River Basin. Pp. 160. 25 cents. Water-Supply Paper 808: Surface Water Supply of the United States, 1936. Part 8: Western Gulf of Mexico Basins. Pp. 262. 35 cents. Water-Supply Paper 809: Surface Water Supply of the United States, 1936. Part 9: Colorado River Basin. Pp. 187. 30 cents. Water-Supply Paper 812: Surface Water Supply of the United States, 1936. Part 12: Pacific Slope Basins in Washington and Upper Columbia River Basins. Pp 161. 25 cents. Water-Supply Paper 813: Surface Water Supply of the United States, 1936. Part 13: Snake River Basin. Pp. 242. 35 cents. (Washington, D.C.: Government Printing Office.) [163

Proceedings of the Fourth International Locust Conference, Cairo, April 22, 1936. Pp. ix+51 papers+4 plates. (Cairo. Government Press.) [183

U.S. Department of the Interior: Geological Survey. Bulletin 880-D: The Eska Creek Coal Deposits, Matanuska Valley, Alaska. By Ralph Tuck. Pp. ii+185–213. 35 cents. Bulletin 895-A: Geophysical Abstracts 88, January–March, 1937. Compiled by W. Ayvazoglou. Pp. ii+42. 10 cents. (Washington, D.C.: Government Printing Office.) [213

Proceedings of the American Academy of Arts and Sciences. Vol. 72, No. 3: An Experimental Study of the Absolute Temperature Scale. 5: The Reproducibility of the Ice Point and the Triple Point of Water; The Temperature of the Triple Point of Water. By James A. Beattie, Tzu-Ching Huang and Manson Benedict. Pp. 136–155 50 cents. Vol. 72, No. 4: The Resistance of Nineteen Metals to 30,000 Kg./Cm.^{2}. By P. W. Bridgman. Pp. 156–205. 90 cents. Vol 72, No. 5: Rough Compressibilities of Fourteen Substances to 45,000 Kg/Cm.^{2}. By P. W. Bridgman. Pp. 206–225. 40 cents. Vol. 72, No. 6: Polymorphic Transitions up to 50,000 Kg./Cm.^{2} of Several Organic Substances. By P. W. Bridgman. Pp. 226–268. 80 cents. (Boston: American Academy of Arts and Sciences.) [213

Field Experiments on Sugar-Cane in Trinidad: Annual Report for 1937. By P. E. Turner. Pp. 95. (Trinidad: Sugar-Cane Investigation Committee.) [213

U.S. Department of Agriculture. Leaflet No. 145: Clothes Moths. By E. A. Back. Pp. 8. (Washington, D.C.: Government Printing Office) 5 cents. [213

University of Illinois: Engineering Experiment Station. Bulletin No. 299: Solution of Electrical Networks by Successive Approximations. By Laurence L. Smith. Pp. 40. (Urbana: University of Illinois.) 45 cents. [213

Det. Kgl. Danske Videnskabernes Selskab. Mathematisk-fysiske Meddelelser, 15, 6: Hg-Dynamics 1: Theory of the Laminar Flow of an Electrically Conductive Liquid in a Homogeneous Magnetic Field. By Prof. Jul. Hartmann. Pp. 28. 1.50 kr. Hg-Dynamics 2: Experimental Investigations on the Flow of Mercury in a Homogeneous Magnetic Field. By Prof. Jul. Hartmann and Freimut Lazarus. Pp. 45. 2.50 kr. (Copenhagen: Levin and Munksgaard.) [213

Department of Natural Resources, Newfoundland: Division of Fishery Research. Annual Report of Fishery Research Laboratory, 1936–37. Pp. 49. (St. Johns, Newfoundland: Department of Natural Resources.) 25 cents. [213

Memoirs of the Geological Survey of India. Vol. 72, Part 1: The Geology of Parts of the Minbu, Pakokku and Lower Chindwin Districts, Burma. By Dr. G. de P. Cotter. Pp. xxi+136+xl+11 plates. (Delhi: Manager of Publications.) 5.12 rupees; 9*s*. 6*d*. [213

Catalogues, etc.

Catalogue of Second-hand Scientific Books mainly from the Library of Dr. J. W. Mellor, D.Sc., F.R.S., including an Important Collection of Transactions of Learned Societies and Scientific Journals. (Catalogue No. 44.) Pp. 68. (London: Harrods Scientific Book Department.)

Rare Africana, 1938. (Catalogue No. 625.) Pp. 37+1 plate. (London. Francis Edwards, Ltd.)

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Vol. 141 SATURDAY, APRIL 16, 1938 No. 3572

The Protectorates and the Union in South Africa

NATIVE affairs in the greater part of South Africa, though no longer under the jurisdiction of the British Parliament, continue to be a prominent factor in the relations between Great Britain and the Union. Both inside the British Parliament and without, there is a spirit of watchfulness, which gives close regard not only to any action of the Union Government, but also to the currents of public opinion in South Africa in all matters affecting the present welfare and future development of the native and coloured populations. In questions relating to the inhabitants of the Protectorates and Territories under British administration, in which this body of informed opinion can make its influence effective, its aim is to avoid opening the door to either exploitation or treatment considered detrimental or not in accord with the methods and principles of native administration in the territories, when the inhabitants of these territories cross the Union borders to meet the demand for labour. Hence it is usual for the appearance of the Protectorates on the question paper of the House of Commons to herald a lively and instructive debate.

An important statement in response to questions dealing with the future of the Protectorates was made by Mr. Malcolm MacDonald, H.M. Secretary of State for Dominion Affairs, in the House of Commons on March 29. It contained an explicit reaffirmation of policy, and went on to announce two practical measures, which are to be put into operation forthwith. In the matter of policy, Mr. MacDonald, while recognizing on behalf of the British Government the meaning and intention of the sections of the South Africa Act of 1909 which deal with transfer, also emphasized the binding character of the pledges that transfer to the Union Government would not take place until, on one hand, the wishes of the natives had been most carefully considered, and on the other, the United Kingdom Parliament had been given the fullest opportunity to express its views. In the meantime, he went on to say, a conference is to be appointed consisting of three representatives of the Union Government and the three resident commissioners of the Protectorates. This conference is to study "openings for co-operation between the Union Government and the Administrations in matters affecting the development of the territories, and to consider any matters of joint concern to the Union and the territories". As regards the nature of the inquiries, it was indicated in subsequent debate that they are to be of a technical character, such as the prevention and control of animal diseases, marketing of produce, prevention of bubonic plague, etc.

The second measure is the preparation by the Union Government of a series of memoranda, which as a whole will place before the peoples of the Territories, native and other, a clear picture of the terms on which the transfer of the government should take place. These terms, it was said, would follow closely the provisions of the schedule of the South Africa Act and deal with the conditions of government, the maintenance of tribal institutions, the economic advantages to accrue to the territories and so forth.

Taken at their face value, these two practical measures have much to commend them. In bringing them forward, the British Government has been anxious to further the policy of co-operation adopted three years ago, of which the aim, as stated at the time, was to demonstrate to the peoples of the territories that "the Union

Government are working in concert with the local administrations with a real and generous desire to develop and improve conditions in the territories". The Union Government in dealing with the Protectorates under this arrangement has been as generous in giving financial and other assistance as it has been to South-West Africa; and its attitude merits recognition. The conference which is to be set up should help to alleviate the legitimate grievances of the Union—advanced as one of the reasons for transfer, and indeed one of the strongest—in that the natives of the territories, who are economically dependent upon the Union, are beyond its control in matters in which the welfare of the Union is vitally affected, such as, for example, the control and prevention of cattle and other diseases, labour supply and other technical or difficult questions of a like character.

There was evident anxiety felt in the House of Commons lest the convention should not be sufficiently possessed of the necessary expert knowledge of such subjects, while there was also perturbation because of the fact that the natives are not to be represented. On both counts Mr. MacDonald expressed confidence in the knowledge of the resident commissioners, as well as in their sense of responsibility for the interests of the natives of their respective territories.

Later in the debate, it became abundantly clear that the members of the House also felt considerable apprehension lest acceptance in principle of the preparation of the memoranda—apparently their preparation is already well advanced—should be construed as a pledge of transfer. This elicited the assurance that the memoranda were no more than an intimation of how the Union Government would propose to deal with the matters recited in the schedule of the Act of 1909, and further that they would be issued in a readily accessible form.

At this point it may be regarded as appropriate and, indeed, instructive, to refer to a statement of future native policy which indicates the line of approach of a legislature outside the Union. In laying the foundation stone of the David Livingstone memorial mission school at Ntabasinduna, Mr. Huggins, the Prime Minister of Southern Rhodesia, announced that in the coming year the Government will provide additional advanced training for natives in training schools. At the same time, he foreshadowed a policy of segregation in which the country would be divided up into separate 'white' and 'black' areas. In the black areas the native is to be protected from white competition. In the white areas the native will be allowed to assist, but not to compete with the white man. Native education, he went on to say, would be by missions and not by the State, until natives had a background of Christianity.

Criticism of such a scheme is obviously out of place, until it is possible to see how far the native tribal controls, to which Mr. Huggins referred, are to be retained. It seems illogical to deprecate the effect of white man's law, religion and example, and yet to refuse the facilities for advanced education until a background of Christianity has been acquired.

In fact the trend of anthropological investigation, that is, investigation not only of native thought and institutions in their integrity, but also as they are affected by European culture contacts, now seems to suggest that if tribal controls are to be regarded as of value, and utilized in the moral training of the individual, early education will involve a scientific and objective study of native taboos and institutions. This cannot fairly be asked of a mission, to which education is left without State assistance or control.

If the Union Government, apart from the spur of advantages to accrue to the Union, is urgent for early transfer of the Protectorates out of a desire to help them, the preparation of the memoranda affords an opportunity for approach to the solution of the problem of native development such as has never occurred before in South Africa, free from tradition and prejudice and the preponderating claims for consideration of a white population. It should then be possible by a scientific and dispassionate study of the situation as a whole, to work out a scheme of administration, education and training, not overlooking opportunities for utilizing that training in after-life which would make the disintegration of tribal life, inevitable in the long run, a slow and gradual process, in which a sense of individuality, appropriately and advantageously suppressed in a tribal form of existence, could be built up to fit the native to take his place in a more advanced civilization. It may be recalled that to carry out an ambitious scheme of this nature South Africa has at its service a school of anthropologists, not only well versed in the study of African tribal thought and institutions, but also well trained, as it has already shown by its work, to gauge the trend and effect of cultural modification and contacts among African peoples.

Scientific Thought in Tudor Times and After

(1) Astronomical Thought in Renaissance England:
a Study of the English Scientific Writings from 1500 to 1645. By Francis R. Johnson. Pp. xv + 357. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 15*s*. net.

(2) Johannes Kepler Gesammelte Werke
Herausgegeben im Auftrag der Deutschen Forschungsgemeinschaft und der Bayerischen Akademie der Wissenschaften, unter der Leitung von Walther von Dyck und Max Caspar. Band 3: Astronomia Nova. Herausgegeben von Max Caspar. Pp. 487. (München: C. H. Beck'sche Verlagsbuchhandlung, 1937.) 12 gold marks.

(3) Œuvres complètes de Christiaan Huygens
Publiées par la Société Hollandaise des Sciences. Tome 19: Mécanique théorique et physique de 1666 à 1695; Huygens à l'Académie Royale des Sciences. Pp. iii + 688 + 6 plates. (La Haye: Martinus Nijhoff, 1937.)

THE Middle Ages in England were buried in Bosworth Field. Science in the next two centuries culminates in the age of Newton. Here are parts of the work of two outstanding figures in the second half of that period. The other book which comes under review covers the greater part of the longer interval of time. Perhaps a happier choice might have been found in the limits of the Tudor period itself. The scientific spirit of the seventeenth century is visibly different from that which had prevailed up to the closing years of the sixteenth. It is often startlingly modern. But Mr. Johnson's choice helps, sometimes unconsciously, to lay stress on this contrast.

(1) Mr. Johnson's book is a well-written and, within limits, a scholarly work. It is the more necessary to explain its intention. It describes the scientific, mainly the astronomical, literature of the period. The material is drawn from the English printed books to be found in libraries, particularly the Huntington Library. It is a bibliographical study for use as a background to the more general literature of the times. But references to this great literature are few and mainly incidental. On the other hand, no very satisfactory picture of the scientific history of the time emerges. For that a more intimate knowledge and a stronger sense of proportion would have been required.

The first half-century is pre-Copernican. The infusion of Hellenic culture denoted by the Renaissance is scarcely more important than its immediate diffusion by the printing press. In relation to science the main influences were threefold. That of Aristotle waned almost continuously. The second may perhaps be indicated by the Pythagorean tradition, which continued in force long enough to number Kepler among its adherents. Taken in a broad sense, this includes the work of the Greek mathematicians, and is associated with the Platonists, though the obscurities of the "Timæus" suggest clearly that Plato himself was a very poor geometer. Finally there was the "Almagest", together with the Alfonsine tables. But as there must have been few capable of understanding the nature of Ptolemy's great work, it seems to have been commonly replaced in popular estimation by a wretched Aristotelian travesty. The writings of the Oxford school of the time of Roger Bacon remained available generally in manuscript form only. Still, they were not without effect.

There is evidence that a fairly general interest was taken in England in these various factors from the past in forming a scientific judgment. Then came the "De Revolutionibus", followed by the Prutenic tables of Reinhold. The general views of Copernicus were readily assimilated by Robert Recorde, a fine Greek scholar, textual critic and mathematician. Tables were reproduced by John Feild. But ready as was the response to new ideas, the scientific value of the reaction seems easily over-estimated. When a work of this particular kind is in question there are three distinct elements in the appreciation of it. There is the simple idea, here a heliocentric theory in the vaguest sense, which many people with open minds can understand. A much smaller number can understand the resulting tables and use them. But the number who can penetrate to the inner spirit of the work is always small indeed. In this case the response scarcely went beyond the first class. The Aristotelians remained entrenched. The energies of a most active age in England were otherwise directed. There were no astronomers to make systematic and purposeful observations, and the mathematicians were left without straw to make bricks. The fine sentiments of the period, which are not wanting, rather serve to emphasize its scientific immaturity.

Mr. Johnson has chosen the reaction to the Copernican theory as a touchstone of scientific progress in his period. A truer estimate of that theory seems therefore to be necessary. Now Copernicus was a great man undeniably, and it is right that history should err in its estimates of great men on the side of generosity. But in this case it is not easy to do so without doing injustice to two far greater men, Ptolemy on one side and Kepler on the other. The "De Revolutionibus" is in the strictest sense a derivative work. Stripped of all detail and represented for the popular taste as a heliocentric theory, it is a reincarnation of Aristarchus of Samos, as Robert Recorde observed. With the detail restored, it is a geometrical transformation of the "Almagest" so slavish in its imitation that the claim to be considered a true heliocentric theory must be abandoned. The only true begetter of such a theory was Kepler. Moreover, the period during which the work of Copernicus can be said to have had a scientific, as opposed to a popular or archæological, value, is limited to sixty-six years, 1543–1609, after which it was superseded by the "Astronomia Nova".

It may be well to indicate where the real greatness of Copernicus lay. To the Arabian astronomers belongs the credit of preserving the "Almagest". But their creative powers were limited. The utmost they could do was to use the work, and their highest efforts are embodied in the Alfonsine tables. The first man who could see to the core of the work, understand its mathematical devices and adapt them to another form, was Copernicus. For this all honour is due to him, though the weapon he fashioned, when applied to the computation of an ephemeris, had exactly the same range as Ptolemy's, no more and no less.

When he enters on the seventeenth century and approaches the date of Newton's birth, Mr. Johnson's account seems to become less satisfactory, certainly as a commentary on the true scientific history of the time. The rival theories are now those of Copernicus and Tycho Brahe. The work of Galileo had an immediate popular appeal. Here it may be noted that the fundamental problem of astronomy was ultimately solved without the aid of the telescope. Galileo's more important contribution was made to the foundation of dynamics. But as judged by the material to which Mr. Johnson has had access, the state of the public mind seems to have become more confused on scientific questions than in the previous century. For some reason he is particularly severe on Francis Bacon. Bacon as a man had his faults, no doubt. But in so far as he embodied the philosophical ideas of his time in a supreme degree, Mr. Johnson should surely have found more satisfaction in revealing the background from which they were drawn than in imputing a lack of originality. The estimate of "Baco Verulamius" formed by Huygens was very different.

(2) The first instalment of Kepler's works to be newly published is the third volume of an edition which is destined to supersede that of Frisch (Frankfurt, 1858–71). The "Astronomia Nova" may be counted one of the three greatest works on astronomy, the other two being the "Almagest" and the "Principia". It is impossible, with the volume at hand, to resist quoting the words in which a true heliocentric theory was first stated :

> Ad Physicas vero causas motuum indagandas primus gradus fuit, ut demonstrarem, concursum illum Eccentricorum non alio loco (prope Solem) contingere, quam in ipsissimo centro corporis Solaris, contra quam Copernicus et Braheus crediderant.

And in the margin :

> Primus ad eas gradus factus. In unico centro corporis Solaris concurrere omnium sex Eccentricorum plana.

In a short space it is only possible to allude to one point, but it seems an interesting one. The book when it appeared was far in advance of its age, and few were capable of understanding it In the editorial appendix (p. 459) it is mentioned that twenty-three years after its publication Galileo denied that there was any certain knowledge of the theory of the planets. But this is not all. In a note (xix, p. 258) on the problem of planetary tables, written for the Paris Academy of Sciences in 1667, Huygens shows no greater understanding of the position. The names of other astronomers in the same case are mentioned by Montucla.

In England, events took a different course. In the years 1606–9, Thomas Harriot was in communication with Kepler. The letters are extant and may be the occasion of some future reference when a later volume of this edition appears. This correspondence is mentioned by Mr. Johnson. That Francis Bacon, writing about 1612, betrays an ignorance of Kepler's laws of planetary motion seems scarcely surprising in the circumstances or a fair subject for reproach. But how far bibliography and history can stand apart is illustrated by the fact that no mention is made in Mr. Johnson's book of Jeremiah Horrocks (*d.* 1641). The nearest contact is through Samuel Foster, whose name occurs in a list of Gresham professors of astronomy. Now Foster was in correspondence with Horrocks. The omission can no doubt be justified on technical grounds, but it is fatal to any true picture of the times. For Horrocks, alone of all his contemporaries, had the proper appreciation of what Tycho Brahe and Kepler had done, and his boyish enthusiasm made him a unique figure in the history of science. Dying almost as soon as he had reached his majority, he can stand in the line Kepler—Horrocks—Newton for all time. As Kepler had stated the laws of undisturbed motion, so Horrocks approached the problem of perturbations both in lunar and planetary theory with perfect insight. To a mathematician like Newton the rest was a logical conclusion. Great credit is due to Gilbert as a pioneer in experiment, but some of the deductions drawn from his work on magnetism seem to have been quite illogical and misleading. Here again Horrocks brushed away with effortless ease the magnetic cobwebs which Kepler had picked up from Gilbert.

(3) When vol. 18 of the monumental edition of the works of Huygens appeared, it seemed as if the stream of rich material was at last beginning to show signs of exhaustion The end cannot be far distant. But the latest volume with its admirable editorial notices returns to a level of interest certainly not below the average. It contains the classical "Traité de la Lumière", surely one of the most beautiful memoirs on a physical subject ever written. This alone is enough to give distinction to the volume in which it appears. An antecedent fragment, here reproduced in facsimile, is headed : "'ΕΥΡΗΚΑ 6 Aug. 1677. Causam mirae refractionis in Crystallo Islandica", and the exultation in the discovery of ellipsoidal waves seems entirely justified. Huygens returned from The Hague to Paris in the following year, and the substance of the "Traité" was delivered to the Academy in a series of discourses. Publication was delayed until 1690, with some idea of preparing a Latin text. It would seem that Huygens had less than Kepler's facility in that tongue. A change of fashion was beginning to set in, though the practice survived to the days of Gauss and Bessel.

The fate of Huygens's ideas on physical optics is well known. The interval from Huygens to Fresnel has some analogy to that from Kepler to Newton, and it was even longer. As the failure to appreciate the significance of Kepler's great work has already been noticed, it may be remarked that, after making the personal acquaintance of Newton in 1689, Huygens accepted the theory of elliptic orbits, even for comets.

This volume, which contains the contributions of Huygens as an academician at Paris, covers the whole range of mechanics and physics as now understood. It is a mine of information on the state of science in the latter half of the seventeenth century, and it gives a singularly complete picture of the mind of this great man. The intellectual heir of Descartes, the influences impressed in youth persisted through his life. How they led him, and how far his natural independence triumphed over inherited prejudice, can be studied and fairly seen in this single volume of his works.

H. C. P.

Quantum Theory in Chemistry

Einführung in die Quantenchemie
Von Prof. Dr. Hans Hellmann. Pp. vii + 350. (Leipzig und Wien : Franz Deuticke, 1937.) 20 gold marks.

Dirac has said, "The general theory of quantum mechanics is now almost complete. . . . The underlying physical laws necessary for the mathematical theory of a large part of physics and the whole of chemistry are thus completely known, and the difficulty is only that an exact application of these laws leads to equations much too complicated to be soluble. . . ." How then is it possible to have a quantum chemistry ? Must the chemist for ever wait on the pleasure of great calculating machines before he can get a new insight into the underlying philosophies of his subject, or must he acquire a mathematical equipment which would only enable him to play about on the fringe of quantum chemistry ?

Bohr's theory of atomic structure was in its mathematical dress difficult for the chemist, and it seemed impossible to base a mathematical theory of valence upon it. Yet G. N. Lewis, by introducing a beautiful and simple conceptual picture, provided the chemist with a framework into which he could fit—mosaic-like—the 'irreducible stubborn facts' of chemistry, thereby giving a new meaning to them.

The ineffectual behaviour of Hamlet was due to the fact that out of the disconnected fragments of experience he chose no pattern or framework ; and theoretical chemistry is in danger of becoming incoherent for lack of a guiding pattern. Again the time has come when chemists need a conception —based upon modern quantum mechanics—which will unify and co-ordinate chemical phenomena in the same way as did the conceptions of G. N. Lewis. Fortunately there are, in the hands of a few, guiding patterns and frameworks into which it is possible to set large sections of chemical phenomena and to see them with new meaning and new insight. The conceptions and methods of such frameworks are described and discussed by Prof. Hellmann in the monograph now under notice.

It is necessary that these methods of thought should not remain with the few active workers in this field ; they should rather be an integral part of the equipment of all chemists. It is not sufficient to graft these new conceptions on to old ideas as reservations and restrictions to be borne in mind while continuing to use older methods. We feel that this monograph is an excellent beginning in the presentation of such underlying principles of quantum chemistry.

The two main methods of approximation to the study of valence problems are presented in great detail. These two schemes—one, the homopolar or bond eigenfunction method associated with the names of Heitler, London, Slater and Pauling; the other, the method of molecular orbitals developed by Lennard-Jones, Hund and Mulliken—already provide a means of describing and explaining the valence behaviour of large groups of chemical substances. Nor are all the successes confined to the relatively simple chemical compounds—the theory of resonance in conjugated compounds has had great influence on the theories of the stability and reactivity of organic molecules.

Another field in which the appearance of quantum concepts has led to new understanding and fresh impetus is that of chemical reaction kinetics. In this book the basis of the work of Eyring and his school on one hand and of Polanyi on the other is very fully discussed. One chapter is devoted to the application of these conceptions to the semi-empirical calculation of activation energies and to the calculation of absolute reaction velocities.

"Einführung in die Quantenchemie" is filling a real need. For those who are able to use the mathematics of the approximate methods of quantum chemistry, this monograph with its very full bibliography is an admirable introduction. On the other hand, by collecting in one place and correlating the various methods which have been used in quantum chemistry, this book may enable readers to find a conceptual structure which will give rise to a new co-ordination of chemical phenomena in a form which can be understood and handled by non-mathematicians.

Mathematics for Technical Students

(1) Calculus

By Prof. Herman W. March and Prof. Henry C. Wolff. (Modern Mathematical Texts.) Pp. xvii + 424. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 15*s*.

(2) The Elementary Theory of Operational Mathematics

By Prof. Eugene Stephens. (Electrical Engineering Texts.) Pp. xi + 313. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21*s*.

(1) "THE bond of union among the physical sciences is the mathematical spirit and the mathematical method which pervade them." Thus in their admirable text-book, Profs. March and Wolff endeavour to develop the fundamental principles of the calculus which play so important a part in the physical sciences, and to lay the emphasis upon the mode of thought so that even though the student may forget the details of the subject, he will continue to apply these fundamental modes of thinking in his later scientific or technical career.

While the needs of technical students have been foremost in the minds of the authors, the book is equally adapted to others. For, in the opinion of Profs. March and Wolff, mathematical courses for technical students and for the students of pure science do not materially differ. Both classes of students profit by the type of study that is assumed to be adapted to the other class.

The book is not divided into two separate parts devoted to the differential and integral calculus respectively. Integration with the determination of the constant of integration and the definite integral as the limit of a sum, are given immediately following the differentiation of algebraic functions, and before the differentiation of the transcendental functions. Thus many of the most important applications of the calculus occur early in the course and constantly recur. Further, by this arrangement the student is in a better position to pursue courses in physics and mechanics simultaneously with the calculus.

(2) In electrical engineering, the algebraic method as an aid to the simplification of work with the differential equations and integrals encountered in mathematical physics, has only been partially appreciated hitherto. The text of Prof. Stephens's book on the elementary theory of operational mathematics is an attempt both to search out the history of these methods and to codify the set of theorems found. Owing to the fundamental character of the methods used, the book will probably be of interest to the mathematician; but the author is careful to point out that it is written primarily for "all those who live and work to make mathematics useful to mankind, because of the beauty and simplicity of the operational forms and because of their wide application to the daily tasks of teachers and workers in engineering schools and industrial laboratories".

The essential nature of the method here presented consists of: (1) 'algebraizing' the operators of the differential and integral calculus; (2) simplifying the algebraic forms thus obtained; and (3) re-interpreting the resulting forms as operators which are then found to be easier to use than the original ones. Wherever the methods are not rigorously justified, reference is made to "The Theory of Linear Operators", by H. T. Davis: and a very extensive bibliography is provided.

Der Chemie-Ingenieur:

ein Handbuch der physikalischen Arbeitsmethoden in chemischen und verwandten Industriebetrieben. Herausgegeben von A. Eucken und M. Jakob. Band 3: Chemische Operationen. Teil 1: Physikalisch-chemische und wirtschaftliche Gesichtspunkte für die durchführung chemischer Operationen. Herausgegeben von A. Eucken. Pp. xvi+564. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1937.) 52 gold marks.

THIS book is the first part of volume 3 of a well-known work on chemical engineering under the editorship of Eucken and Jakob, the former of whom in the opening chapter of this book considers the determination of the maximum output from the point of view of chemical equilibrium, both of homogeneous and heterogeneous systems under constant conditions of temperature, as well as the thermodynamics involved and practical applications thereof.

The first part of the second chapter is from the pen of H. von Dohse, and is concerned with the subject of the velocity of reaction particularly in homogeneous systems and where catalysts are present. K. von Fischbeck, who is responsible for the second part of this chapter, has treated the subject of the reaction velocity in heterogeneous systems such as may arise in the burning of coal, decomposition of salts and between compact bodies.

Responsibility for the last section of this chapter is taken by G. von Danikohler, who has considered such subjects as the influence of diffusion, flow and heat on the yield in reactions carried out on an industrial scale.

Involving as they do the application of the principles of physical chemistry to industrial problems, the treatment of the aspects discussed in these chapters is quantitative as well as qualitative, and numerous references are made to much recent work.

Not of least interest and importance to the chemical engineer and industrialist is the cost of the various operations involved in the manufacture, packing and selling of his product, an important subject which is discussed in Chapter iii by L. von. Meyer, who, realizing the variations which may be introduced, has wisely stressed the general principles involved.

The book is uniform with the parts of volumes 1 and 2, and contains much useful and valuable information relating to the transfer of a process from the laboratory to the industrial scale, which should be of assistance to the chemical engineer and industrial chemist.

The Bantu-speaking Tribes of South Africa:

an Ethnographical Survey. Edited for the (South African) Inter-University Committee for African Studies by I. Schapera. Pp. xv+453+24 plates. (London: George Routledge and Sons, Ltd., 1937.) 21*s*. net.

IN view of the increasing importance of native policy as a factor in determining the future of British and Mandated Africa, it is essentially desirable that accurate information about the native should be available in a readily accessible and easily assimilable form. For this purpose this volume is in every way admirable. The life of the Bantu-speaking peoples of South Africa is described from every side as lived before modification by European contacts. Each chapter is written by an acknowledged expert among South African anthropologists. Among those dealing with the more general questions, Prof. Raymond Dart writes on racial origins and Dr. A. J. H. Godwin describes the geographical environment, while Dr. N. J. van Warmilo deals with grouping and racial history. Dr. C. M. Doke is responsible for the account of language and Mrs. Hoernlé analyses their social organization and records their magical and medical practices. The other aspects of native life and culture are covered by writers of equal authority; the editor himself has been responsible for economics, politics, and law and justice.

It is unnecessary to enter further into detail. The name of the editor is a sufficient guarantee that nothing which is essential to give the layman a comprehensive view of South Africa Bantu culture—using the term in a broad sense—has been omitted. The special merit of the book, however, is that not only does it deal with the native of South Africa as he was, but it also gives objectively, and impartially, be it said, an adequate account of present-day conditions—the native as he is, after contact with European civilization and now that he has become a 'problem'—information that is essential, if we in Great Britain are to understand what is involved in the difficulties which the people of the Union of South Africa have to solve. Here Prof. Schapera, Dr. Monica Hunter, and the colleagues who have collaborated with them are guides whose scientific detachment is above suspicion of political bias.

Light:

Principles and Experiments. By Prof. George S. Monk. Pp. xi + 477. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30*s*.

THERE is a rapid increase in the number of elementary treatises on light intended to serve the needs of the student of a good pass or first year honours grade. Prof. Monk's book is of this standard. It provides a very well balanced course of geometrical and physical optics in which the emphasis is, naturally, on the physical side. The fundamentals of the subject are carefully developed and expounded, and, though the treatment is relatively elementary, intensity-distribution problems receive due consideration, and there are concise but comprehensive chapters on spectra, light and material media, the effects of magnetic and electric fields, and the eye and colour vision. The geometrical part contains a useful discussion of the cardinal points of an optical system developed on classical lines, apertures, aberrations, photometry and instruments. About seventy pages are devoted to a series of twenty-three laboratory experiments, ranging from the focal lengths of simple lenses to the optical constants of metals.

The book forms an excellent introduction to a more specialized treatment for students in an honours grade.

A. F.

Natural and Artificial Rubber: the Elasticity of Long-chain Molecules

By Prof. H. Mark, University of Vienna

INTRODUCTION

THE elasticity of rubber and related substances is not of the same kind as the elasticity of steel or glass, but seems more to possess the nature of the elasticity of gases. This may appear strange, because we are accustomed to regard rubber as a solid body, but as a matter of fact technical men have since long realized this peculiar relationship. Hence they nearly always use rubber or rubber-like material in conjunction with air, when they try to produce a high elastic combination as a ball, a tube, a tyre, etc., but they never combine soft rubber with metals or other solid bodies. Only hard rubber is used in this field. Our technical experience so far can be summarized thus: soft rubber is best used in conjunction with gases, hard rubber with solid bodies.

It may be very surprising that recent research work in the field of high molecular substances has shown, indeed, that the elasticity of soft rubber is based on exactly the same fundamental effect as the elasticity of gases, while on the other hand the elastic properties of hard rubber are closely related to those of metals or other solid bodies.

We have well-founded ideas on the elastic behaviour of normal crystals, and we know that the single atoms or ions oscillate around equilibrium positions, which are shifted when we extend the crystal elastically. The energy which enters in this way in the lattice represents the elastic energy of the sample; this is the cause of the experimentally observed fact that a normal crystal cools during rapid extension and heats during rapid relaxation. On the other hand, soft rubber heats during rapid extension and cools down when it is rapidly relaxed, while hard rubber shows the same behaviour as normal solid crystals.

All these facts show that we have to look for quite a different mechanism when we want to explain the high reversible elasticity of soft rubber and a number of analogous substances, which are grouped together under the title 'synthetic rubber', but may be built up from substances chemically quite different. Searching for such a new explanation, we have first to note that all bodies with characteristic rubber-like elasticity have one common property, namely, they are built up of long chain-like molecules, every one of which consists of some hundred members and every one of which shows a remarkable internal flexibility. Substances built up of long thread-like molecules, so-called main-valence chains, play an important part in the constitution of organized matter. There are rubber, proteins, cellulose, chitin, starch, etc. Synthetic products of the same molecular type are the well-known high polymeric substances such as polystyrene, buna, duprene, sowpren, thiokol, perdurene, etc. Always, when the long chains are flexible, as is the case with rubber, proteins, buna, duprene, thiokol, sulphur, etc., we get typical rubber-like elasticity, while in the case of more or less stiff chains—cellulose, chitin, polystyrene—we get plastic materials, which may be used technically as artificial resins.

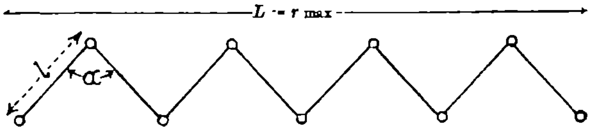
We have therefore to put the question: What particular properties have long flexible chain-like molecules?

BEHAVIOUR OF A SINGLE CHAIN-MOLECULE

Starting from very simple assumptions, we study an isolated chain-molecule of the type

$$\underbrace{CH_3.CH_2.CH_2 \quad . \quad . \quad . \quad . \quad . \quad CH_2.CH_2.CH_3}_{n \text{ C-atoms}},$$

n being a number between 100 and 10,000. We are quite aware that our results must be preliminary, because rubber does not consist of one single chain of this type, but contains many such chains substituted with methyl groups and linked together by secondary valences.



$n = 9$

Fig. 1.

Bragg's experiments show that the length of every carbon linkage is 1·45 A. and stereochemistry teaches us that the angle between two valencies is 109°, and that, around every linkage, free or nearly free rotation has to be assumed. When we stretch the molecule we get a chain of the length

$$L = (n - 1).\ l \sin \frac{\alpha}{2} = r_{\max}$$

the shape of which is shown in Fig. 1. The distance between the first and the last atom of the chain represents the maximum possible distance which can be produced between these two atoms, and can be realized only in the way represented by Fig. 1.

But when we prescribe for the distance between the first and last C-atom another value r such that

$$r < r_{\max},$$

it is easily seen that we can obtain this distance in many different ways. According to the flexibility of the chain, we are free to fold it together in different ways, so that the distance between the ends is just r. To every given r belongs a certain number of possibilities, realizing this value in geometrically different ways. This reminds us rather closely of the Boltzmann statistics of an ideal gas, where we also have to enumerate the possibilities of microscopic realization for one given macroscopic state. In our case the macroscopic state is the fixed distance r between the chain-ends, and the different possibilities or aspects are afforded by the different shapes of the chain, all of which give the same distance between the ends (compare Fig. 2).

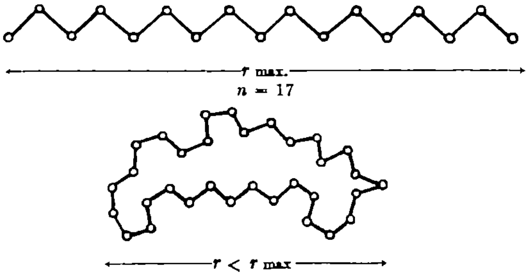


Fig. 2.

These considerations invite us to assume that a chain-like molecule, being in thermodynamical equilibrium with its surrounding—getting from all directions at random thermal impulses—will by itself always appear in that state which has the greatest number of aspects. This means nothing else but the application of Boltzmann's ideas to the case of a single chain-like molecule. When we have the extended chain and allow it to be in free contact with its surroundings, it will try to increase its number of possible states, that is, to reach a higher statistical probability. This is certainly not the extended state, because that has the realization number *one*. It will be another state, in which the ends of the chain are nearer together than in the case shown in Fig. 1. That means nothing else but that the extended chain will *contract by itself*, as an ideal gas expands by itself, because the number of aspects increases with increasing volume of the gas. On the other hand, when we want to extend the contracted chain, we have to bring it in a less probable state. According to the general laws of thermodynamics, this is only possible if one puts work into the system, and this work is used to extend the elastic chain.

It is seen, therefore, that the contraction of an extended piece of rubber is not due to the action of molecular forces but to the thermal movement of the single members in the different chain molecules which build up the sample. Exactly in the same way, the pressure which an ideal gas exerts on its wall is not due to forces but to the thermal movement of the single molecules. It is very significant that in both cases thermodynamics requires that with increasing temperature the effect should increase. In fact, it has long been well known that the pressure of an ideal gas is proportional to the absolute temperature, and it was a very important observation made independently by K. H. Meyer, to whom we owe the new development on this field, and L. S. Ornstein that the elasticity of rubber also increases with the temperature.

It is not very difficult to put all this in formulæ, which was done by E Guth some years ago. To every prescribed distance r between the ends of the chain belongs a certain number of realization possibilities. It can be calculated by the laws of probability. One finds the probability, W, that a chain with n members each of the length l, combined together by a valence angle α, should give a distance r between its first and last atom is given by:

$$W(n, l, a, r)r^2dr = \sqrt{\frac{6}{\pi}} \cdot \frac{3}{n^{3/2}\, l_\alpha^2} \cdot \exp\left(-\frac{3r^2}{2nl_\alpha^2}\right) r^2dr.$$

$$l_\alpha^2 = l^2 \frac{1 + \cos\alpha}{1 - \cos\alpha} \qquad (1)$$

When we regard this as the statistical probability function of our system, we may define the *entropy of a single chain* by the well-known Boltzmann expression,

$$S = k \log W, \qquad (2)$$

and can derive from the entropy all properties of the substance. It is well known that in the theory of ideal gases the pressure can be calculated from the entropy by the formula

$$p = +\left(\frac{\partial S}{\partial V}\right)_T . T.$$

When we put in this equation the entropy of an ideal gas, we get the fundamental equation of state

$$pV = RT.$$

In very close analogy to this we can put for our chain molecule the relation

$$\sigma = -\left(\frac{\partial S}{\partial \delta l}\right)_T . T$$

σ = tension or stress. (3)
δl = extension.

Taking (2) for S and (1) for W, we get the equation of state for our system. In this way we obtain:

$$\sigma = kT\frac{3}{nl^2} \cdot \frac{1 - \cos\alpha}{1 + \cos\alpha} \cdot \delta l, \qquad (4)$$

which is nothing else than a theoretical expression for the *extension curve* of a single flexible molecular chain in thermodynamical equilibrium with its surroundings.

APPLICATION OF THE THEORY

It is interesting to note that experiment is in very fair agreement with these ideas. We have already mentioned the experiments of K. H. Meyer and L. S. Ornstein, which show the fundamental fact that the elasticity of rubber increases with increasing temperature. Other measurements due to L. Hock and to P. A. Thiessen show that the thermo-elastic properties of rubber do not at all contradict the ideas of statistical elasticity. The relation (4) contains the number n of the chain-members, which is closely connected with its molecular weight. In fact, W. Kuhn, to whom we owe very interesting calculations on this field, was able to derive the average molecular weight of rubber starting from its modulus of elasticity. He got values between 20,000 and 100,000, in very satisfactory agreement with other methods earlier applied. Another consequence is that the specific heat of stretched rubber measured at constant length must be different from the specific heat measured at constant tension. This also has been proved experimentally, and supports the ideas put forward in this article.

To get real quantitative agreement between experiment and theory it is necessary to improve our model in two directions:

(1) We have to consider that a macroscopic piece of rubber consists of *many* long-chain molecules connected together by van der Waals' forces. This means that the molecules are not independent of one another, but have the property of hindering each other during the extension.

(2) It is not necessary that the rotation around the single carbon linkages in one chain should be really free. There can be some steric hindrance, which allows only a certain amount of free rotation.

Both improvements are on the same lines by which one proceeds from the equation of state of an ideal gas to the van der Waals' equation.

Our second point is identical with the van der Waals' volume correction, while the first one brings into consideration the forces between the different molecules. From the theory of gases we know that at high pressures and low temperatures during the compression of a gas a new phase, namely a liquid phase, arises, and that in this region an equilibrium between two phases plays an important part in the behaviour of the system. In very close analogy it has been found that rubber also shows at high tensions and low temperatures a new phase, namely, the small rubber crystals, which were detected by J. R. Katz and afterwards were investigated by many other workers. Under these conditions, again, an equilibrium between liquid and solid rubber determines the behaviour of the system. This equilibrium was carefully investigated by G. v. Susich and by P. A. Thiessen and his collaborators. In gases the condensation process is subject to the Clausius-Clapeyron equation, and it is very easy to derive from the formulæ mentioned above a relation which corresponds exactly to the Clausius-Clapeyron equation and which seems to be in very good agreement with the experimental facts found by L. Hock, G. v. Susich, P. A. Thiessen and others.

There is no question that a lot of experimental and theoretical work has still to be done before we shall be able to survey the whole field of elastic extensibility of high-molecular substances, but we seem to be on the right path, and many other properties, such as the viscosity of high-molecular solutions and the dielectric behaviour of long-chain dipoles, will be elucidated by such studies.

Science, Logic and Philosophy*

By Dr. Harold Jeffreys, F.R.S.

MUCH in current discussion of scientific method turns on the ancient problem of idealism versus realism. As I understand it, an idealist holds that he is inventing a universe for himself as he goes along, while a realist holds that there is a "universe existing independently of our thought and our examination of it"—to use the words of Prof. Dingle—and that what we are doing in science is to find out something about this universe. Realism has been severely criticized, and some forms of it not too severely. Nevertheless, I do not believe that anybody is an idealist. If an idealist regards the world as a mere mental construct of his own, so are other people, being part of that world. Hence if an idealist argues with other people he must think that he is arguing with his own mental constructs, and all discussion should be futile for him. So far as my observation goes, people that call themselves idealists are at least as argumentative as the rest of mankind; whereas if their belief was genuine I should have expected them to retire into a state of psychotic isolation.

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*Based on a lecture given at the University of Leeds on January 31.

The great difficulty about idealism is that every idealist must have his own separate idealism. If A and B are idealists, A thinks that he has invented B and vice versa. The relation between them is that between 'Alice' and the 'Red King'; but while Alice was willing to believe that she was imagining the King, she found the idea that the King was imagining her quite intolerable. This fundamental asymmetry makes it quite impossible for two idealists to agree. They may support idealism in similar forms of words, but each is advocating his own particular idealism, which is flatly contradictory to the other's; and if they think that they agree they must have used some other principle.

Nevertheless, idealism contains an important principle recognized by Karl Pearson[1], that any person's data consist of his own individual experiences and that his opinions are the result of his own individual thought acting on those experiences. Any form of realism that denies this is merely false in fact. A hypothesis does not exist until some one person has thought of it; an inference does not exist until one person has made it. We must and do in fact begin with the individual. But early in life he recognizes groups of sensations that habitually occur together, and in particular he notices resemblances between those groups that we, as adults, call observations of oneself and other people. When he learns to speak he has already made the observation that sounds belonging to these groups are habitually associated with other groups, and has inferred the rule that we should express by saying that particular things and actions are denoted by particular words; and when he himself uses language he has generalized the rule to say that it may be expected to hold for future events.

The use of language accepts the principle that generalization from experience is possible; and this is far from being the only such generalization made in infancy. But if we accept it in one case we have no ground for denying it in another. But he also observes similarities of appearance and behaviour between himself and other people, and as he is associated with a conscious personality it is a natural generalization to suppose that other people are too. Thus the departure from primitive solipsism is made possible by admitting the possibility of generalization. Further, it abolishes the asymmetry between different people, and it is possible for them to understand and agree with each other simultaneously, which appears to be quite impossible for two idealists. But it does not say that nothing is to be believed until everybody believes it. The situation is that one person makes an observation or an inference; but this is an individual act. If he reports it to anybody else the second person must himself make an individual act of acceptance or rejection; all that the first can say is that, from the observed similarities between himself and other people, he would expect the second to accept it. The facts that organized society is possible and that scientific disagreements tend to disappear when the participants exchange their data or when new data accumulate are confirmation of this generalization; but to take universal agreement as a primary requisite for belief is a superfluous hypothesis, and it cannot be applied in practice. It is impossible for a person to ask everybody's permission before he believes anything.

The need for an understanding of generalization is quite fundamental. It is not worth while to invent or postulate an object unless we find that we can co-ordinate many sensations by doing so. The Nautical Almanac's predictions of planetary positions, an engineer's estimate of the output of a new dynamo, and an agricultural statistician's advice to a farmer about the utility of a new fertilizer are all generalizations from experience. So are my expectations about the flavour of my next meal. Now if our reasoning is restricted to traditional logic such inferences are impossible. Traditional logic admits only three alternatives about any proposition: complete certainty, absolute denial, or blank ignorance. In pure mathematics it deals only with logical relations between nothing in particular, and is frankly admitted to have nothing to do with sensory experience until some extra hypotheses are supplied. In applied mathematics these are supplied, usually without mention of their origin, and results are deduced as exact consequences. Thus it is impossible to say anything at all until we can say it with certainty.

Generalizations from experience are not, however, made with certainty. To say that they are involves the fallacy known in logic as the excluded middle term. It appears in accounts of scientific method in various forms. Thus it may be said that a quantitative law is a description of the observations; but that refers only to the observations that have yet been made, and an infinite number of laws would fit any finite number of observations ([3], pp. 37–39). To infer any new observation from it we must select a particular law from this infinite set; and without some rule not contemplated in traditional logic there is no means of making such a selection, or therefore of preferring any prediction to any other. Conversely, if we say that we learn our laws from experience we can avoid the fallacy of the excluded middle only at the cost of admitting that there are valid inferences that are not made with certainty. We must, in fact, choose between three alternatives.

(1) Prediction is meaningless: then all practical men are wasting their time, the sun may rise in the west to-morrow, and human relations that depend on people understanding one another's language are impossible.

(2) Prediction is made deductively, not from experience, but from some general principle alleged to be logically certain; if experience plays any part at all it is only to fill in a few details. This is the attitude of many modern theoretical physicists. However, their general principles and their results differ even within the very limited field of knowledge where they have been applied; and at the most we can regard them only as guesses worthy of proper test by experiment.

(3) Generalizations from experience can be valid inferences, but are not made with certainty. But in that case traditional deductive logic is admitted to be inapplicable to either ordinary life or scientific method.

There are no other alternatives; nobody believes the first; the second is very doubtfully applicable at all, and has not been applied to the fundamental problems; the third is generally accepted, but asserts the inadequacy of deductive logic. It demands the notion of a degree of reasonable confidence, of which certainty and impossibility are the extreme possible values; but the former, while it may be approached by a generalization or an inference from one, is never quite attained.

The need is indeed obvious without this discussion if we consider the kind of inferences that we actually draw. Suppose that we measure the distance between two points once and get 18·1 mm.; we measure it again ten times and get values from 18·0 mm. to 18·2 mm.; we measure another distance ten times and get values from 17 mm. to 19 mm. What will we infer about the distance that we should get in a further measurement? Obviously we cannot infer a single exact value in any case; but we can say that in the second case the next value is very likely to lie between 18·0 mm. and 18·2 mm.; in the third it is much less likely; in the first we have no idea at all except that the most likely result will be 18·1 mm., unless we have independent evidence about the accuracy of our readings; if we have not, the next observation may depart by any amount. Everybody that has ever made observations is fully aware of these facts. Very few, however, have grasped the consequence, that any theory of inference that can make only exact predictions or none at all is for that reason inadequate. We must have a theory that deals with the probability of variations of different amounts. Meanwhile I shall use the adjectives "naive" to denote any theory, whether realist or idealist, that maintains that inferences are made with certainty, and "critical" for one that admits that they are not, but nevertheless have validity.

Again, suppose that we repeat the second and third of the above series of measures a day later, and get in each case an average value of 17·5 mm. Are we to say that this is a variation similar to what we have already found, or that the distance has changed? Evidently in the third series it is more likely to be of the old type than in the second; but where are we to draw the line? In neither case can we assign any definite value and say that any discrepancy less than this is certainly of the kind that we have already had and that any larger one certainly represents a change of distance. Yet we must draw some sort of a line somewhere, even though we cannot be sure of drawing it in the right place. Such problems are of everyday occurrence; but traditional logic has nothing whatever to say about them. That does not say that they cannot be treated mathematically; it is perfectly possible to generalize mathematics to give it greater elasticity, and modern physicists have done much in that direction. They have, however, shown a curious reluctance to recognize the inadequacy of traditional logic itself, being apparently saturated with the naive realistic ideas of applied mathematical teaching. Yet traditional logic denies the possibility of learning from experience, and it is right if we restrict this to mean learning with certainty; if we believe that we can learn from experience it must be with different degrees of probability.

The notion of probability as a statement of a degree of reasonable confidence goes back at least to James Bernoulli, and is quite explicit in the works of Bayes, Laplace, and a number of other writers. Other definitions have been attempted, but they all lead either to the introduction of superfluous postulates or are insufficiently general to cover the ground. I mention only one. Some writers speak of 'mathematical probability' as meaning simply that if there are n possible results of a trial and m of them include the event considered, the probability of the event is m/n. (See, for example, the series of reviews in NATURE of January 8, p. 55.) In earlier works, such as those of Laplace, this was stated with the proviso 'provided that all the ways are equally likely'. Thus it was not a definition of probability, since the notion occurred in the statement; it was a rule stating how to estimate probabilities in certain circumstances, the idea of probability itself being taken as already understood. If the proviso is dropped, however, we find that the 'mathematical probability' of a coin coming down heads is ½ even if it has been loaded with lead on one side and has already given ten heads in succession. The definition is simply a concession to traditional logic and discards the essence of the matter; and traditional logic admits no compromise. It says that the result of a trial, or of any number of trials, is simply unknown and there is no more to be said.

The question is, then, can we construct a mathematical theory of probability, in the ordinary sense of the term, that will be consistent, and will meet the requirements of scientific procedure—and incidentally of ordinary life? It turns out that we can. The fundamental idea is simply that of the probability of a proposition, given the data; we need the postulate that such probabilities can be arranged in an order*, and a few minor postulates and conventions that make it possible to assign numbers in a one-one correspondence to probabilities[2,3]. The principle of inverse probability follows as a theorem, and enables us to compare the probabilities of different hypotheses on the same data. The results are consistent in the sense that if we compare the probabilities of two hypotheses at any stage of our knowledge, and other information is afterwards attained, the ratio of the final probabilities will be the same in whatever order the new pieces of information are taken into account. (It is known that complete consistency cannot be proved even for pure mathematics.) Inconsistency can arise if we speak of the probability of a proposition without reference to the data, which is still liable to be done on account of an inadequate notation that does not mention the data explicitly; but with a correct notation (due in principle to W. E. Johnson) no such trouble can arise. The essential point is that to say that we can learn by experience is the same as saying that the probability of a proposition is a function of both the proposition and the data. With this theory we can proceed to discuss what confidence we may attach to hypotheses, given observed data, if we are to follow consistent rules, and not to have different standards of validity depending, say, on whose hypothesis we are discussing.

Ordinary and scientific reasoning both admit learning from experience and therefore recognize the inadequacy of deductive logic; and everybody admits the significance of the statement "on data r, p is more probable than q". Different people may disagree in particular cases about which is the more probable, but they agree that the statement has a meaning. We start with the agreement and postpone consideration of the differences. It turns out that they can be attributed either to incomplete working out of the results (which can happen in pure mathematics) or to allowing our beliefs to be influenced by our wishes. Science has got on fairly well without any formal statement of its principles, but it is definitely advantageous in practice to have such a statement, which will at least allow these complications to be placed where we can see them and may possibly enable them to be removed, since they are perfectly capable of being tested; and on the theoretical side it liberates inference from experience from the charge of being indistinguishable from a set of arbitrary assumptions. It turns out that the apparent assumptions are all closely connected and that the process is much more coherent than might have been thought.

One immediate result is that the traditional idea of causality must be discarded as possibly wrong and certainly useless. With the possible exception of mere counting, a scientific law is never exactly verified. This fact appears to be quite unknown to philosophical critics and to be conveniently forgotten by most scientists when talking about the basis of science. We must either choose our laws to fit the data exactly or be satisfied with a compromise. At the times when Euclid and Newton worked, the unexplained discrepancies were some hundreds of times those that ultimately led to modifications of their laws; but in spite of this the laws were taught as having deductive certainty. Scientific success does not consist in exact correspondence, but in the improvement of approximation. However carefully we measure, our measures never repeat themselves exactly; we may speak of 'experimental error' in some metaphysical sense, but the solid fact is that the measures vary—unless we use so coarse a measuring scale that all variations are swamped by the step of the scale, and if we do that even such a law as the additive property of distance is not verified. Even the simple law that the length of a solid body is constant is not exactly verified. But what is true is that the variation is irregular, and we can consider the hypothesis of 'random variation'; that is, that there is a part of each measure which cannot be foretold at all from previous measures.

On this hypothesis we can find a distribution of the probability of the remaining or permanent part. But this hypothesis is not certain, and we are entitled to consider the alternative that only part of the variation is random, the rest varying at an unknown rate the most probable value of which has to be estimated from the observations. It might account for any fraction of the total variation*, and the prior probability of its possible values has to be distributed uniformly within the range permitted by the total variation to express this. We can then compare the total probabilities, given the observations, that the whole of the variation is random and that part of it is systematic in this sense. It is found that if the new term as found by a least squares solution is more than a certain amount, the observations increase the probability that part of the variation is systematic; if it is less than this amount, they decrease it and support the proposition that the whole of the variation is random. The critical value is usually two to three times the standard error as usually estimated, and therefore is in good agreement with the rule that has been found to work well in practice.

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* The postulate is actually that "on data r, p is more probable than q" has a meaning and that this relation is transitive; when a practical statistician gives advice on the "best" way to proceed in order to achieve a desired result, he is assuming that "p is more probable on data q than on data r" has a meaning. But the latter can be proved from the other postulates and need not be taken as a separate postulate.

The method can be stated as saying that, if we have no previous knowledge beyond the fact that the new parameter is worth considering, we take the prior probability that it is zero as ½, and we accept it as genuine if the posterior probability is less than ½ (though not with much confidence unless it is considerably less). This is what I have called a 'simplicity postulate' ([2], p. 250). Some objection has been made to it by alleged naive realists, who would apparently accept every estimate uncritically as an exact determination. I can only say that every competent statistician does reject new parameters below about the limit that I find, and that nobody who has ever accepted two estimates as consistent because they agreed within the standard error of their difference is a naive realist. Anybody who rejects the simplicity postulate must apparently believe that the Nautical Almanac Office, in predicting the positions of the planets, would get better agreement with future observation by fitting polynomials exactly to the whole of the observations and then extrapolating, than it gets by the actual method of finding the minimum number of parameters by least squares and calculating according to the law of gravitation. But if anybody really believes that, he would add to the clarity of discussion by saying so explicitly. If, on the other hand, current procedure is admitted as valid, it is thereby admitted that probability must be introduced at some stage before we can get practical results. But if it has to come in sooner or later anyhow, we may as well have it at the start; and then it is found to solve most of the problems that have led to controversy, since the apparent postulates turn out to be either superfluous or legitimate inferences from experience.

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* It is because it often accounts for nearly all of it that a physicist can think that there is evidence for strict causality. In such a subject as agriculture no such confusion is possible. Fisher's term "the analysis of variance", though used by him only in relation to a particular technique, goes straight to the root of the general problem.

[1] Karl Pearson, "The Grammar of Science".

[2] Jeffreys, "Scientific Inference", 1937.

[3] Jeffreys, *Proc. Roy. Soc.*, A, **160**, 330–335 (1937).

[*To be continued.*]

Obituary Notices

Mr. W. H. B. Cameron

The untimely death of Mr. W. H. B. Cameron on February 16, at the early age of thirty-six years, came as a great shock to all who knew him.

A native of Ulster, Mr. Cameron entered Queen's University, Belfast, as Sullivan scholar from the Royal Belfast Academical Institution, and graduated in 1923 with honours in physics and mathematical physics. During the next three years he was successively Musgrave demonstrator in physics and Musgrave research student at that University, and undertook research work in spectroscopy under the direction of Dr. R. C. Johnson. His work on spectra associated with oxygen and nitrogen, for which he was awarded the M.Sc. degree, was followed by work on the nitrogen afterglow, and on the production of various spectra in the presence of neon and argon. During this work he discovered the bands of carbon monoxide now generally known as the Cameron bands, and also some new bands of silicon oxide.

Mr. Cameron joined the staff of the Physics Department at the University of Sheffield in 1926, and continued there his spectroscopic researches, working first on the band spectrum of sulphur, and later carrying out the construction of a novel grating spectrograph. Later work was done in collaboration with his colleague, Dr. A. Elliott, on intensity measurements of the first positive band spectrum of nitrogen excited by various methods. This was followed by a joint analysis of the visible emission bands of chlorine, recently published, in which it was shown that the bands are emitted by singly ionized chlorine molecules. Further work on the continuous spectra excited in chlorine by active nitrogen was in progress when he was stricken by his fatal illness.

Mr. Cameron's activities, however, were by no means confined to his scientific work. He had been leader of the University Rover Crew from its inception, as well as resident tutor at Crewe Hall and supervisor of University lodgings since 1936. During his time in Sheffield he was actively associated with St. Andrew's Presbyterian Church. He was secretary and past president of the Sheffield Physical Society, and an associate of the Institute of Physics.

In all phases of his varied activities, Mr. Cameron's work was characterized by unflagging patience and carefulness. This was particularly evident in his dealings with students, who held him in high affection and for whom no amount of work was a trouble to him. Besides being an excellent and sympathetic teacher and a delightful colleague, he had many sterling qualities; his modest manner, quiet humour, and kindly smile endeared him to all with whom he associated. It can truly be said of him that he spent himself gladly in the service of others. R. W. L.

Sir Arthur Downes

SIR ARTHUR DOWNES, who died on March 11, at his home on Mount Carmel, Haifa, Palestine, at the age of eighty-six years, had a long career in the public health service. He was educated at Shrewsbury School, University College, London, and the University of Aberdeen, where he graduated M.B., C.M. with honours in 1873. He became M.D. in 1875, and took the diploma of public health, Cambridge, in 1877.

After serving as deputy medical officer for Shropshire, and medical officer of health for the Essex Combined Areas, 1879–99, Downes was made inspector in the old Local Government Board, rising to become its senior medical inspector. He represented that body on many occasions, and served on the Royal Commission on the Poor Laws, and on a number of departmental committees.

Sir Arthur Downes will be best remembered for the pioneer work he did on the effect of light in inducing certain chemical changes, upon protoplasm and micro-organisms, and upon the activity of enzymes, publishing several communications on these subjects between 1877 and 1886, alone or in association with T. P. Blunt, in the *Chemical News*, *Proceedings of the Royal Society* and NATURE. Downes and Blunt showed that oxalic acid is completely oxidized and hydrogen peroxide is partially destroyed by insolation. In their "Researches on the Effect of Light upon Bacteria and other Organisms" in 1877, they found that light is inimical to the development of bacteria and micro-fungi, and under favourable conditions may wholly prevent development, the fitness of the culture liquid for growth being unimpaired, and they stated that this effect appeared to be associated with the actinic rays.

They carried this investigation a stage further in 1878 in their work "On the Influence of Light on Protoplasm". They tested the action of light upon Bacteria and Torulæ grown in test-tubes screened with different coloured glasses, the light-transmission of which was determined spectroscopically, and found that the action depends chiefly upon the blue and violet rays. Downes published another paper in 1886 on "The Action of Sunlight on Micro-Organisms", and in a letter in NATURE of the same year (34, 546) stated that the enzymes invertase, malt diastase, pancreatic diastase and trypsin, are all destroyed by insolation for a month.

Not inappropriately, Downes became a vice-president of the Sunlight League; he was knighted in 1910, and held the Order of the Crown of Belgium.

R. T. HEWLETT.

Sir Raymond Crawfurd

WE regret to announce the death on March 9 at the age of seventy-two years of Sir Raymond Crawfurd, registrar of the Royal College of Physicians of London, consulting physician to King's College Hospital and fellow of King's College, London.

Raymond Henry Payne Crawfurd was born on November 9, 1865, at East Grinstead, where he afterwards became consulting physician to the dispensary. He was the son of the Rev. Walter Payne Crawfurd, and was educated at Winchester and New College, Oxford. He qualified M.B. in 1894 and M.D. in 1896 with a thesis on Graves's disease, on which he afterwards contributed an article to Quain's "Dictionary of Medicine" (1900). In addition to his position on the staff of King's College Hospital, to which he was appointed assistant physician in 1898, dean in 1900 and full physician in 1905, his two chief spheres of activity were Epsom College, where he was chairman of the Council for thirteen years, and the Royal College of Physicians, where he was successively Fitzpatrick lecturer (1911–12), examiner (1912–16), censor (1918), Harveian orator (1919) and registrar from 1925 until the time of his death.

Apart from his joint editorship with Dr. (now Sir Farquhar) Buzzard of the fourth edition of Burney Yeo's "Manual of Treatment" (1909), Crawfurd contributed little to the literature of modern medicine, but he took a scholarly interest in the history of his art, being secretary of the section of medical history in the International Congress of Medicine held in London in 1913 and afterwards president of the Section of the History of Medicine of the Royal Society of Medicine, in the formation of which he took an active part. In 1909 he published a work entitled "The Last Days of Charles II", and in 1911 and 1912 chose as the subjects of his Fitzpatrick lectures "The King's Evil" and "Echoes of Pestilence in Literature and Art" respectively. Crawfurd was not only a fine scholar and an urbane and kindly physician, but also an excellent organizer and man of business whose loss it will be difficult to replace.

J. D. R.

WE regret to announce the following deaths:

Mr. Frederick J. Gould, author of many papers on moral education and world unity, who devoted his life to the promotion of social progress, on April 6, aged eighty-two years.

Prof. F. Mesnil, of the Pasteur Institute of Paris, member of the Section of Anatomy and Zoology of the Paris Academy of Sciences, aged seventy years.

Prof. Otto Naegeli, professor of internal medicine and director of the Medical Clinic in Zurich, known for his work on diseases of the blood, aged sixty-seven years.

Prof. D. W. Hering, emeritus professor of physics in New York University, on March 24, aged eighty-eight years.

Mr. F. A. Molitor, consulting engineer of New York, known for his work in railroad engineering, on March 12, aged sixty-nine years.

News and Views

Science at the Empire Exhibition, Glasgow

THE Empire Exhibition, which opens next month at Glasgow, will be the largest and most representative exhibition, with the exception of Wembley, that has been held in the history of the British Commonwealth. The Exhibition will present an impressive representation of the industrial and manufacturing capacity of the Empire and will show the progress of civilization within the Empire in many of its different aspects. Both in the industrial exhibits and in those for which the Government is directly responsible, research will occupy a prominent position. The theme of research will be symbolized in the huge sculptured feature, more than 40 ft. in height, which occupies the lofty entrance court of the United Kingdom Pavilion. Above the 'original elements', earth, water and air, represented by a golden sphere about which water continuously plays, a figure typifying man's questing spirit is seen to ride on a great silver wave. This figure bears the symbols of energy which science has placed within the grasp of man. The first of the four exhibition halls, each covering an area of 5,000 square feet, which form the United Kingdom Pavilion, is being devoted to a 'Fitter Britain' exhibit organized by the Ministry of Health in co-operation with the Board of Education, the Scottish Department of Health and the National Fitness Council. This exhibit will illustrate in a striking and interesting manner how the application of scientific knowledge is leading to a healthier nation.

EXHIBITS in the other three halls in the Pavilion have been organized by the Department of Scientific and Industrial Research. The aim of these halls is to demonstrate the part played by scientific knowledge and research in the industrial life of the nation. The three great national industries, coal, iron and steel, and shipbuilding, have been selected to illustrate this theme, and one hall is devoted to each of these subjects. In planning the exhibits the Department has had the fullest co-operation from industry. Important industrial organizations, such as the Mining Association of Great Britain, the Gas Federation, the Iron and Steel Federation and the Shipbuilding Conference, besides scores of leading firms, have freely given their assistance. Elsewhere in the Exhibition, the Ministry of Agriculture and Fisheries and the Forestry Commission, in co-operation with the Scottish Department of Agriculture and the Scottish Fishery Board, are showing exhibits illustrating some of the benefits which modern research has brought to agriculture, fishing and forestry. In the agricultural section, dairying, animal nutrition, fruit growing, land crop improvement and animal diseases are dealt with. One interesting section will deal with the gas storage of fruit developed by the Food Investigation Board, and another shows the application of chemistry to the problem of keeping soil fertile. In the forestry section the Forest Products Research Laboratory is co-operating with the Forestry Commission in staging an exhibit illustrating the work of the Laboratory as applied to home-grown timber. Another application of industrial research will be shown in an exhibit in the Palace of Engineering arranged by the Home Office, which will demonstrate modern methods of promoting the safety, health and welfare of industrial workers.

Press and the Public

THE broadsheet on "The Press and the Public" which has recently been issued by P E P (Political and Economic Planning) is of special interest in view of the recent attacks made upon the freedom of the Press in Great Britain by certain foreign powers, and of the Prime Minister's spirited championship of the Press in his speech at the annual dinner of the Parliamentary Press Gallery. The present broadsheet is concerned with the social influences of the Press, and its admirable exposition of the intricacy of the relationship with the public, and of the functions, amounting essentially to the provision of a daily magazine, which a newspaper is expected by many of its readers to fulfil, shows clearly how unfair is much of the criticism of the Press for sensationalism and inaccuracy. In its presentation and selection of material the Press is largely limited by the educational standards of its readers, and the broadsheet suggests that for one important class of readers all four of the popular dailies represent an improvement in taste and information. Equally it is emphasized that large numbers of readers would apparently support a newspaper considerably more sensational, more scandalous and more irresponsible than anything which the scruples of journalists, advertisers and proprietors and the restraints of the law will allow to appear.

THE basic function of the Press is to provide its readers with trustworthy news on which they can, if necessary, form sound opinions on current events, and in referring to the question of the standard of accuracy outside of the political field, the broadsheet points out that criticisms of accuracy in regard to scientific matters are criticisms not only of the Press but also of organized science itself. In scientific matters the giving of extra time to working up the statement properly would often prevent false or misleading impressions being conveyed. Though many scientific workers will have experience of inaccuracies even when a very careful statement was supplied to the Press, it should not be forgotten that organized science has as yet evolved no adequate means in Great Britain of telling the Press in advance what scientific workers have to say when the time comes for announcements of progress to be made. The broadsheet suggests that the influence of the Press may best be estimated by considering it as the principal agenda-making body for the everyday conversation of the ordinary man or woman, and therefore for that elusive element called public opinion. From that point of view alone, the broadsheet deserves the attention of those scientific workers who are interested in the shaping of public opinion and the encouragement of a scientific outlook or approach to the many social problems in which scientific and technical factors are involved.

The Conception of Curved Space

In a paper read at a meeting of the Victoria Institute, London, on April 4, entitled "Fallacies underlying the Einstein-Eddington Conception of Curved Space", Mr. Albert Eagle declared that "the whole conception does such violence to the nature of our minds that we can only call it a lie. . . ." He admitted that a disk might change its dimensions in a gravitational field, and so be distorted, but this should be regarded as a distortion of matter, not of space. The relativity formula for the distance between two points in a gravitational field might be correct if applied to the measurements taken with a material measuring rod, but such measurements should not be taken as the space of external reality. Mr. Eagle regarded the idea of curved space as self-contradictory, chiefly on psychological grounds. Moreover, he deprecated the attempt to abstract from reality everything that is tangible, and the attempt to reduce the physical universe to a purely geometrical universe. He complained that "practically no editor will publish an article making an attack on the theory". Quite apart from the difficulty under which most editors labour of finding space for the many contributions submitted, it may be suggested that a partial explanation may be, in Mr. Eagle's own words, that "Some people may think that I have more moral indignation, perhaps amounting even to animosity, against the theory of curved space than can be justified against any mere theory, no matter how erroneous or misleading it is."

Discovery

With the April issue our contemporary, *Discovery*, enters upon a new phase of its existence. It appears in new format, an octavo size, approximately that of a popular magazine, instead of a quarto ; and it is now published by the Cambridge University Press. *Discovery*, since its foundation soon after the Great War, with Sir J. J. Thom on, Sir Frederic Kenyon and the late Prof. R. S. Conway as its trustees, has consistently maintained a high standard of accuracy and a uniform distinction in style in bringing before an educated, but non-technical, public, information relating to the latest advances in knowledge and scientific discovery. Originally published by the house of John Murray, it was transferred to Messrs. Benn Bros. in 1924, by whom it has been published since that date until March of the current year, when responsibility for its future production was accepted by the Syndics of the Cambridge University Press. Dr. C. P. Snow, of Christ's College, Cambridge, will act as editor. Although the form of publication is changed, there will be no break in policy, which under the general supervision of the Committee representing the Trustees will be to continue to place before its readers, so far as possible, an accurate and universal view of advance, not only in physics, astronomy, biochemistry and medicine, but also in archæology, travel, architecture and the like in terms and phrasing of general appeal. The first issue in the new form holds out every hope of the fullest attainment of this aim. Among the contributors are Sir James Jeans, who writes on "The Origin of the Planets", and Dr. L. Infeld, a pupil of and collaborator with Prof. Einstein, on "Holes in Empty Space", while Mr. R. Philmore and Dr. J. Judkin contribute an amusing inquest on the scientific aspects of methods of murder in detective fiction. An article on new developments in colour photography is illustrated by a colour plate taken on the New Agfacolour film. We wish the new editor and publishers every success in their endeavour to enlarge popular interest in the progress of science.

Social Background of the Rise of Science

The sixth lecture of the series "Science in the Social World" organized by the Left Book Club Scientists' Group was delivered on March 28 by Prof. P. M. S. Blackett, his subject being "The Social Background of the Rise of Science in the Seventeenth Century". Prof. Blackett contrasted the view that the rather sudden rise of modern science in the seventeenth century was largely a matter of chance, with the view that this rise was closely related to the technical needs of the time. In particular, the progress of navigation and mining in the fifteenth and sixteenth centuries had led to a very urgent demand for the solution of certain scientific problems. The importance attached to these problems is shown by the efforts made to solve them. For example, at the end of the fifteenth century, eighty-three astronomers were employed in Lisbon on problems connected mainly with navigation, and by the end of the sixteenth century large financial rewards in the shape of prizes were offered for the solution of the problem of longitude. Again, Agricola in his book "De Re Metallica", published in 1556, listed sixteen different ways of pumping mines clear of water, a clear sign that no one of them was really satisfactory. It is interesting to note that the use of a clock at sea as a way of finding longitude was suggested so early as 1530, but that it was not until 1764 that this method was successfully used. Many of the scientific problems solved by Newton and his contemporaries had been raised into prominence between one and two hundred years before by the demand of practical techniques. The technical progress in the Middle Ages was not only an important contributory cause of the rise of modern science, but also led to a political struggle between the monarchy and feudal aristocracy against the rising merchant and business class. In England the struggle had been won by the latter by the time of the founding of the Royal Society, and this fact undoubtedly contributed to the rapidity with which science and technique developed in England.

The Value of Forests

THE value of forests to mankind in their beneficial influence on climate and the protection they exert against erosion, flood disasters and the man-made desert has come to the fore of recent years as one of the serious questions of present-day administration and civilization. It has been recognized that in both the Old and the New Worlds the results of the ignorant interference with the world's formerly existing and widespread forests and the failure to understand Nature's laws and the equilibrium she maintains when left alone has resulted in the past, and is resulting at the present day, in disasters of unforeseen magnitude. In a study of the past, India can show many instances of the results of interference with Nature's delicate balance between the forest, grassland and water supplies, and in that country, as a result of seventy years of forest conservancy, the lesson of the importance of the forests to the country has been grasped to some extent by her administrators. Even the people in some localities have become aware of the value of their local forests. The wireless has now come to the assistance of the Forest Department in making this value, for varying reasons in varying localities differing in configuration, elevation, aspect and climate, generally known to the people chiefly concerned, and including the town-bred population. The *Indian Forester* (63, No. 8; 1937) reproduces a radio talk on forests and climate given by Sir Gerald Trevor, inspector-general of forests, from Delhi. Those with a knowledge of the Indian district and its methods of administration in the past will appreciate to the full the significance of the enormous stride from the past which such a method of forest propaganda foreshadows.

Forestry in Sweden

AN interesting historical study by Lars Tirén of forestry conditions in the Degerfors district of the province of Västerbotten has recently been published (*Rep. Swedish Inst. Exp. Forestry*, No. 30. Centraltryckeriet, Esselte A.-B., Stockholm). The foundation upon which the paper is based is drawn from the work of the Forestry Research Institute in the Kulbäcksliden research forest situated in the above-mentioned region in the north of Sweden at an altitude of 160–320 metres. The history of the forest area has been traced back to the coming of human beings into north Sweden in the form of a Nordic stone age people who immigrated soon after the inland ice had receded from Vasterbotten 8,000 years ago. This race had, as fishermen and hunters, already spread widely in the region by about 2,000 years B.C. The progress in development of the people is traced, and with this development the inevitable effect on the forests of the region. The influence on the forest of fires, especially the great fire of 1694, is traced, and the contrast made between the area affected by this great fire and the forest which escaped. Not the least informative parts of the paper are those dealing with tar production and potash manufacture. The production of tar in Sweden goes back to very olden times. It was known in Viking days, and tar was exported in the thirteenth century. In the seventeenth century for long periods the export amounted to 70,000–80,000 barrels annually. In the region here specially dealt with, tar production was an important article of export. Hardwoods are used in potash manufacture, and here again the industry is a very old Swedish one in which the peasantry take a prominent part.

The Fairbridge Farm Schools

The story of Kingsley Fairbridge's life-work was told at a meeting of the Royal Society of Arts on February 1 by the Hon. Sir Hal Colebatch, Agent-General for Western Australia, who, as a member of the Western Australian Government, saved the original Fairbridge Farm School from collapse during the Great War by arranging for a State subsidy for it. It had at first been financed wholly from private subscriptions raised by the Child Emigration Society which Fairbridge formed in 1909 while an Oxford Rhodes scholar. The purpose of the scheme was, and is, to take from unpromising if not hopeless surroundings children of 7–12 years of age and give them a good general education with special training in all phases of farm and domestic activity, up to the age of sixteen years. Their subsequent careers are self-chosen. Many do not choose farm work, but their farm training is none the less valuable to them. The Farm School method involves: residence in a cottage home restricted to fourteen inmates (boys or girls) controlled by a carefully selected house-mother, training combined with teaching, provision for leisure time occupations, an elaborate 'after-care' system, including the banking of half of all earnings up to the age of twenty-one years. Judged by results, as represented by some 700 ex-pupils, all self-respecting self-supporting citizens, pulling their full weight in the community, the scheme has been an outstanding success. Similar schools have now been founded in Canada, Victoria and New South Wales. By the end of next year, the four schools should be in full operation with an aggregate enrolment of nearly 1,200 and an annual intake and outflow of 250, the total cost per head being about £50 a year.

Accessions to the British Museum (Bloomsbury)

AMONG accessions to the British Museum (Bloomsbury) reported at the April meeting of the Trustees are two which are of outstanding interest on the history of cultural development in Great Britain. Of these the earliest and from its unique character the more arresting comes from a bronze age burial on the north Yorkshire moors. In Loose Howe, a barrow overlooking Rosedale, excavated by Dr. and Mrs. Frank Elgee, was found a coffin consisting of two canoes, with a third canoe beside it. A bronze dagger associated with this burial afforded evidence of date; but the barrow also contained secondary burials, with one of which was a polished stone axe-hammer of Danish type. Canoe-burial is a new feature in archæology. The canoes had fresh bark on them and evidently had been made expressly for the burial, pointing to a hitherto unknown ritual of canoe-burial. It has been suggested that such canoe-burials may have given rise to the custom of coffin burial, typical in northern England and Denmark. In view of the conservatism characteristic of later maritime forms and custom in Scandinavia, the comparison with the ship-burials of a much later period inevitably is also suggested. These antiquities are on loan to the Museum by Captain A. W. Milburn. The second object of special interest is a stud ornamented with *millefiori* enamel, found at Chesterholme (Vindolanda) in Northumberland in an early fourth century deposit. It has been given by Mr. Eric Birley. It is the only example of *millefiori* of a late Roman date as yet found in Britain. It is thought that it may, on further study, provide a link with post-Roman Celtic enamels. Bronze objects belonging to the first Babylonian dynasty, *circa* 2000 B.C., are additions to examples of the art of a period at present poorly represented in the Museum. They are a bronze bar decorated with a ram's head, and three small figures of women. It is probable that they come from sites near the Diyalah River in Iraq.

Meteorological Observation in Certain British Colonies

It may be within the recollection of many readers of Nature that the period August 1, 1932–August 31, 1933, was chosen as the Second International Polar Year, during which meteorological observations were to be made at as many places as possible in both arctic and antarctic regions in furtherance of the study of world meteorology. Since the First International Polar Year, fifty years earlier, attention had become directed more to the problem of the exchange of air between equatorial and polar regions, and for that reason corresponding observations were required from middle and lower latitudes. The Governments of several British Colonies have published the special observations made within their areas, and the Meteorological Office, Air Ministry, is supplementing these with the publication of the observations made at a number of places not included in the above-mentioned Colonies, namely, Ascension Island, St. Helena, South Georgia, Falkland Islands, Ocean Island and British Somaliland. These summaries constitute Geophysical Memoir No. 73 of the Meteorological Office (H.M. Stationery Office. 4*s*. 6*d*. net). Monthly summaries of daily observations of the meteorological quantities most commonly observed are given in tabular form. These are supplemented by hourly readings in a few instances and by records of autographic instruments. The memoir contains no indication of the results of the undertaking as a whole, being only part of the observational material that is becoming available for students of the atmospheric circulation of the globe.

Telephone Circuit Noise Meters

Mr. H. R. Harbottle of the Post Office Research Station read a paper on February 4 to the Institution of Electrical Engineers describing an instrument for measuring the disturbing effect of induction from power lines on telephones. During a meeting of the Commission Mixte Internationale held at Dollis Hill, the delegates made comparative measurements of four different types of disturbances by the American, German and valve voltmeter methods. It was agreed that the last-mentioned should be developed and that the precise specification for the actual instrument should be determined by the Comité Consultatif Internationale (the C.C.I. for telephonic communications at great distances). It has been agreed internationally to call an instrument of this type a psophometer. The latest proposals are explained by the author. He states that from comparative measurements of the induction from the Midi Railway, which is supplied with power through mercury arc rectifiers, to the overhead communication lines of the French administration, the results obtained by using the psophometer fully justify this method of making noise measurements. The British Electrical and Allied Industries Research Association has published a pamphlet *M*/*T* 38 describing the method of constructing a psophometer. About a year ago, a commercial model on similar lines was constructed by the General Electric Co. at Coventry. Others have been made by Siemens and Halske in Germany, by the Administration and Ericssons in Sweden, by Standard Telephones and Cables in England and by the American Telephone and Telegraph Co. At the same meeting, a paper by Dr. A. H. Davis entitled "An Objective Noise Meter for the Measurement of Moderate and Loud, Steady and Impulsive Noises" was also read. The difficulties experienced were surmounted by adopting a technique in which the noise and the reference note are listened to alternately.

Carnegie Trust for the Universities of Scotland

The circumstances of the origin of the Trust are recalled in its recently published report for the year 1936–37. Referring to the passing of Lord Craigmyle, formerly one of the trustees, the report quotes a passage from Mr. Carnegie's autobiography which shows that it was an article contributed by the former to the *Nineteenth Century* magazine in 1897 that led to the idea of a gift of ten million dollars—"half of the yearly revenue from it to be used to pay the fees of deserving poor students and the other half to improve the universities". Last year the Trust devoted nearly £52,000 to the payment of fees of deserving poor students—2,637 men and 897 women. Voluntary refunds of fees advanced by the Trust in previous years, that is, since 1901, amount to nearly £40,000, namely, £25,000 by 569 men and £14,500 by 454 women. Women beneficiaries would seem to be more given to expressing their gratitude in this way than men. Expenditure on post-graduation fellowships, scholarships and grants for research amounted to £17,500. Resignations of fellows and scholars for the purpose of entering upon professional careers were numerous—a sign, perhaps, of reviving prosperity. This was specially noticeable in the field of chemical research. Of thirty-four fellows and scholars in this field, thirteen were absorbed into industry before the termination of their grants.

Mauritius Plants

THE flora of Mauritius is of great interest on account of the geographical position of the Mascarenes, their relation to the great land masses of the Old World and the high endemism of the species. Unfortunately, the remnants of the original vegetation are fast disappearing. It is therefore very necessary to obtain adequate and critical herbarium material upon which must depend the advancement of knowledge of the flora. A complete list of the flowering plants in the herbarium of the Mauritius Institute, compiled by R. E. Vaughan, forms the subject of the first part of a new publication (*Mauritius Institute Bulletin*) dealing with the taxonomy and ecology of the flora and fauna of the Mascarenes. About eight hundred species are listed, many of which are introduced weeds. Attention is directed to the urgency of acquiring additional material in many of the more interesting genera such as *Eugenia*, *Diospyros* (ebony) and *Tambourissa*, at present inadequately represented in the collection. Further material is also required of the native orchids, of which there were probably more than eighty species in the island, though many have already become extinct owing to the destruction of the large trees on which they were epiphytic.

Fusible Metals

IN No. 5, Series B, of the Technical Publications of the International Tin Research and Development Council, E. J. Daniels summarizes existing knowledge of the fusible metals containing tin. The mechanical and creep properties of these materials are dealt with, together with their 'castability', corrosion and applications. Among the latter are mentioned their uses in automatic safety devices for fire alarms, etc. as solders and seals, for making foundry patterns and for the production of hollow bodies by electrodeposition, as fillings for thin-walled tubes to prevent buckling during bending, as tempering baths for steel tools, as matrix alloys for mounting dies and punches, for the metallization of wood and for a number of research purposes.

Special Libraries and Information Bureaux

THE report of the proceedings at the fourteenth Annual Conference of the Association of Special Libraries and Information Bureaux at Cambridge last September has now appeared. It contains full reports of the discussions on technical translating, and the uses of micro-photographic processes in documentation, as well as the other papers given at the Conference, including one by Mr. B. M. Headicar containing a number of practical notes on the storage of pamphlets and the preservation and restoration of books and documents. In addition to its value as a permanent record of the proceedings at the Conference, the report indicates the wide range of interests of A.S.L.I.B.

Science Abstracts

THE volume for 1937 devoted to physics has 1,504 pages, covering 5,494 abstracts, a subject index of 215 pages, an apparatus and instrument index of 24 pages and an author index of 78 pages. The volume for electrical engineering has 934 pages, 3,252 abstracts, a subject index of 121 pages and an author index of 48 pages. In pages and abstracts each volume is about 7 per cent less than that for 1936, but continues to be indispensable to research workers and all who wish to keep up to date in the subject with which it deals. The system of indexing in the physics volume greatly facilitates quick and easy reference.

Rabbit Control in Australia

ON Wardang Island, which lies to the west of Yorke Peninsula in South Australia, a field test is now in progress of the virus of myxomatosis, as an agent in reducing rabbit population. The marked specificity of the disease to the European wild rabbit (*Oryctolagus*) and its retention of virulence after passage through many hosts make it well worth trial in a country where rabbits constitute a pest ever-present, though varying in intensity. The test is on a small infested area of some ninety acres under strictly controlled conditions.

Grocers' Company Scholarship

THE Grocers' Company is offering a scholarship for the encouragement of original medical research into the causation of prevalent diseases or as to means of preventing premature death. The award, which is tenable for two years from September 1, is £300 for the first year and £450 for the second year, in addition to which the Council will grant up to £150 a year towards the cost of special apparatus required by the scholar. Candidates should not be more than thirty-five years of age and should send their applications to the Clerk, Grocers' Company Hall, London, E.C.2, before May 1.

Two Astronomical Handbooks for 1938

FLAMMARION'S "Annuaire Astronomique" is a remarkable little handbook, and those responsible for it evidently take great pains that it shall include the latest information on astronomical data. For example, the list of double star orbits contains the latest ones published. A note is given by Lyot on the transit of Mercury, on June 24, 1937, across the sun's corona; the list contributed by Störmer of auroras seen from Norway is continued as far as October 1, 1937, and there are some new geophysical data comprising sudden radio fadings observed from November 26, 1936, to July 1, 1937. The utility of this handbook to the novice is illustrated by the three maps showing the star field of the variable star, o (Mira) Ceti, as seen respectively with the naked eye, a pair of binoculars, and a moderate-sized telescope. The "Anuario" of the Astronomical Observatory of Madrid contains information that is chiefly of use to those living in Spain or in adjacent latitudes. There are, however, other astronomical tables and explanations (in Spanish) of general interest. A short description is appended of graphical solutions of spherical triangles used in problems of positional astronomy.

A Large Sunspot Group

On April 8, a pair of large sunspots, with smaller attendant spots, came into view around the sun's north-east limb. The group crossed the sun's central meridian on April 14·1 U.T. and will reach the western limb on April 20. The latitude of the group is 27° north, and its area on April 8 was 1,500 millionths of the sun's visible hemisphere. Sunspots of this size are found to show, statistically, a marked association with the occurrence of terrestrial magnetic storms, the storm commencing on the average about one day after the time of central meridian passage of the associated sunspot.

Announcements

The Kelvin Medal Award Committee announces that the Kelvin Medal for 1938 has been awarded to Sir Joseph J. Thomson, and that the presentation will be made by Lord Rayleigh in the Great Hall of the Institution of Civil Engineers, on Tuesday, May 3, at 5 p.m.

Dr. W. T. Calman, formerly keeper of zoology in the British Museum (Natural History), has been elected an honorary member of the Société Zoologique de France.

The following have been elected associates of the Royal Astronomical Society: M. L. d'Azambuja, Meudon Observatory, France; Prof. A. O. Leuschner, director of the Students' Observatory, Berkeley, California, and professor of astronomy in the University of California; Prof. Knut Lundmark, director of the Lund Observatory and professor of astronomy in the University of Lund.

M. Robert Courrier has been nominated professor of experimental morphology and endocrinology at the Collège de France.

Lieut.-Colonel J. H. M. Greenly has been appointed president of the Institute of Fuel in succession to Sir Philip Dawson, as from October 13 next. Colonel Greenly, who has been a vice-president of the Institute for the past few years, is the chairman of Messrs. Babcock and Wilcox, Ltd.; he is also a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, and chairman of the British Non-Ferrous Metals Research Association.

The following appointments and promotions have recently been made in the Colonial Service: K. M. Francis, European assistant, East African Meteorological Service, East Africa; J. P. Henderson, European assistant, East African Meteorological Service, East Africa; R. G. Ffoulkes-Jones, second assistant petroleum technologist, Trinidad; R. R. Waterer (assistant conservator of forests), conservator of forests, Cyprus; W. E. Bassett (assistant agricultural officer, Agricultural Department, Dominica), curator, Agricultural Department, Montserrat, Leeward Islands; C. J. M. Krige (senior agricultural assistant), agricultural officer, Tanganyika.

The annual Conference of the Institute of Public Cleansing will be held in Glasgow on June 13–17.

The eighth International Congress for Logopædics and Phoniatrics will be held at Salzburg on July 28–30. Further information can be obtained from the president, Ferstelgasse 6, Wien ix.

The eighth Netherlands Indies Congress of Natural Science will be held at Soerabaja on July 20–23 and will consist of sections devoted to mathematics, natural history, physics, medicine, biology, chemistry, veterinary science, geology and geography. Further information can be obtained from the general secretary, Dr. H. W. Lubberhuizen, Embong Kemiri 4, Soerabaja.

The seventh International Congress of Entomology will be held in Berlin on August 13–20, and will consist of a general section and a special section, the latter comprising a subsection of medical and veterinary entomology. The president will be Prof. E. Martini of Hamburg. Further information can be obtained from the general secretary, Dr. Hering, Zoologisches Museum, Invalidenstrasse 43, Berlin, N.4.

A health congress of the Royal Sanitary Institute will be held at Portsmouth on July 11–18 under the presidency of Lord Bessborough. Sections will be allotted to preventive medicine, architecture, town planning and engineering, maternity and child welfare and school hygiene, veterinary hygiene, national health insurance, hygiene of food, and tropical hygiene. Conferences of local authorities, medical officers of health, engineers, surveyors, sanitary inspectors and health visitors will also take place during the Congress. Further information can be obtained from the Secretary of the Institute, 90 Buckingham Palace Road, S.W.1.

We have received a copy of the complete, official list of the British papers which are being prepared for presentation at the sectional meeting of the World Power Conference to be held in Vienna on August 25–September 2. Copies of the technical programme may be obtained now, and copies of the general programme, time-table and membership application form will be obtainable in due course, from the British National Committee, World Power Conference, 36 Kingsway, London, W.C.2.

Erratum. In the article "Scientific Work of the Drifting North Polar Station" published in Nature of April 9, pp. 629–632, it should have been stated that the distances quoted in English units were in nautical miles. On p. 629, col. 2, line 4, the distance covered by the drift was 1,134 nautical miles (2089 km.); line 11, the average drift of the floe was 9·1 km. (4·9 nautical miles) a day; line 15, the daily drift was sometimes 23 nautical miles (42 km.) a day.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

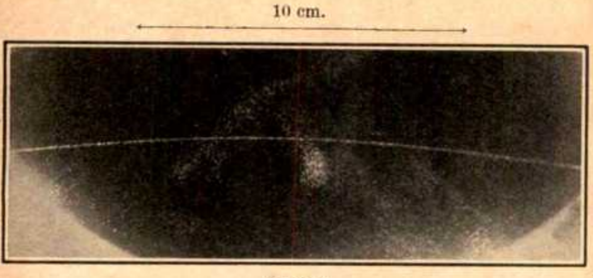
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 692.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Heavy Electrons in Cosmic Rays

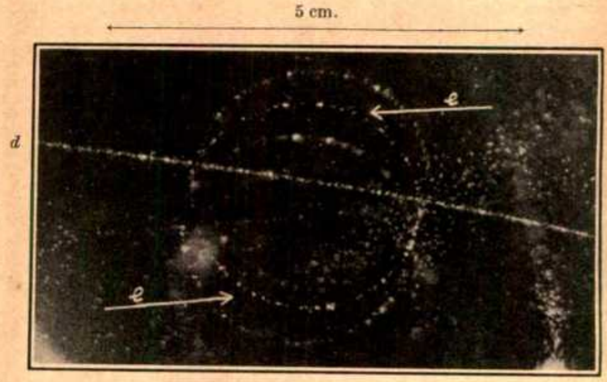
Neddermeyer and Anderson[1], on the basis of their experiments on the loss of energy by cosmic ray particles, have suggested that there are present in cosmic rays 'new' particles of mass greater than that of an electron and less than that of a proton. In this note we give additional evidence for such a particle (some of which has previously been reported by one of us at the Conferences on Physics in Copenhagen and Moscow in September 1937, the report at the latter being published), of a type which has also been put forward by other workers since the appearance of Neddermeyer and Anderson's paper.

The object of the present experiments was to investigate the nature of cosmic ray particles by measuring the primary ionization per centimetre along their tracks using the Wilson cloud chamber method, with a magnetic field to determine the momentum of the particles. The results of the early observations of Kunze[2] on this effect had led one of us to suggest that cosmic ray particles of high energy are predominantly protons, those of low-energy electrons[3]. It was expected that further observations in the region of 10^8 'volts' would throw some light on the situation. In our experiments the method of random expansions is used as it is desirable to have sharp tracks for the purpose of counting the primary ions, the tracks in a counter-controlled chamber being of necessity somewhat diffused. With a large chamber (30 cm. diameter, 30 cm. deep) about 10 cm. of sharp cosmic ray track was recorded on every photograph.



Track *d*.

In the first two hundred photographs, taken with a field of 1,000 gauss in the chamber, three tracks were observed (we shall refer to them as *a*, *b*, and *c*) the specific ionization of which was considerably greater than that of an electron track of the same curvature (that is, momentum), while a proton track with the same ionization would have a much smaller curvature and would in fact be nearly straight. It was concluded that if the curvature was due to the magnetic field, and not spurious, the tracks could only have been produced by a new particle of mass between that of an electron and a proton. A spurious curvature can be due to optical defects or to distortion of the track by motion of the gas in the chamber. The optical distortion was negligible. As regards the effect of air motion, tracks *a* and *b* passed through after the expansion and their curvature could scarcely have been spurious, judging from the straightness of sharp electron tracks appearing in the same series of photographs. At this stage of our work the paper by Neddermeyer and Anderson appeared which proposed on different grounds the type of particle which these tracks had suggested to us.



Tracks *e*, with *d* (across centre of photograph) superimposed.

To reduce the doubt regarding the curvature we increased the magnetic field from 1,000 to 2,200 gauss, but in the following four hundred photographs no heavy tracks of appreciable length appeared. The work was recently resumed using a mixture of 50 per cent hydrogen and 50 per cent air in the chamber. The greater separation of the ions occasioned by the hydrogen enables a more accurate count of their number to be made, so that smaller departures of the specific ionization from the normal could be detected. In one of the photographs taken in this series there appeared the track which is here reproduced (track *d*). The number of primary ions per centimetre along this track is about three times greater than that along an electron track of the same curvature, while a proton with this ionization would have a curvature about ten times less. In this case we are convinced that the curvature cannot have been produced by air motion. Photographs taken in the same 'run' happened to have tracks of fast particles in the same part of the chamber and these showed that spurious curvature was not more than about one twentieth of the curvature of the track *d* (the radius of curvature of which is about 55 cm.). Moreover, the spurious curvature was in the opposite direction to that of the latter. Old tracks passing through before the expansion showed obvious distortion, but even for these the extent of the corresponding spurious curvature was small and again in the opposite direction to that of the heavy track. As regards the specific ionization, we reproduce here the track of a $0{\cdot}5 \times 10^6$ volt electron (track *e*) taken under the same conditions as *d*, a part of which is superimposed on the same photograph for purposes of comparison. If *d* was the track of an electron it should have about the same number of ions per centimetre as *e*, while actually it is seen to have many more.

In the accompanying table, we give the details of each of the four tracks referred to, together with the estimated mass. The momentum in column (4) is given in terms of *mc*, where *m* is electron mass, and the ionization in column (3) is expressed in terms of the observed ionization for million-volt electrons. The sign of the charge of the particle, assuming downward motion, is given in the last column. Apart from track *b*, the tracks indicate a consistent mass of nearly 200 times electronic mass.

Track	$H\rho$ $\times 10^{-5}$	Ionization	Momentum (unit, *mc*)	Velocity (unit, *c*)	Mass (unit, *m*)	Sign of Charge
a	1·10	5	65	0·30	220 ± 50	−
b	1·83	>7	107	< 0·25	>430 (<800*)	+
c	1·47	3·0	86	0·45	190 ± 60	+
d	1·15	3·3	67	0·41	160 ± 30	+

* This limit is set by a minimum range equal to the observed length of track in the chamber.

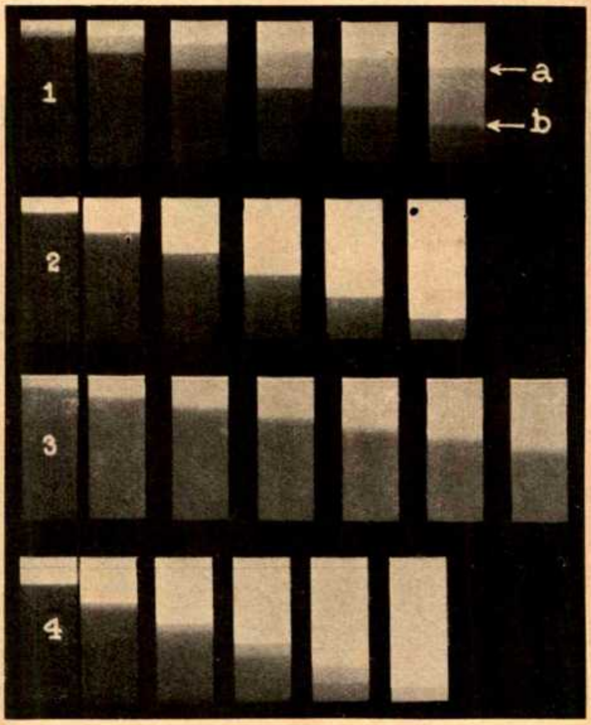
As we have already stated, evidence of the type presented here has also been found by other workers. The results obtained by Street and Stevenson[4], and by Ruhlig and Crane[5] require a particle with a mass in satisfactory agreement with that required by the tracks *a*, *c* and *d* above. However, those of Nishina, Takeuchi and Ichimiya[6], and of Corson and Brode[7], require an appreciably bigger mass which is comparable with the mass indicated by the track *b*. It is, however, possible that the track *b* in our experiments was produced by a proton, the observed curvature being partly spurious. It might also be mentioned that in our experiments, in addition to the tracks referred to above, three or four heavily ionizing tracks were observed which were obviously due to protons.

E. J. Williams.
E. Pickup.
George Holt Physics Laboratory,
University of Liverpool.
March 28.

[1] Neddermeyer and Anderson, *Phys. Rev.*, **51**, 884 (1937).
[2] Kunze, *Z. Phys.*, **83**, 1 (1933).
[3] Williams, *Phys. Rev.*, **45**, 729 (1934).
[4] Street and Stevenson, *Phys. Rev.*, **52**, 1003 (1937).
[5] Ruhlig and Crane, *Phys. Rev.*, **53**, 266 (1938).
[6] Nishina, Takeuchi and Ichimiya, *Phys. Rev.*, **52**, 1198 (1937).
[7] Corson and Brode, Abstract, Stanford Meeting, Dec. 18, 1937.

The Ultracentrifugation of the Proteins of Cucumber Viruses 3 and 4

Cucumber mosaic viruses 3 and 4 of Ainsworth[1] have many properties in common with tobacco mosaic virus, in spite of the fact that they do not cause disease when inoculated to tobacco plants. They are sufficiently stable so that their virus proteins have been isolated chemically[2]; these proteins resemble the tobacco mosaic virus protein in optical characteristics when in solution, in high inactivation temperatures, in the X-ray diffraction patterns[3] they produce, and in serological reactions. We have carried through ultracentrifugal isolations of the cucumber virus proteins and have found that they are also like tobacco mosaic virus protein in sedimentation rates.



SEDIMENTATION ABSORPTION PHOTOGRAPHS. EXPOSURE, 1·5 SEC. MADE EXACTLY 5 MIN. APART, USING ULTRA-VIOLET LIGHT OF WAVE-LENGTHS BETWEEN 2700 A. AND 2300 A.

1. AQUEOUS SOLUTION OF PELLET OBTAINED BY ONE PROLONGED ULTRACENTRIFUGATION OF THE JUICE OF CUCUMBER PLANTS DISEASED WITH CUCUMBER 4 VIRUS. The molecular component producing boundary (*a*) is present in both healthy and diseased plant juice, that responsible for (*b*) is found only in the juice of virus-diseased plants. Centrifugal field at the mid-point of the analytical cell, 23,780 times gravity.

2. SALINE SOLUTION OF CUCUMBER 4 VIRUS PROTEIN PURIFIED FROM THE LIGHTER MACROMOLECULES BY FRACTIONAL ULTRACENTRIFUGATION. The sedimenting boundary corresponding to (*b*) of 1 is single and sharp. Mean centrifugal field, 30,690 times gravity. A photograph of the purified cucumber 3 protein is indistinguishable from this one.

3. SOLUTION OF THE MACROMOLECULES PRESENT IN THE JUICE OF HEALTHY CUCUMBER PLANTS. This boundary moves at the same rate as (*a*) of 1. Mean centrifugal field, 31,290 times gravity.

4. SALINE SOLUTION OF THE CUCUMBER 3 VIRUS PROTEIN AFTER SEVERAL ULTRACENTRIFUGAL PRECIPITATIONS. The upper boundary corresponds to (*b*) of 1, the lower has a constant of about 200×10^{-13} cm. sec.$^{-1}$ dynes^{-1}. Mean centrifugal field, 31,660 times gravity.

The method used in this isolation was essentially the same as that developed for the ultracentrifugal crystallization of the tobacco mosaic virus protein[4] and for the purification of several other less stable plant[5] and animal[6] virus proteins. Juices of plants infected with either of these viruses were found to contain two macromolecular substances giving sharp boundaries with the analytical ultracentrifuge. The more rapidly sedimenting boundary (*b* of photo.) is due to virus protein; the lighter component (*a*) is present in the juice of healthy as well as diseased plants. Purified solutions of the virus proteins have been obtained after two quantity ultracentrifugations[7], using saline for re-solution of precipitated protein and a time of centrifugation that would sediment only a negligible amount of the lighter component. Under the conditions of our experiments, the two heavy components were almost completely separated by applying a centrifugal field of 40,000 times gravity for not more than half an hour. The proteins of cucumber viruses 3 and 4 differ from unaltered tobacco mosaic virus protein in being practically insoluble in pure water. Saline dissolves them and facilitates the breakdown of traces of the smaller high molecular weight substances (corresponding to (*a*)).

Cucumber mosaic viruses 3 and 4 do not lend themselves so well to quantitative work as viruses giving necrotic local lesions. Nevertheless, Bawden and Pirie[2] have demonstrated that infectivity was concentrated in their chemically isolated virus protein preparations. Our heavier components are highly infectious and without doubt they are essentially the same as Bawden and Pirie's proteins. Fresh preparations of the proteins of cucumber viruses 3 and 4 give single sharp boundaries in the analytical ultracentrifuge (Photo. 2); their sedimentation diagrams are indistinguishable from each other and from that of unaltered tobacco mosaic virus protein[8]. As nearly as can be determined, these three proteins sediment at the same rate and thus probably have substantially the same molecular weights; sedimentation constants averaged from several closely agreeing photographs are $s_{20} = 173 \times 10^{-13}$ cm. sec.$^{-1}$ dynes^{-1} for the cucumber virus 3 protein, and $s_{20} = 175 \times 10^{-13}$ for the cucumber virus 4 protein. A recent determination[8] for the tobacco mosaic virus protein gave $s_{20} = 174 \times 10^{-13}$. Tobacco mosaic virus protein derived from plants infected for more than four weeks and purified by quantity ultracentrifugation with phosphate buffer as solvent shows[8] a second more rapidly sedimenting component with $s_{20} = 200 \times 10^{-13}$. Similar components (Photo. 4) were found in purified preparations of cucumber viruses 3 and 4 that were subjected to repeated ultracentrifugations.

Special interest is attached to the presence in cucumber plants of a homogeneous high molecular weight substance other than the virus protein. Purified solutions from either healthy or diseased plants sediment with a single fairly sharp boundary corresponding to $s_{20} = 77 \times 10^{-13}$ (Photo. 3). They have given the usual qualitative tests for proteins and have always had a clear chlorophyll-green colour. Water solutions can be kept in the icebox for several days; in saline, decomposition is more rapid. Considerable molecular damage follows repeated sedimentations in the quantity ultracentrifuge, but in this respect this macromolecular substance is not unique. When repeated ultracentrifugations were made of saline solutions of purified cucumber mosaic and tobacco mosaic virus proteins, the proteins were denatured and rendered insoluble.

As milder methods of extraction and purification have been introduced, there have been found an increasing number of apparently non-infectious heavy substances[9]. They are comparable with virus proteins in homogeneity and rate of sedimentation, in stability, and in concentration in tissues. It is reasonable to expect that their further study may throw light on the nature and the origin of the virus proteins.

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Feb. 15.

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[1] Ainsworth, G. C., *Ann. Appl. Biol.*, **22**, 55 (1935).

[2] Bawden, F. C., and Pirie, N. W., *Brit. J. Exp. Path.*, **18**, 275 (1937); Nature, **139**, 546 (1937).

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[4] Wyckoff, R. W. G., and Corey, R. B., *Science*, **84**, 513 (1936).

[5] Stanley, W. M., and Wyckoff, R. W. G., *Science*, **85**, 181 (1937); Loring, H. S., and Wyckoff, R. W. G., *J. Biol. Chem.*, **121**, 225 (1937).

[6] Beard, J. W., and Wyckoff, R. W. G., *Science*, **85**, 201 (1937); Wyckoff, R. W. G., *Proc. Soc. Exp. Biol. and Med.*, **36** 771 (1937).

[7] Wyckoff, R. W. G., and Lagsdin, J. B., *Rev. Sci. Instr.*, **8**, 74, 427 (1937).

[8] Wyckoff, R. W. G., *J. Biol. Chem.*, **121**, 219 (1937).

[9] Glaser, R. W., and Wyckoff, R. W. G., *Proc. Soc. Exp. Biol. and Med.*, **37**, 503 (1937); Loring, H. S., and Wyckoff, R. W. G., *Proc. Soc. Exp. Biol. and Med.* (In the press).

Cosmic Rays and the Aurora of January 25-26

Between January 16 and 26, there occurred three violent magnetic storms; the storm of January 25 was accompanied by a magnificent aurora borealis which was visible nearly in all parts of Europe (see Nature, Jan. 29 and Feb. 5).

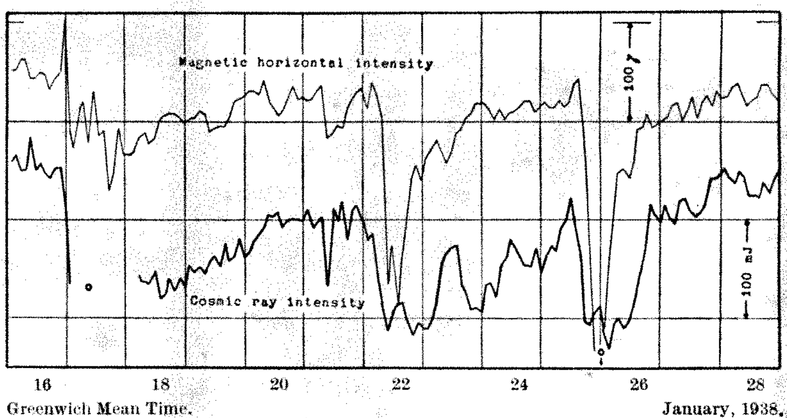

Fig. 1.

Two-hour mean values of the magnetic horizontal intensity and of the cosmic ray ionization during the magnetic and auroral disturbances of January 16–28, 1938. Average cosmic ray intensity, 2356 mJ. Average horizontal intensity 20,432 γ.

In 1937, during the severe disturbances from April 25 until April 30, S. E. Forbush[1] and two of the present writers[2] found from simultaneous registrations in North America, Peru and Central Europe, that cosmic ray ionization was influenced all over the earth by the magnetic storm, and that a sharp decrease of cosmic ray ionization followed a decrease of the magnetic horizontal force. A similar effect was also noticed by J. Clay[3] in Amsterdam.

This parallelism between the variations of the horizontal magnetic intensity and the cosmic ray ionization was observed once more and even more strikingly during the recent aurora and the two preceding magnetic storms mentioned above.

In the accompanying graph, the two-hour means of the magnetic horizontal intensity (as observed at the magnetic observatory, Vienna-Auhof, for which we are indebted to Prof. von Ficker) and the corresponding values of the cosmic ray intensity (from the registrations of the Hafelekar Observatory near Innsbruck, Austria, 2,300 metres above sea-level) are plotted together. The cosmic ray ionization was registered by means of a Steinke standard apparatus, completely screened from local radiations on all sides by iron (7 cm. thick) and lead screens (10 cm. thick). All observations are reduced to the same barometric pressure.

From inspection of the curves, it can be said that there is a very close parallelism between the variations of *H* (magnetic horizontal force) and *J* (cosmic ray ionization). The correlation coefficient as calculated from the curves is + 0·72.

On the day of the aurora (January 25) the ionization decreased from noon to 4 h. a.m. of the following day by 170 m*J* (= 0·170 *J*), that is, by about 7 per cent. Then an increase of the same amount followed, and on the evening of January 26 both *J* and *H* were quite normal. The recovery of *J* occurred some hours later than that of *H*, and this was also noticed after the disturbance of January 22.

During the magnetic storm in the night of January 16–17, the decrease of the cosmic ray ionization amounted to 5·7 per cent within the first five hours; the further decrease could not be measured since the image of the electrometer fibre disappeared from the field of view. For the sake of comparison, it may be said that on magnetically undisturbed days the average deviation of the hourly values of *J* amounts to not more than ± 0·62 per cent.

From our observations shown in the diagram, it was calculated by Charlier's method that on the average the variation of the ionization was 0·82 m*J* for a change in the magnetic horizontal intensity of 1γ (1γ = 0·00001 gauss). This magnetic effect corresponds to 0·3 per mille per γ. During the magnetic storm in April 1937, Hess and Demmelmair[2] found an effect of the same order of magnitude (1·4 m*J* per γ) and from the correlation of daily mean values in periods when the correlation is positive a similar effect was calculated by us in our last publication[4].

The effect of the variation of *H* during magnetic and auroral disturbances on the cosmic ray ionization can be explained by the assumption of corpuscular ring currents encircling the earth at distances of a few earth radii and supplied by solar eruptions (S. Chapman[5]). If during a solar outburst these ring currents are increased, the magnetic dipole moment of the earth is strengthened for regions outside these rings or shells, while inside, near the surface of the earth, the magnetic field is reduced. The increase of the magnetic field in outer space causes a considerable deflection of the normal paths of the cosmic ray particles, thus reducing the observed cosmic ray intensity on the earth.

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[1] Forbush, S. E., *Phys. Rev.*, **51**, 1108 (1937).

[2] Hess, V. F., and Demmelmair, A., NATURE, **140**, 316 (1937).

[3] Clay, J., *Physica*, **5**, 111 (1938).

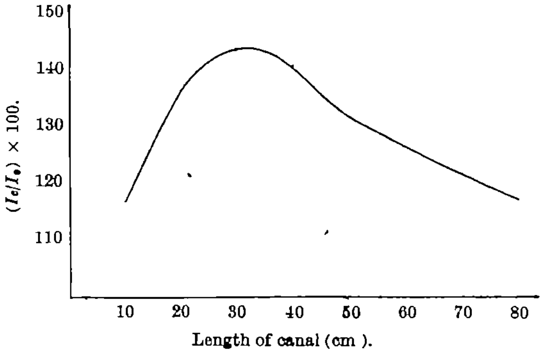
[4] Hess, V. F., Demmelmair, A., and Steinmaurer, R., *Wien. Sitz. Ber.*, IIa, **147** (Feb 1938); *Terr. Mag.* (March 1938).

[5] Chapman, S., NATURE, **140**, 423 (1937).

Canalization of Gamma Rays

IN an earlier communication from this laboratory[1] a method of canalizing neutrons was described which made it possible to investigate the action of these particles at distances of a metre and upwards from weak sources. In the interval, apparatus capable of producing powerful beams of neutrons and penetrating X- or gamma rays has been developed in many laboratories.

This has made it desirable to investigate the possibility of canalizing electromagnetic radiations, and we have carried out such an investigation for the gamma rays from radium (B + C). For these measurements we have used the radiations from one, to ten or more, milligrams of radium filtered by 0·5 mm. of platinum, and canalized them by tubes of wax, lead, zinc, iron, etc., having lengths from 10 cm. to 1 m. and of varying wall thickness.



The ratio of the intensity of the canalized beam (I_c) to that of the direct uncanalized beam (I_0), is shown in the accompanying figure for iron canals of various lengths; the ionization being measured by a thin-walled ionization chamber. The internal and external diameters of these tubes were 70 mm. and 78 mm. respectively. Fuller details of these experiments, including the effects of varying the wall thickness of the ionization chamber, will be published elsewhere.

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March 18.

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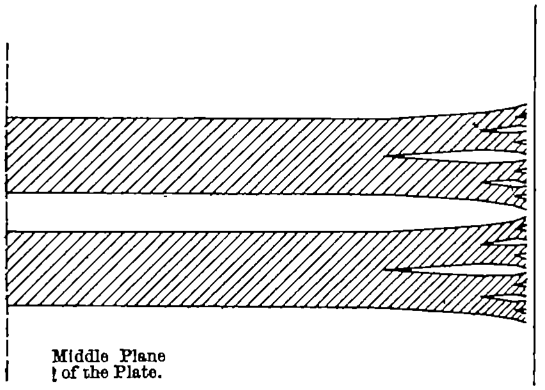
[1] Hopwood and Chalmers, NATURE, **135**, 341 (March 2, 1935). See also T. A. Chambers, *Brit. J. Radiol.*, 8, No. 87, p. 163 (March 1935).

The Intermediate State of Supraconductors

In a previous paper[1], I have shown that a body in the so-called 'intermediate' state consists of alternating layers of the supraconducting and normal phases. It can be shown, however, that the plane-parallel form of these layers discussed in this paper does not correspond to a minimum of the free energy*. A detailed investigation leads to the result that the thickness of the layers does not remain constant throughout the body, but is greatest in the inner part, and becomes very small near the surface of the body. The accompanying figure shows a section of a plate in a transverse magnetic field. The normal layers (shaded in the figure) branch in both directions towards the surface of the plate. A similar branching along the lines of force occurs in the intermediate state of a body of any other shape.



Calculation shows that the thickness of the layers in the middle of the body is of the order of magnitude $(l_0 l^2)^{1/3}$, l being the total length of the line of force inside the body and l_0 the depth of penetration of the magnetic field in a supraconductor (probably of the order 10^{-5} cm.).

The branching of the layers towards the surface continues until the thickness of the layers becomes of the order of magnitude of l_0, when it is no longer really possible to speak of the normal and supraconducting states as distinct phases. Hence, a region of the width l_0 near the surface of the body is not in the intermediate state, that is, does not consist of layers; but is in some different state which may be called the 'mixed' state.

The conception of the alternating layers leads to the conclusion that the intermediate state must be supraconducting in the direction of the magnetic field, but has resistance in perpendicular directions. It might seem that the body should be supraconducting also in the direction which is parallel to the layers but perpendicular to the direction of the field; however, it can easily be shown that, if the current is flowing in this direction, the layers turn so as to be perpendicular to the current.

For the resistance of the intermediate state perpendicular to the magnetic field, we should have $R = R_0 \dfrac{B}{H_c}$ (B, magnetic induction; H_c, critical field; R_0, resistance of the normal state). However, experiment shows[2] that the resistance of a wire in a transverse field tends to this value only if the current is comparatively large, the resistance for very small currents being much smaller. This indicates that an appreciable part of the current flows not in the middle of the wire through the intermediate state, but in the mixed state near the surface. More detailed experiments could in this way supply information about the properties of the mixed state, about which at present very little can be said theoretically.

The detailed calculations will appear elsewhere.

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Feb. 28.

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* I am indebted to Prof. R. Peierls for directing my attention to this point.

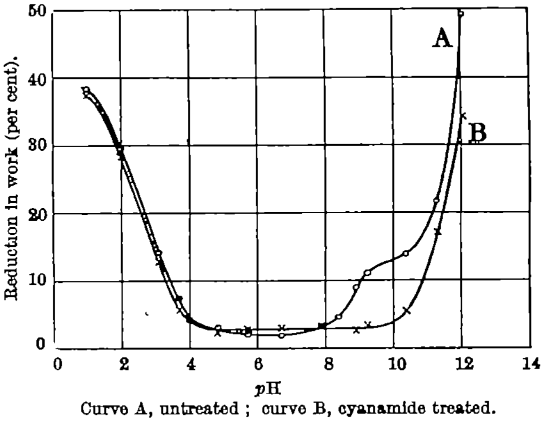
[1] Landau, L., *Sov. Phys.*, 11, 130 (1937).

[2] de Haas, Voogd, Jonker, *Physica*, 1, 281 (1934).

Action of Cyanamide on Wool

When wool fibres are exposed to the action of light and air, the cystine linkages undergo decomposition with loss of sulphur and development of sulphydryl and aldehyde groups. In consequence, the increased alkali-combining power of the exposed tips, as compared with the unexposed roots of wool staples above *p*H 8, has been referred to the presence of excess sulphydryl groups in exposed wool[1]. On treatment with cyanamide, however, sulphydryl compounds are converted into derivatives of isothiourea[2], and the *p*H-stability region of exposed wool, which normally ranges from *p*H 5 to 7 in buffer solutions, should be capable of extension to *p*H 10 by treating the wool with cyanamide, especially as the amino groups of lysine side-chains are simultaneously converted into more strongly basic guanido groups[3].

The truth of this deduction has been established by comparing the elastic properties of untreated and cyanamide-treated exposed wool in buffer solutions of varying *p*H. Fibres from the middle portion of a Cotswold wool staple were purified by successive extraction with alcohol, ether and distilled water, and a curve illustrating the reduction in their resistance to 30 per cent extension at 22·2° C. in buffer solutions of varying *p*H, as compared with water at *p*H 5·5, is given in the accompanying figure. The increased ease of extension between *p*H 8 and 10 is due to the fibre-swelling which follows combination of sulphydryl groups with alkali. When, however, the fibres had been treated with a 10 per cent cyanamide solution for 47 hours at 22·2° C., their resistance to extension was independent of *p*H between *p*H 5 and 10, as shown in the figure, owing to the conversion of cystein side-chains into corresponding isothiourea derivatives. The extent of the *p*H-stability region of cyanamide-treated wool, which has been confirmed by comparing the titration curves



Curve A, untreated; curve B, cyanamide treated.

of untreated and cyanamide-treated wools, lends further support to the salt-linkage hypothesis[4].

In conclusion, it should be noted that the enhanced reducing power of exposed wool is minimized by cyanamide treatment, and the industrial significance of this aspect of the cyanamide reaction has been investigated in conjunction with other workers and Imperial Chemical Industries (Dyestuffs Group), Ltd.[5].

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March 14.

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[1] McMahon and Speakman, *Trans. Faraday Soc.*, 33, 844 (1937).

[2] Arndt, *Ann.*, 384, 322 (1911).

[3] Cf. Sorensen, *Ber.*, 43, 643 (1910)

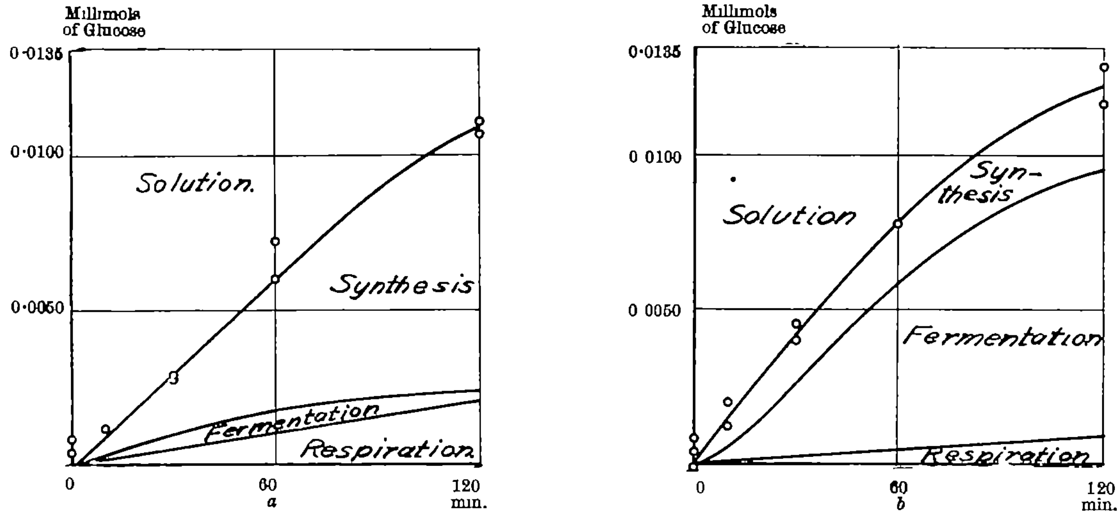
[4] Speakman and Hirst, *Trans. Faraday Soc*, 29, 148 (1933); Speakman and Stott, Nature, 141, 414 (1938)

[5] Race, E, Rowe, F. M, Speakman, J. B, and Vickerstaff, T, *J Soc. Dyers and Colourists* (in the press).

Action of Cystein on Respiration, Fermentation and Synthesis in Yeast Cells

Quastel and Wheatley[1] have demonstrated that cystein and glutathione promote the ærobic fermentation in baker's yeast. Cystein inhibits very strongly the respiration in this material. We have confirmed these results for a Swedish baker's yeast[2]. In our experiments, carried out generally at 30° and pH 5, the concentrations of glucose as well as those of cystein have been greatly varied. In higher concentrations of glucose alone (0·027–0·108 m.mol per 2·4 c.c. suspension containing 20 mgm. fresh yeast) the rate of ærobic fermentation is low at the beginning of the experiment but increases soon considerably. High concentrations of glucose give an effect similar to that following the addition of cystein to lower concentrations of glucose. In presence of cystein, however, the rapid ærobic fermentation starts immediately upon the addition of glucose. In the absence of cystein fermentation comes to an end, giving place to a slow respiration. The amount of carbon dioxide formed through ærobic fermentation is directly proportional to the concentration of glucose. The maximum rates of fermentation are directly proportional to log (glucose), range tested: 0·00455–0·108 m.mol per 2·4 c.c. suspension. During the period of rapid ærobic fermentation the added cystein is partly oxidized. The quotient total CO_2/O_2 decreases fairly rapidly during the period of ærobic fermentation. The mean of the total CO_2/O_2 values during the period of ærobic fermentation is directly proportional to log (cystein), or in other words, to the oxidation reduction potential of the cystein solution (cf. Dixon and Quastel[3]). The range tested was 0·0002–0·005 m.mol cystein per 2·4 c.c. suspension.

In medium and lower concentrations of glucose (0·0045–0·027 m.mol per 2·4 c.c. suspension) the respiration and the (slight) ærobic fermentation comes to an end when about 40–45 per cent of the added glucose has been broken down. Estimations by adding fresh yeast or by the orcin method[4] demonstrate that practically no glucose is left in the solution surrounding the yeast cells. As is well known[5], the yeast synthesizes glucose to higher carbohydrates. When cystein is present, all the added glucose is broken down. The higher carbohydrates are not formed or, possibly, they are not stable. All the glucose rapidly taken up by the cells is available for the breakdown processes. The graphs give representative experiments with and without cystein.



Consumption of glucose by baker's yeast through respiration, fermentation and synthesis of higher carbohydrates at 15° C. (*a*) Without cystein; (*b*) With 0·005 millimols of cystein added to 2·4 c.c. cell suspension of 20 mgm. yeast in a buffer, succinic acid and succinate, pH 5. Initial amount of glucose: 0·0135 m.mol.

The synthesis is considerably lower under anærobic than under ærobic conditions. The rate of respiration is, over a very wide range, independent of the concentration of glucose, but decreases very rapidly with increasing concentrations of cystein.

Baker's yeast which has been kept in a dried state exhibits qualities very similar to those described for fresh yeast treated with cystein. The respiration is comparatively low; the ærobic fermentation considerable. Further, the capacity for synthetic storage of glucose is impaired. This can be changed very considerably by aerating the yeast in the presence of glucose. Following the æration the respiration is increased, the ærobic fermentation strongly decreased and the capacity for synthesis restored.

The results reported may contribute to the discussions concerning the 'Pasteur reaction'. This reaction may be due to the mechanism causing storage of higher carbohydrates. The oxidation or reduction of certain systems decides whether synthesis or fermentative breakdown will occur in the cell. This interpretation combines in a somewhat modified form elements from the ideas presented by Meyerhof[6], Quastel, Wheatley[3] and Lipmann[7].

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Stockholms Hogskola,
Stockholm. March 2.

[1] *Biochem J.*, 26, 2169 (1932) This paper unfortunately was overlooked in our previous publication[2].

[2] *Die Naturwiss.*, 25, 540 (1937).

[3] *J. Chem. Soc.*, 123, 2943 (1923).

[4] Sorensen, M., and Haugaard, G., *Biochem. Z.*, 260, 287 (1933).

[5] Willstätter, H., and Rhodewald, M., *Hoppe Seylers Z.* 2, 247, 269 (1937).

[6] cf. Meyerhof, O , "Die chemischen Vorgange im Muskel" (Berlin, 1930).

[7] *Biochem. Z.*, 265, 133 (1933); 268, 205 (1934)

Forms of *Gammarus* from Ireland

THROUGH Miss Frost, of the Ministry of Fisheries, Eire, I have received a collection of *Gammarus* from the rivers and freshwater loughs of Ireland. This collection was sent in the hope that in waters of widely differing hydrogen ion concentration, some species other than *G. pulex* (L) might be present.

On examination, however, it became obvious that the collection did not contain a single specimen of *G. pulex*. The specimens were very distinctly the allied and usually brackish-water species *G. duebeni* Lilljeb.

This is a very astonishing fact, for though *G. duebeni* is known to range into fresh water, its occurrence there is by no means common. Also, *G. pulex* is the usual freshwater form which is found generally distributed in the fresh waters of Europe, although I have not found it in the waters of high acidity in Scotland.

The Irish collection was made from rivers and loughs all over the country and the *p*H varied from 4·8 (which incidentally produced an enormous specimen) to the strongly alkaline waters of the limestone districts.

By the courtesy of Dr. Harding I have also examined the collection of *G. pulex* from Ireland in the British Museum (Natural History) and find them to be *G. duebeni* with the exception of a few specimens of *G. pulex* from Lough Erne. These are the only *G. pulex* I have seen from Ireland.

These freshwater *G. duebeni* differ only slightly from the brackish-water form. There are fewer bristles among the groups of spines on the urosome. This is merely a matter of degree and it would be very difficult, if not impossible, to draw any definite distinction anatomically between this and the brackish-water form.

A full report will appear later.

DOUGLAS M. REID.

The Science Schools,
Harrow School,
Harrow, Middx.
March 15.

Action of Insulin in Cell-free Extracts

IT has recently been reported that the Ostern reaction, the formation of hexosemonophosphate from glycogen and phosphate in muscle extract, is inhibited by glucose[1]. It was suggested it might be possible to correlate this phenomenon with known facts of carbohydrate metabolism *in vivo*. It can now be stated that an inhibition of glycogen breakdown in muscle extract can also be produced by adding minute amounts of insulin, the hormone which removes glucose *in vivo*. The same effect can be demonstrated using extract of dried yeast as enzyme. The esterification of phosphate in the Ostern reaction takes place in two steps; a non-reducing easily hydrolysable ester appears first, which is then followed by the irreversible formation of Embden ester. The second step is inhibited by insulin. The hormone, even if added at intervals, considerably retards the formation of Embden ester, but unlike glucose does not interfere with the eventual end point. It is known that *in vivo* the symptoms of hypoglycæmia, after vigorous insulin treatment, do not follow the fall of the blood sugar immediately.

Details of the action of insulin will be published elsewhere. It may be mentioned here that diabetes and hypoglycæmia can be more easily understood by considering that the essential task of insulin is rather to provide glycogen and to regulate its breakdown by the presence of the hormone itself and the level of glucose, than to lower the blood sugar. The latter may be considered the substrate of 'glucolysis proper' (Needham), the polysaccharide as the source of Embden ester which is an acceptor of further phosphate or oxygen. The loss of inorganic phosphate and the need of oxygen in insulin shock or the accumulation of compounds to be reduced (acidosis) in insulin deficiency, which is illustrated by the old saying of "fats burning in the fire of carbohydrate", may thus gain more biochemical substantiation.

HERMANN LEHMANN.

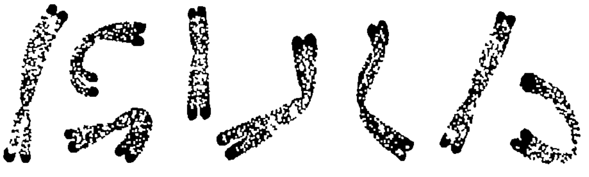
Biochemical Laboratory,
Cambridge.

[1] NATURE, 141, 470 (1938).

Heterochromatin at the Distal Ends of the Chromosomes in *Triticum monococcum*

Kihara and Katayama[1] and Chizaki[2] studied meiosis in haploid *Triticum monococcum* ($n = 7$) and found that the chromosomes often become attached end-to-end, especially during diakinesis. It seemed very improbable that so many duplications or interchanges are responsible for this chromosome behaviour in the haploid *T. monococcum*. I suspected that this phenomenon is probably due to associations between heterochromatic regions of non-homologous chromosomes[3,4]. In studying this problem, I fixed root tips of *T. monococcum* in one part 1 per cent platinum chloride with one part commercial formalin and stained the preparations with Newton's gentian violet. In the chromosome plates of the preparations, stained somewhat more deeply than usual, I found that small portions of the distal ends of almost all chromosomes remained dark, while all the other parts became lighter (being very deeply stained). In the accompanying illustration are shown several chromosomes drawn separately from one and the same metaphase plate. Only the lighter and the darker regions are indicated.

This finding of differential staining suggests that heterochromatin might also be located at the distal regions, and that it is very probable that this heterochromatin is responsible for the end-to-end associations in the haploid *T. monococcum*. Associations between the heterochromatic (inert) regions of non-homologous chromosomes in *Drosophila* occur as a rule in the salivary glands. Our case suggests that this phenomenon is probably more general and is of great significance for the hereditable variations in plants and probably in animals. This problem is being discussed elsewhere.



GROUP OF CHROMOSOMES, DRAWN SEPARATELY, FROM ONE AND THE SAME SOMATIC METAPHASE PLATE (*Triticum monococcum* ROOT TIP).

DONTCHO KOSTOFF.

Institute of Genetics,
Academy of Sciences of the U.S.S.R.,
Moscow. March 1.

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[1] Kihara, H., and Katayama, J., *Agric. and Hortic.*, 8, 1–17 (1932).

[2] Chizaki, J., *Bot. Mag.* (Tokyo), 48, 621–628 (1934).

[3] Kostoff, D., *Genetica* (in the press).

[4] Kostoff, D., and Arutiunian, N. S., NATURE, 141, 514 (1938).

Determination of Azeotropic Concentrations by the Twin Pycnometers Method

EXTREME precision and accuracy of the method of determining the density of liquid substances by means of twin silica pycnometers[1] opens up the way to precise determination of azeotropic concentrations. The new method is based upon investigating the relation between the density of a mixture of two components and its concentration. For this purpose, several mixtures covering either the whole scale of concentrations or the region about the expected concentration of the azeotrope under investigation, are prepared, and their densities are measured. Then an azeotropic mixture of the same components is distilled with an efficient column, its density is determined and the azeotropic concentration is read directly on the diagram, density/concentration.

The accuracy of this method depends upon the difference in density of the two components, but when dealing with organic liquids it is of the order of a few hundredths of one per cent or better. The certainty and the accuracy of this method are based also on working with high-purity substances and azeotropic mixtures as well as on the precise density determination. The easy means for measuring density of organic liquids within a few parts per million, which is secured by the use of the twin silica pycnometers method, and on the other hand the sensitive method of the control of purity of the liquids by the aid of Swietosławski's[2] differential ebulliometer, makes this method of determining the azeotropic concentrations superior in accuracy to other methods formerly used.

Actual examples will soon be published elsewhere.

MIECZYSŁAW WOJCIECHOWSKI.

Institute of Physical Chemistry,
Polytechnic,
Warsaw. March 2.

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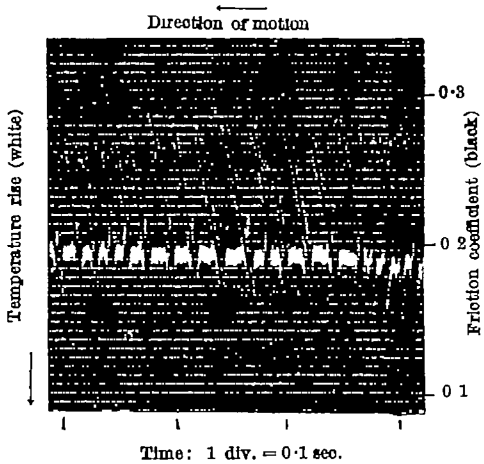
[1] Smith, E. R., and Wojciechowski, M., *Bull. Int. Acad. Polon.*, A, 281 (1936); *Roczniki Chem.*, 16, 104 (1936).

[2] Swietosławski, W., "Ebulliometry" (Polish Academy of Sciences, Cracow, 1936; Chemical Publishing Co., New York, 1937).

Nature of Sliding and the Analysis of Friction

MOST methods of measuring kinetic friction merely record the *average* force necessary to maintain sliding. On theoretical grounds, and from the results of some earlier more primitive experiments, it was considered probable that the frictional force between sliding metals might not be constant. An apparatus was constructed which was capable of recording any fluctuations in the frictional force if they occurred. The lower surface was driven at a slow uniform rate, and the top surface, which rested on it, was attached to a high-frequency device for measuring the friction.

Experiments with this apparatus show that the frictional force is indeed not constant, but is undergoing most violent fluctuations. Sliding is not continuous; the motion proceeds in jerks. The top surface 'sticks' to the bottom one and moves with it until, as a result of the gradually increasing pull, there is a sudden and very rapid 'slip'. The process is then repeated indefinitely. Experiments with a number of different metals and other solid surfaces prepared and polished in various ways show that this phenomenon is a general one. It is not due to surface scratches or irregularities. Even if the surfaces are lubricated with a mineral oil or other lubricants the behaviour may be essentially the same. Sliding proceeds by a process of 'stick and slip'. Certain long-chain fatty acids will, however, cause continuous sliding.



It is possible, by using two different metals as a thermocouple, to measure the surface temperature reached by the sliding metals. Earlier work has shown that this local surface temperature may be very high indeed[1]. A simultaneous analysis of the friction and the surface temperature is given in the accompanying photograph. In this case the top surface was of constantan and the lower surface was of steel. The metals were lubricated with medicinal paraffin and the lower surface was driven at a slow uniform rate of 0·3 cm. per sec.

The black trace measures the frictional force between the surfaces and it will be seen that large fluctuations are occurring in it. The slope of the darker portion of this trace corresponds to the speed of movement of the lower surface so that no relative motion is occurring; the surfaces are sticking together. Then suddenly a very rapid 'slip' occurs. This 'slip' is so rapid that it cannot be followed with accuracy. The surfaces again 'stick' and the process is then repeated.

The white trace measures the surface temperature. It will be seen that the surface temperature remains sensibly constant during the 'stick'; but, at the instant that 'slip' occurs, there is a sudden very rapid rise and fall of the temperature. The whole temperature 'flash' may be over in less than one thousandth of a second. (The temperature rise is shown by the downward movement of the white trace. It appears only faintly on the photograph. The more obvious upward kick beyond the zero is instrumental and may be ignored.)

The fact that an intermittent clutching and breaking away of the surfaces takes place during sliding and that the friction and the surface temperature are fluctuating violently has an important bearing on the theory of friction and lubrication.

F. P. Bowden.
L. Leben.

Laboratory of Physical Chemistry,
Cambridge.
March 1.

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[1] Bowden and Ridler, *Proc. Roy Soc.*, A, 154, 640–656 (1936).

Possible Role of Urea in Formation of Cancerous Growths

The interesting method of treatment of osteomyelitis developed in recent years in the United States is well known. First 'surgical maggots' were used. Then it was found that the beneficial effect was due to the presence of allantoin in the natural excretions of the maggots, so that the use of the latter could be eliminated. Later research showed that the chemically related (and much cheaper) substance urea could be substituted for allantoin in the treatment of osteomyelitis.

Apparently, one effect of urea is to cause rapid multiplication of cells. Is it possible that urea may be a factor in the formation of cancerous growths in the human body, either owing to an excess of urea in the blood stream or to certain organs being made more susceptible to the action of urea by minor lesions?

J. C. M. Gardner.

6 New Forest,
Dehra Dun.
Feb. 9.

Points from Foregoing Letters

Further evidence for the existence of particles with mass between that of the electron and that of the proton is given by Dr. E. J. Williams and E. Pickup. They describe four curved tracks obtained in a Wilson chamber using magnetic fields of 1,000 and 2,200 gauss. The tracks indicate that the mass of the new particle is nearly 200 times the electronic mass.

Photographs showing the sedimentation (in an ultra-centrifuge) of cucumber viruses 3 and 4, are submitted by Dr. W. C. Price and Dr. R. W. G. Wyckoff. Two highly infectious heavy components were almost completely separated by a field of 40,000 times gravity acting for half an hour. They have the same sedimentation rate as the tobacco virus, but are 'insoluble' in water. The presence of a homogeneous high molecular weight substance, other than the virus, was also demonstrated in the cucumber plant, and the authors consider that the study of such non-infectious heavy proteins may throw light on the origin of the virus.

Graphs showing the cosmic ray intensity and the magnetic horizontal force between January 16 and 26, when magnetic storms and brilliant auroral displays occurred, are given by Prof. V. F. Hess, R. Steinmaurer and A. Demmelmair. The graphs show a close parallelism (the variation of the ionization due to cosmic rays being 0·82 mJ for a change in the magnetic horizontal component of 1γ or 0·00001 gauss). The effect, the authors state, may be explained by Chapman's hypothesis of corpuscular ring currents, fed by solar eruptions, encircling the earth at a distance of a few earth radii.

A curve showing the canalization effect of an iron tube 70 mm. diameter and 8 mm. thick upon gamma rays from radium (B + C) filtered by 0·5 mm. of platinum, is submitted by Prof. F. L. Hopwood and Dr. T. E. Banks.

Dr. L. Landau calculates that the laminæ of the intermediate state of supraconductors have to become thinner towards the surface, producing a kind of mixed phase very close to the surface.

A curve illustrating the changes in the resistance to extension of wool fibres in buffer solutions of varying *p*H, with and without previous cyanamide treatment, is given by Dr. J. B. Speakman, B. Nilssen and C. S. Whewell. The authors state that the results support the salt-linkage hypothesis of the structure of wool.

Prof. J. Runnström and E. Sperber submit graphs showing the consumption of glucose by baker's yeast —with and without the addition of cystein—through respiration, fermentation and synthesis of higher carbohydrates. Baker's yeast which has been kept in a dry state resembles to some extent that to which cystein has been added.

D. M. Reid writes that in a collection of the fresh-water shrimp *Gammarus* from Ireland, he has found that all the specimens belong to the species *G. duebeni* and not to *G. pulex*, which is the usual species in the fresh waters of Europe.

According to H. Lehmann, the formation of Embden ester in extract of muscle and dried yeast from glycogen and inorganic phosphate is considerably retarded by minute amounts of insulin.

Prof. D. Kostoff finds that the distal ends of the chromosomes in *Triticum monococcum* stain more deeply when fixed with platinum chloride and formalin and treated with Newton's gentian violet. He suggests that the presence of heterochromatin is responsible for the end-to-end association of the chromosomes.

A detailed analysis of the kinetic friction between unlubricated metals made by Dr. F. P. Bowden and L. Leben shows that the frictional force is not constant but is fluctuating violently. Sliding is not a continuous process; motion proceeds by a process of 'stick and slip'. When 'slip' occurs the surface temperature rises and falls again very rapidly. Even if the metals are lubricated with mineral oils the behaviour is essentially the same.

Research Items

Greek Wolf Lore

A dissertation by Dr. Richard Preston Eckels on "Greek Wolf Lore" (Philadelphia: University of Pennsylvania, 1937. Pp. 88) discusses the place of the wolf both in popular belief and as the object of a cult in ancient Greece, and concludes generally that the evidence is unfavourable both to the view of A. B. Cook that in connexion with the cult of Apollo it is a manifestation of a 'light' cult, and the view that it points to totemism in Greece. The author touches incidentally on the Romulus and Remus legend, which he concludes is not of Greek origin, and its modern parallels of children reputed to have been suckled by wolves and other wild animals. In coping with wild animals, primitive man has two choices only, extermination and domestication. The wolf problem could be solved partially only by domestication, and the wolf, with an effective range of about thirty miles, was in Europe a constant danger to the shepherd. In European folk-lore, therefore, it holds an arbitrary position as the wild animal most widely feared and the embodiment of all that is most malignant and terrible in the natural world—an unconscious abtraction that may be called the Baleful Beast, a mirror of the darker side of human imagination. A number of folk-lore beliefs were current in ancient Greece, such as that the wolf had one cervical vertebra only, that he was an eater of earth and that he was stupefied by squills, while men became mute when they met the wolf's eye, but music could put him to flight. An examination of Greek wer-wolf belief in relation to the beliefs in other wer-animals, as found widely distributed, reduces the importance of the wolf as a specific vehicle of the superstition. The belief is seen to be a manifestation of the Baleful Beast, one of a number of animals which appear in 'shape-shifting'. The more difficult problem is the place of the wolf in certain cults—Zeus Λύκαιος, Apollo Λύκειος, and the belief that Leto, the mother of Apollo, was a wolf. The connexion of Zeus with the wolf and cannibalism in Arcadia seems a piece of folk-etymology to explain the epithet, while that with Apollo is probably derivative from an original function in popular belief of the protection of the flocks from harmful beasts.

A Giant Fairy Shrimp

Mr. James E. Lynch describes an enormous new species of fairy shrimp, discovered in 1935 by Mr. J. F. Clark of Washington State College from the vicinity of Coulee City, Washington, and later found in numbers by the author in temporary alkali ponds in the Upper Grand Coulee, 19 miles north of Coulee City, Grant County (*Proc. United States Nat. Mus.*, 84, No. 3025; 1937). This is the fourteenth species of *Branchinecta* to be described and the fifth reported from North America. In *Branchinecta gigas* the male measures 63 (61–70) mm. in length and the female 86 (69–97) mm. The only other species of the genus approaching it in size is *Branchinecta ferox* from Eastern Europe and Asia Minor, the female of which may reach 70 mm. *B. gigas* differs from all other species of the genus in its large size and in having the antennæ in the female as long as those of the male. It is interesting to find that its food is a *Diaptomus*, the intestine of fresh specimens being bright red from the remains of this crustacean which it has eaten.

West North American Mollusca

A. Myra Keen has expended a great deal of labour in making the check list of west North American Mollusca ("An Abridged Check List and Bibliography of West North American Marine Mollusca". 1937. Stanford University Press). An enormous amount of matter is compressed into this small volume, which is very useful to all conchological workers, especially on the statistical side. Ranges of all species are given. The method employed for using the list to its full advantage is simple, and a large amount of information can be obtained, including literature during the past thirty years besides references to other works of general importance. The maps and diagrams are on the small side and require much enlargement in order to read them, but the whole is comprehensive and a valuable addition to any molluscan library. The book has been reproduced from typewritten sheets.

A Leaf-rolling Weevil

Gum leaves rolled into cylinders and known as 'ant-letters' have been attributed in parts of Australia to the activities of ants of the bullant tribe (Myrmecii). But since the structure of the mouth parts of these ants makes leaf-cutting impossible, John McAreavy has investigated the matter (*Victorian Naturalist*, 54, 123; 1938) and finds that the cutting and rolling of the small gum leaves and the regular scratches made upon the surfaces of the leaves are due to a weevil. The species concerned, *Euops falcata*, sub-family Attelabinæ, is common in Victoria and New South Wales. It works upon young gum trees or on suckers from old stumps, because on these the leaves are tender and easy to roll. The cutting is carried out by the female, and as soon as a leaf section is cut, the upper and sometimes the under surface also are marked with small scratches by the tips of the mandibles. The male takes no part in the operation, but remains close at hand upon the leaf, and at this stage mating takes place. Thereafter the female, after making a couple of deep cuts, which enable her to begin the rolling of the leaf, lays one yellow egg, and then proceeds to roll the rest of the leaf strip tightly with her feet. The cylinder is finally sealed by sticky sap squeezed from the cut surfaces by the rostrum of the beetle, and the author surmises that the scratches made upon the leaf-surface encourage the exudation of sap sufficient to hold the surfaces of the cylinder together as the rolling process is carried out. The beetles prefer for the formation of this egg-case the leaves of *Eucalyptus macrorrhyncha*, the red stringybark tree.

Incompatibility between Stock and Scion

INCOMPATIBILITY between stock and scion occurs in a number of fruit tree species and may be due to diverse causes. Dr. W. T. Chang, working at the East Malling Research Station, has investigated the problem in the case of pears, plums, cherries and peaches (*J. Pom. and Hort. Sci.*, 15, 4, 267; 1938). The symptoms of incompatibility were generally a low percentage take of grafts or buds, premature autumn leaf coloration and flower bud formation, early defoliation, and dying back of young shoots. Defoliation was basipetal in incompatible combinations and acropetal in compatible ones. The graft union was invariably weak mechanically in incompatible combinations due to discontinuity of bark or wood fibres or both, this being associated with slow diffusion of dyes across the union, resistance to flow of water under pressure, and a heavy deposit of starch above the union in November. It is concluded that mechanical weakness and obstruction at the union are the immediate causes of shoot and root decline in incompatible combinations, whilst differences in the periodicity of cambial activity and wide divergences between the growth periods of stock and scion are important contributory causes.

Soil Conditions and the 'Take-all' Fungus

MR. S. D. GARRETT has investigated the effects of soil reaction and aeration upon growth of *Ophiobolus graminis*, the fungus which causes 'take-all' disease of wheat. A recent paper (*Ann. App. Biol.*, 24, No. 4, 747–751, Nov. 1937) describes experiments upon the forced aeration of soil in relation to the incidence of the fungus. Such treatment was found to permit considerable activity of the organism in soils which were normally too acid for its good growth. Even in alkaline soils, aeration brought a marked increase in mycelial extension. Mr. Garrett has also evolved a method of clearing and staining fungus-infected rootlets (*Ann. Bot.* (New series), 1, No. 3, 563, July 1937). A solution of 0·04 per cent brom-thymol blue in 4 per cent sodium hydroxide is allowed to act upon the roots for a period of 5 minutes or more. The effect is a combination of clearing and maceration, whilst the brom-thymol blue stains fungal hyphæ to a deeper colour than any non-meristematic tissues of the host.

Age of the Slieve Gullion Gabbros

THE apparently ambiguous evidence bearing on the age of the Slieve Gullion gabbros has now been satisfactorily cleared up by Doris L. Reynolds (*Proc. Geol. Assoc.*, 247–275; 1937). The gabbro intrusions of Camlough Mt. and near Flurrybridge are shown to contact-alter the Caledonian Newry granodiorite in such a way as to cause the development of micropegmatite around each quartz group. As shown by alkali determinations, the alteration is a metasomatic change, potash having been introduced into, and soda driven out from, the granodiorite. The Slieve Gullion gabbro is found to be associated with a similar micropegmatite-bearing granodiorite and adamellite, and to enclose a block of the micropegmatitic granodiorite. Micropegmatitic veins extend from the zone of altered acid rock into the gabbro, both on Slieve Gullion and near Flurrybridge, and provide evidence that the metasomatized rock eventually became magmatic (rheomorphic). The rocks which result from the metasomatism and rheomorphism of the Caledonian granodiorite are shown to have petrological peculiarities in common with the Tertiary granophyre of Slieve Gullion. It is suggested that the Tertiary granophyre is the final product of metasomatism or rheomorphism of the Caledonian granodiorite. If this is so, it follows, since the change is correlatable with the gabbro contacts, that the gabbros are all (like that of Camlough Mt.) of Tertiary age. This is consistent with Egan's findings, that the gabbro and granophyre of Slieve Gullion mutually intrude one another. Richey's more recent conclusions, that the gabbros of Slieve Gullion and Flurrybridge are Caledonian, are shown to be founded on invalid evidence.

Distribution of Deep-Focus Earthquakes

MESSRS. B. Gutenberg and C. F. Richter, to whose work in connexion with deep-focus earthquakes we owe so much, have recently added an important memoir on the depth and geographical distribution of these earthquakes (*Bull. Geol. Soc. America*, 49, 249–288; 1937). They give a catalogue including all important deep-focus earthquakes from January 1, 1918, until March 31, 1932 (taken chiefly from the "International Seismological Summary"), as well as 12 earthquakes from 1905 until 1917, and 47 others from April 1932 until June 8, 1937, the total number being 255. The authors distinguish three classes of earthquakes, namely, normal earthquakes with focal depths up to 60 km., intermediate earthquakes with depths from 70 km. to 250 km., and deep earthquakes with depths from 350 km. to 730 km. It is a remarkable and well-established fact that no earthquake has been found with a focal depth much in excess of 700 km., a fact the more striking since some of the deepest earthquakes are among the greatest recorded. The distribution of earthquakes with very deep foci shows no direct relationship with the surface geology, though the epicentres occur in zones that are usually parallel to the larger structures. They are confined to zones bordering the Pacific Ocean, at some distance inland from the regions in which normal or intermediate earthquakes occur. The authors believe that the data already collected show that deep-focus earthquakes, like normal earthquakes, originate in a shearing or faulting movement, that takes place in the same direction over large areas and persists over long intervals of time.

Industrial Luminescence Research

IN the case of several manufactured products, luminescence can be employed to detect abnormalities. In *Philips' Technical Review* of January, A. Van Wijk describes a simple practical method of doing this by means of an 80-watt quartz-mercury lamp, the visible light being absorbed by a suitable filter. The filter is made of glass 'blackened' with nickel oxide and an extra addition to the molten glass cuts out the rays which cause conjunctivitis. In the Philips apparatus the lamp is surrounded by an outer bulb of the filter glass and the total useful radiation of the lamp is made available. The author suggests possible uses for these luminescent lamps. For example, it is known that the age of hens' eggs can be ascertained at a glance by means of the fluorescence of the shell. A fresh egg fluoresces red, and an old egg blue. It is stated that luminescence analysis is the best method for checking large numbers of eggs, in an egg market, where whole racks can be inspected at once. If hard water which contains lime is used in a laundry, spots of insoluble calcium soap appear in the material. When these spots are new they are invisible under normal lighting conditions. But under the luminescence lamp they glow with a bluish brightness. Instead of using disfiguring numbers or other marks on linen the laundry stamps the incoming goods with a number in invisible ink which luminesces strongly. The ink is 'fast' to washing so that after being washed the goods can be sorted in the usual way by luminiscent light. Luminescence analysis is useful in the following industries: textile, paper, paint, rubber and food. In addition, there is room for application in goods inspection, and for detecting all kinds of falsifications—cheques, postage stamps, banknotes, paintings, etc.

Progress in Power Rectifiers

DR. W. G. Thompson's paper on recent progress in power rectifiers and their applications, read on March 17 before the Institution of Electrical Engineers, gives a general survey of the present stage of their development. The introduction of the arc rectifier into power engineering may be considered to mark the beginning of a new stage in electrical development. The engineer has not only to extend the scope of his technical knowledge so as to include a field of electron phenomena, hitherto regarded as the physicist's domain, but he has also to adapt in engineering practice much of the vacuum technique of the physical laboratory. During the last twenty years the steady progress of rectifier installations shows how effectively the new knowledge has been applied. Some of the outstanding advantages of the rectifier arc, used for converting alternating into direct current, are its static nature, robust construction, high efficiency and low cost. The demand for this type of apparatus is steady and progressive, and shows no immediate sign of diminution. More than four million kilowatts of rectifier plant is in operation throughout the world. There is now little competition between this plant and rotating machinery; the competition is now between different types and makes of rectifier. With one or two exceptions, recent progress in practice has been by way of improvement and simplification of existing types rather than by new innovations. At the present time power rectifiers are divided into two main groups: (1) vacuum, or more strictly low-pressure vapour apparatus and (2) non-vacuum types. Of the equipment installed the vacuum type is much the larger, but active experimental work is being carried out on alternative forms of rectifier. The power rectifier has a widespread application and there are no signs of its limits of usefulness being approached. Typical examples of rectifier traction work associated with British industry are the London Transport Board's system and the electrification of the Southern Railway, the South African Railways and the Polish State Railways.

The Aurora

THE meeting of the British Astronomical Association held on February 23 was devoted almost entirely to a discussion of the auroras of January 25. Prof. S. Chapman discussed auroras in general, and a considerable number of the members contributed notes and papers on the subject or took part in the discussion at the close of Prof. Chapman's address, which has recently been published (*J. Brit. Astro. Assoc.*, 48, 5, March 1938). Prof. Chapman showed on the screen the iso-auroral lines—most frequent along the auroral zone which was more or less circular, centred at the magnetic axis pole. The usual height of auroras is about 60 miles for the bottom of the streamers, though on rare occasions heights of 40 miles have been recorded. An aurora might extend 300 miles or more upwards. The association between auroras and sunspots is rather nebulous, though there is a definite increase in auroral activity at the times of sunspot activity, but good statistics are difficult because suitable conditions are essential for the observation of auroras. Particles ejected from the sun with parabolic or greater velocity would, if they came within the region of our planet, be guided along the magnetic lines of force and diverted to polar regions, assuming that they were electrified. The light of auroras is due to excited atoms returning to the normal state or to electrons recombining with ions, ionization and breaking up of molecules into atoms being due to collisions between the solar particles and our atmosphere. For this reason, the spectrum of the aurora gives us information, not about the particles, but about the constituents of the upper atmosphere; and this was shown to contain neutral molecular nitrogen, ionized molecular nitrogen, and atomic oxygen. Discontinuities in auroral light, large gaps of clear sky appearing between active regions, may find an explanation on the assumption that exciting agents are absent from these zones.

A Comparison Image Micrometer

MESSRS. C. R. Davidson and L. S. T. Symms have recently published a paper with the above title (*Mon. Not. Roy. Astro. Soc.*, 98, 3; Jan. 1938), in which they describe the results obtained with a comparison image micrometer applied to the 28-inch refractor at Greenwich. Mr. F. J. Hargreaves formerly described a method for improving the measurement of double stars (*Mon. Not. Roy. Astro. Soc.*, 92, 72; 1931). This consisted in producing in the field of the telescope an artificial double star which could be varied in distance, position-angle and brightness, so that it matched the real double star. He made a micrometer on this principle with which he obtained excellent results, and it was sent to Greenwich to be applied to the 28-inch refractor. A Wollaston prism was utilized to produce the double star, crossed nicols controlling the relative brightness of the components, and the paper describes fully the use of these additions to the original micrometer of Mr. Hargreaves. Very remarkable results have been obtained by the apparatus, the advantages of which are most apparent in the case of close pairs. Where it has been impossible to measure these with the filar micrometer owing to the overlapping of disks of diffusion, with the comparison image micrometer glimpses of the nuclei are of sufficiently long duration to observe whether the real and artificial images match. The authors are of opinion that the claim of great accuracy made by Mr. Hargreaves is fully justified, and a comparison between his results obtained with the original micrometer mounted on his 12-inch reflector and those obtained with the Greenwich instrument shows a remarkably close agreement.

Geology in Great Britain

Geological Survey Publications

REPORT FOR 1935

PART 1 of the "Summary of Progress of the Geological Survey of Great Britain" for 1935[1] contains the usual annual reports of the Geological Survey Board and of the Director. Besides giving particulars of the routine work carried out during the year under review, an account is given of the opening of the new museum and offices at South Kensington and of the centenary celebrations in July 1935 (see NATURE, 136, 75; 1935). A more detailed record of these important proceedings appears in the memorial volume which has since appeared from the pen of Sir John Flett on "The First Hundred Years of the Geological Survey of Great Britain". Sir John Flett retired from the position of Director in September 1935, and was succeeded by Dr. Bernard Smith, whose term of office was, alas, tragically shortened by his untimely death in August 1936 (see NATURE, 138, 354; 1936). The Survey suffered another serious loss by the sudden death in May 1935 of Dr. H. H. Thomas, who had served as petrographer since 1911. The vacancy thus caused was filled by the appointment of Dr. J. Phemister.

The Director's report contains an interesting review of the progress which has been made during the years of recovery since the War. More than a thousand maps were issued in the period 1920–35 and nearly two hundred memoirs were published. During 1935 itself forty-three maps were issued, while a further fifty-one were in the press at the end of the year; thirteen memoirs were also published, all of which have already been noticed in our columns (NATURE, 138, 373 and 389; 1936). It is announced that a geological map of England and Wales on the 1/M scale is in preparation, and that a similar map of Scotland on the scale of 10 miles to one inch is being put in hand.

Part 2 of the "Summary of Progress"[2] contains a series of papers on subjects of special interest. R. G. S. Hudson and G. H. Mitchell contribute a valuable account of the Carboniferous geology of the Skipton Anticline, illustrated by a clear and particularly instructive geological map. The greater part of the Dinantian succession is exposed in the area, and the age of the two major earth movements which affected these beds is clearly demonstrated. J. E. Richey describes the areas of sedimentation of Lower Carboniferous age in the Midland Valley of Scotland, with special attention to rhythmic cycles and lateral variation. Washouts in the Haigh Moor Coal of West Yorkshire are discussed by W. Edwards. An account of the geology (mainly Rhætic and Liassic) of the district around Dunhampstead and Himbleton in Worcestershire is given by T. N. George. Some notes on Corallian rocks near Cambridge are contributed by E. E. L. Dixon. An assemblage of ammonites from the Ampthill clay is described by W. J. Arkell, and a new species of *Taxocrinus* from the Delabole Slates of Cornwall by J. Wright. J. E. Richey records and discusses the distribution of apatite in British Tertiary igneous rocks. It appears that apatite tends to be most plentiful in the intermediate rock types and that gravitative settling of early-formed crystals is not a factor that leads to enrichment. An apatite rock from the Ordovician volcanic vent of Bail Hill in Dumfriesshire has been studied by W. Q. Kennedy, who regards it as a pneumatolytically altered calcareous sediment, the alteration having been effected by volcanic gases at relatively low temperature.

MEMOIRS

The memoir describing the geology of the Rothbury-Ashington district in mid-Northumberland[3] is mainly devoted to the representatives of the Carboniferous system. Beds of the Cementstone Group occur in the north-west, and as the dip is mainly to the south-east there is a progressive rise in the sequence in this direction, until Coal Measure strata are encountered along the coastal belt. Much of the area is covered by a varying thickness of glacial drift, and only to the north-west does the form of the ground bear any clear relation to the underlying structure. The Fell Sandstone is responsible for the most prominent topographical features, particularly around Rothbury and the Simonside Hills. The Great Limestone gives rise to minor features, as also does the Whin Sill, locally. The Coal Measures of the coastal belt form the northernmost part of Northumberland and Durham coalfield. Whereas in Durham coking and gas coals are characteristic, here steam and bunker coals predominate. Considerable progress in the correlation of the seams has been made in the course of the recent survey. Important records of borings and pits are given in an appendix.

The Gosforth District[4] forms part of the iron-ore field of west Cumberland and lies between the western part of the Lake District and the Irish Sea. The eastern portion is hilly and is occupied by the rocks of the Borrowdale Volcanic Series, along with some parts of the Ennerdale Granophyre and the Eskdale Granite. The Carboniferous is almost entirely concealed beneath the formations of the New Red Sandstone which form the lower ground to the west. The glacial history of the district is chiefly concerned with the waxing and waning phases of two episodes: the Main Glaciation and the Scottish Readvance Glaciation. In an interesting chapter on the structure the effects of Ordovician, Caledonian, Hercynian and post-Triassic movements are clearly distinguished. It is shown that the stock-like Ennerdale intrusion is later than the Caledonian folding, but possibly earlier than the thrusting and faulting. A similar position in time is probably to be assigned to the Eskdale Granite. The chapter on the igneous intrusions suggests many problems in petrogenesis that still await solution. The iron ores of the Carboniferous form a concealed extension of the exposed area to the north; they have already been described in an earlier memoir (1924) on the "Hæmatites of West Cumberland, Lancashire and Lake District".

The memoir on the Sanquhar Coalfield[5] is mainly devoted to a detailed description of the Carboniferous sediments of the Sanquhar and Thornhill districts in Dumfriesshire, but it also includes an account of the Permian rocks and of the Glacial and Recent deposits. Both districts are situated along the upper valley of the Nith, a river which flows south-eastwards across the southern uplands to Dumfries and the Solway. The Carboniferous strata are especially noteworthy for the number of exposures of fossiliferous horizons. The majority of the 'mussel' zones which have been established in England have been recognized at Sanquhar, and their vertical range can be fixed within relatively narrow limits. Accordingly, means are now available for comparing in a broad way the Coal Measure sequence of Sanquhar with that of Ayrshire on one hand and with the English successions on the other. The palæontology of the Upper Carboniferous is dealt with in appropriate detail, with excellent illustrations. The Permian volcanic rocks of Thornhill and Sanquhar belong to an assemblage that extends to the north-west at least as far as Ardrossan. Around Thornhill the Permian lavas are succeeded by brick-red sandstones made up largely of wind-rounded grains of quartz. These desert deposits have been correlated with the Penrith Sandstone of the Carlisle district.

Descriptive Handbooks

Eleven of the descriptive handbooks issued under the general title of "British Regional Geology" have already been noticed (Nature, 138, 389–391; 1936). Five more of these invaluable summaries of local geology have now been issued. To complete the series only two more have still to come. All the handbooks are beautifully illustrated with maps, diagrams and plates; they are sold at the remarkably attractive price of 1*s*. 6*d*. each.

"The Hampshire Basin and Adjoining Areas"[6] embraces the whole of Dorset, the greater part of Wiltshire and Hampshire, and the Isle of Wight. Here are exposed all the formations in the Jurassic, Cretaceous, Eocene and Oligocene systems, together with a variety of superficial deposits. Attractive scenery and many famous holiday resorts have made the area generally familiar, while the profusion of fossils in many of the strata have made the region a classic one in the history of palæontology. Structurally, this part of England has been folded by earth-movements—the outer ripples of the Alpine storm—which reached their maximum intensity during the Miocene. The diagrams, maps and other illustrations add effectively to a particularly interesting and well-written handbook.

"East Anglia and Adjoining Areas"[7] extends from the Wash to the Thames Valley District. Jurassic formations crop out in the west and Pliocene in the east, along the coast, while between these the Cretaceous occupies a broad stretch of country. The Crag (Pliocene) deposits of East Anglia, with their abundant and well-preserved shells and remains of other organisms, have attracted many famous geologists. In particular, the Cromer Forest-Bed is celebrated for its fossil trees and plants and vertebrate remains. East Anglia is also of special interest to the archæologist because of the many discoveries relating to the history of early man that have been made within the area. Here also occurs the most complete succession of glacial deposits to be found in England. Geologists and workers in related branches of science will appreciate the clear summaries that are given of these and many other topics of abiding interest. In future editions of the Hampshire and East Anglia handbooks a selected bibliography of publications additional to those of the Survey would be welcome.

"The Central England District"[8], though a somewhat arbitrarily defined area, stretches from East Anglia across the central plain to North Wales and the Welsh Borderlands and is of great and varied interest since its exposed rocks embrace all the geological systems from the Pre-Cambrian to the Jurassic with the exception of the Ordovician. The strata contain economically important deposits of coal, fire-clay, gypsum, salt and iron ore and, as a consequence, highly industrialized areas, comprising the Potteries and the Black Country and including Birmingham, Coventry and Stoke-upon-Trent, have developed. The southern part is mainly of a pastoral character, broken here and there by recent exploitation of iron ores. Apart from the Survey work, many fundamental contributions to Midland geology were made by Charles Lapworth, particularly with regard to the Pre-Cambrian and Cambrian rocks. Adequate recognition is given to his work and that of many well-known geologists who have followed his inspiring lead.

"The Midland Valley of Scotland"[9], measuring about 120 miles in length and 50 miles in breadth, is an ancient rift-valley bounded on the north-west by the great Highland Boundary fault from Stonehaven to the Firth of Clyde and on the south-east by the Southern Upland fault from Dunbar to Girvan. The principal formations are of Old Red Sandstone and Carboniferous age. In both systems there occur great thicknesses of contemporaneous lavas and tuffs and many intrusions in the form of vents, plugs, sills and dykes. Plateaux and ridges of volcanic rocks and smaller eminences and crags marking intrusions rise from the softer sediments and give the region its characteristically varied scenery. Petrologically the area is of unrivalled interest, and the handbook is especially noteworthy for the remarkably fine summaries that are given of the various superimposed petrological provinces. The excellent maps and correlation tables also deserve special mention. The handbook is, indeed, one that will be found invaluable by students and teachers alike, as well as by the interested amateur.

"Scotland: The Northern Highlands"[10] is the region that lies west of the Great Glen and its seaward continuations, the Moray Firth and the Firth of Larne. It includes the Inner and Outer Hebrides, but the Orkneys and Shetlands are excluded. A small part of the mainland and much of the Inner Hebrides are composed of Tertiary igneous rocks to which a special handbook has already been devoted (Nature, 138, 391; 1936). Otherwise, Scotland beyond the Great Glen consists mainly of Archæan, Torridonian and Palæozoic rocks, on which rest fragments of Mesozoic strata. The area has won world-wide renown among geologists for its great Caledonian thrust-zone, extending for 120 miles from Skye, through the classic belt of Assynt to Whitten Head. Here it was, in 1883, that Lapworth solved 'the secret of the Highlands'. The handbook provides an admirable summary of many fascinating groups of rocks: the Lewisian Gneiss with its associated intrusions; the Moine series and its injection complexes; the Torridonian and Cambrian; the post-Cambrian intrusions of Loch Borrolan and Loch Ailsh; the Newer Igneous Rocks and Hybrids of Ach'uaine; and the later formations from Old Red Sandstone to Pleistocene. Many excellent maps are given, making the handbook a most attractive guide to a region which hitherto has not been dealt with as a whole.

CATALOGUE OF FOSSILS

The Catalogue[11] of type and figured specimens of fossils in the Geological Survey Gallery of the Royal Scottish Museum will be useful to palæontologists. Localities and references are given. It is noted that the Dunlop collection and the material of the Hugh Miller, Traquair and Neilson Collections in the Natural History Department are outside the scope of the catalogue.

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[1] "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1935". Part 1. Pp. viii+98. 1*s*. 6*d*. net

[2] *ibid*., Part 2. Pp x+129+7 plates 3*s* net.

[3] "The Geology of the Country around Rothbury, Amble and Ashington" By A. Fowler. Pp. xii+159+5 plates. 3*s*. 6*d*. net.

[4] "Gosforth District". By F. M. Trotter, S E. Hollingworth, T. Eastwood and W. C C Rose Pp. xii+136+6 plates. 3*s*. 6*d*. net.

[5] "The Geology of the Sanquhar Coalfield and Adjacent Basin of Thornhill". By J. B Simpson and J E. Richey, with contributions by A. G Macgregor. Palæontology by J. Pringle Pp. viii+97+6 plates 3*s* net.

[6] British Regional Geology. "The Hampshire Basin and Adjoining Areas". By C. P. Chatwin. Pp 94+8 plates 1*s* 6*d* net.

[7] *ibid*. "East Anglia and Adjoining Areas". By C. P. Chatwin. Pp. 91+8 plates. 1*s* 6*d* net.

[8] *ibid* "The Central England District" By F. H. Edmunds and K. P. Oakley Pp. 88+8 plates. 1*s*. 6*d*. net.

[9] *ibid*. "The Midland Valley of Scotland". By M. Macgregor and A. G. MacGregor. Pp 89+8 plates 1*s*. 6*d*. net.

[10] *ibid*. "Scotland: The Northern Highlands" By J. Phemister Pp. 100+8 plates. 1*s*. 6*d* net.

[11] Catalogue of Types and Figured Specimens of Fossils in the Geological Survey Collections now exhibited in the Royal Scottish Museum, Edinburgh". By E. M Anderson. Pp. 77. 1s. 6*d*. net. (H M Stationery Office.)

Noise on the Road

THE Departmental Committee of the Ministry of Transport, which was appointed in August 1934 to consider the source and prevention of the noises from mechanically propelled vehicles on the road, has issued its fourth and final report*, this time on the subject of warning devices. The Committee, to the work of which we have previously referred, and of which Dr. G. W. C. Kaye has been chairman since shortly after its inception, arranged for experimental measurements to be made of the noise levels of some forty present-day warning devices, in relation to both the annoyance which they excite and their degree of effectiveness under representative road conditions. The measurements were carried out for the Committee by the National Physical Laboratory as heretofore.

The warning devices subjected to test included electric buzzer-operated horns, electric gongs, sirens, Klaxon horns, bulb horns and wind-driven horns. Measured 20 feet away, the figures for the overall loudness ranged from 82 to 113 phons at the front, and from 80 to 104 phons at the side of the warning device.

In the difficult task of assessing the degree of annoyance caused by different types of horns, more than 200 people, both old and young of both sexes, were invited to record their impressions of the various sounds, under the headings of agreeable, tolerable, objectionable, very objectionable, and unbearable. While the divergence in the opinions was perhaps even wider than might have been anticipated, nevertheless the observations, some 30,000 in number, plainly indicated the influence of increasing loudness on the scale of annoyance. There are other factors, of course; for example, the Committee conclude that horns emitting musical sounds marked by the absence of strong high-frequency components tend in general to be regarded as less annoying than harsh or non-musical high-pitched sounds of equal loudness. Furthermore, the circumstances, for example, the inconsiderate staccato or sustained operation of a horn by the user, can markedly influence the annoyance factor. But in general, if a single criterion of annoyance is looked for, which will lend itself to measurement and can be made the basis of regulations, then the loudness would seem to fill the bill sufficiently adequately in a large majority of cases.

On this basis, the Committee infers that from the point of view of residents, pedestrians and other quiet road users in relatively quiet streets, horns of loudness exceeding 95–100 phons at a distance of 20 feet are likely to cause a material degree of annoyance. In relation to such conditions, it is clear that many present-day motor-horns are excessively loud. From the point of view, however, of a driver subjected to the noise of his own vehicle and who is being followed by another vehicle desirous of overtaking, the tests show that horns of loudnesses of the order of 105 phons may be necessary in the case of vehicles of moderate noise-level, such as private cars and light commercial vehicles, while horns of so much as 110 phons or more may be required to attract the attention of drivers in the cabs of heavy noisy lorries. In such circumstances, horns with very distinctive characteristics are most readily noticeable.

A compromise to meet these diverse requirements had to be arrived at, and the Committee was led to recommend a loudness limit of 100 phons at 20 feet, as one which would result in material improvement as regards annoyance from horns to quiet users of the road, and which would be sufficient to meet the needs of the majority of drivers of vehicles. It points out that, as and when compliance is obtained with the recommendations concerning the level of motor-vehicle noise in their previous reports, the difficulty experienced by drivers of very noisy vehicles in hearing horns which are not extremely strident will be progressively reduced.

The Committee was given a difficult task, and now that its work has been brought to a successful conclusion, appreciation may be expressed of the way it has directed chief attention to the small and noisy section of road users, so that its recommendations, if brought into force, would not inconvenience the great majority who have consideration for the amenities of the road.

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* H.M. Stationery Office. 1*s*. 3*d* net

Anthropology as an Imperial Study*

THE process of incorporation of subject peoples into a great imperial organization, such as the British Empire, with duties, responsibilities and privileges, for which their previous experience has all inadequately prepared them, only too often has been so severe an ordeal that the novice has succumbed to the hardships involved, and instead of attaining a fuller life in a new society of peoples, has disappeared from among the nations of the earth.

Sometimes this disappearance has been the result of deliberate and calculated severity, as the Easter Islander at the hands of Peru, or the Tasmanians at those of the British. Far more often the fatalities of this ordeal have been the result of ignorance, of indifference or even of kindness misdirected with the best of intentions, as has happened in the Andaman Islands, where the Rev. Mr. Corbyn's policy of attempting to civilize the Andamanese has combined with other factors, such as the introduction of diseases from which the Islanders had not acquired immunity, to reduce the number of inhabitants from 5,000 in 1858 to 460 in 1931.

The causes of such decline have been variously estimated. A some-time lieutenant-governor of Papua is quoted as writing of "tribes who apparently must disappear before long, and when one considers their habits the only cause of surprise is that they should have come into existence at all". The habits specified seem to be child-marriage and "the probability of unnatural offences and other filthy customs", which do not afford convincing testimony of the causes of decline. Native customs, often repugnant to Europeans, such as head-hunting expeditions, are frequently the culminating point of a preparation lasting over years, which has provided interesting work in the building of canoes, etc., punctuated by rites and feasts relieving the monotony of life, and stimulating agriculture and pig-breeding. On the economic side again, the introduction of coin into the Naga Hills of Assam and its greatly increased circulation have led not only to much indebtedness, but also to the growth of a landless class. Loans formerly repaid in kind are now paid in cash, to obtain which something must be sold, generally the land, leading to a loss of independence. Great harm has been done by the complete failure to understand native systems of ownership and tenure of land.

In many parts of Asia and Africa, ownership has been communal. Under this system, destitution is impossible; for the tribe is responsible for all its members. It has happened repeatedly, however, that the chief has been treated as owner and not as trustee, as he really is. The deplorable results can be seen in the landless condition of a large proportion of the Indians of North America, or in conditions among the aboriginal tribes of India, especially in Chota, Nagpur and the Chittagong Hills, where the chief has been converted to Hinduism, and has alienated the land, which belonged to the village, and not to him as an individual. A similar misunderstanding of the tribal point of view is likely to arise in the case of many customs, and also in the administration of justice. Among the aboriginals of India the application of a system of law, which they do not understand, has more often than not resulted in ruining them economically and degrading them morally. Even the efforts of missionaries have succeeded in adding to the black man's burden by undermining the prestige of the natural leaders of the people, the pastor encroaching on the prerogative of the chief. When the chief, the medicine man, and other natural leaders become mere figure-heads, native culture no longer offers any objective worthy of effort or sacrifice, and the native lapses into an existence devoid of purpose or ambition, and, therefore, of contentment. A people who have thus lost interest in life succumb to any disease of body or mind and fail to reproduce their species in sufficient quantity to survive the chances of death.

Other causes might be cited, indicating the responsibility for decline—at any rate in part; but if we assume that decline had set in before the white man came, of what value is the culture he has to offer, if it cannot arrest, but only accentuates, the existing process of decay. We have no right to incorporate in our system peoples of other culture than ours if the ordeal of that incorporation be so severe as to destroy the peoples incorporated.

It is here that the study of anthropology comes in. The first necessity in dealing with a race of so-called 'primitive' culture, as Dr. A. C. Haddon pointed out so long ago as 1921, is an ability to adopt an attitude in which the observer divests himself entirely of his own outlook on life, and regards everything from the point of view of members of the other race, as they exist for themselves in their own scheme of life. If such a point of view is at all attainable, it is through a study of social anthropology that it can be obtained with least difficulty. For to the anthropologist all customs are natural, and even head-hunting and cannibalism are not revolting crimes, but reasonable and inevitable acts resulting from beliefs and ideas logically applied to circumstances and environment. A failure on the part of administrators and administered to recognize each other's point of view may well lead to rebellion or disturbance, but must certainly lead to apathy, depression and degeneracy on the part of the administered, whereupon, as W. H. R. Rivers pointed out, they languish and die.

The anthropologist can do a great deal towards solving these difficulties, if the various branches of that science act in collaboration. The dangers of apathy, depression, and decline is primarily the province of the social psychologist. If the result of the impact of Western civilization can be foreseen, any sudden upsetting change can be guarded against. Thus an outlet has been provided to take the place of head-hunting in New Guinea, where the substitution of a wild boar has averted the deleterious effects on the marriage rate, which threatened when head-hunting was abolished. Similarly, problems of interbreeding and the influence of changed conditions of life, owing to the introduction of new styles of dress or in buildings, call for investigation. For the anthropological economist, problems are raised by changes in the methods of production, and by such measures as the wholesale suppression of slavery, which latter on the Assam-Burmese frontier has thrown land out of cultivation. The introduction of mill-spun yarn or machine woven cloth may completely supersede indigenous manufacture, to the great detriment of certain sections of the community. Again, in Assam, the anthropologist will discover that the administration of previously independent tribes has had a deleterious effect. The old conditions of intermittent warfare, raids, and head-hunting involved competition and a hard life, the need for vigilance, resource and quick reactions. Personal efficiency was the primary standard, and wealth secondary. With the prevention of warfare and raiding, wealth comes to stand first and the whole tribe suffers by the change.

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* Substance of the inaugural lecture of Dr. J. H. Hutton, William Wyse professor of social anthropology in the University of Cambridge, delivered on February 14.

The imposition of taxation is another important factor in change, necessitating the use of money, leading to detribalization and the acceptance of European values. Another difficulty is the belief in witchcraft, which cannot be ignored as a vain superstition, when the people themselves believe in it.

The obstacle in the way of anthropology's contribution to the solution of these and other problems has been in the past largely due to the absence of recognition of the practical value of this science. The end of the Great War, as Rivers prophesied, has brought the duty of meeting old responsibilities in new ways. The feeling is growing in Great Britain that dependencies inhabited by people of primitive culture are held in trust primarily for their inhabitants, and secondarily for the world in general. Those responsible for the administration of such areas have been slow to recognize the value of anthropology in meeting such responsibilities. The Colonial Office, it is true, has now recognized the value of a knowledge of anthropology, and probationers going out do not now go out without at least some knowledge of that science ; but politicians and men of affairs are apt to regard learning and theoretical knowledge with consistent distrust.

Forest Products Research

THE report of the Forest Products Research Board for the year 1936 with the report of the Director of Forest Products Research for the same year (H.M. Stationery Office, Dec. 1937) give evidence of the increasing interest being taken in timber research by industry.

The Board states that the period covered by the report has been of special importance to the Board as it includes a survey of the work and policy of the Forest Products Research Laboratory carried out on behalf of the Department of Scientific and Industrial Research by a Committee appointed for the purpose. It is of public interest to know that inspections of this nature are held periodically by the Department on the various activities under its control and the Board welcomed the opportunity thereby afforded to review the present position and to adjust future policy. Throughout the year, the Board was in close touch with the Reviewing Committee set up by the Department and the suggestions of the Committee were submitted to the Board for opinion at a meeting held at the Forest Products Laboratory at Princes Risborough in October. The Board's comments were afterwards laid before the Advisory Council for Scientific and Industrial Research.

During the year, more than 2,200 inquiries were dealt with at the Forest Products Research Laboratory—or twice the number dealt with five years ago, a fourth of these being from trade sources, asking for advice and assistance in practical problems connected with the seasoning and bending of wood.

As evidence of the varied nature of the work undertaken at the Laboratory, tests were carried out for British firms in the country on a number of species of foreign timbers, on the strength of a new fire-resisting wall board, on timbers for aircraft, for furniture and on a method of packing crushed bamboo and on the adhesion of plywood and glued joints generally. Another fourth of the inquiries, the majority from private individuals, related to the attacks on timber by beetles.

An interesting and perhaps unsuspected outcome, as the result of a large number of mechanical tests on selected hardwoods similar in weight, is the determined factor that tropical timbers are generally inferior in resistance to shock (toughness) to those grown in temperate regions. On the other hand, the tropical timbers are appreciably stronger in resistance to compression parallel to the grain. Both these strength properties are fairly closely related to specific gravity or weight per cubic foot and, therefore, indirectly to one another ; but statistical analysis shows that toughness and strength in compression parallel to the grain are inversely related. Search has been made, among the newer Empire timbers from tropical Africa and Asia recently appearing on the markets, for substitutes for ash and hickory but none of outstanding toughness have yet been discovered to replace these two well-known timbers.

The report deals with the investigation work carried out on shrinkage problems, box testing, insect and fungus researches, plywood products and test work in connexion with Empire timbers. Several species of the latter are mentioned. It would appear that in some of these cases the work of the Research Laboratory is in advance of the Colonies and their Forest Departments from which the timbers originate. It is of little practical utility to the trade to know that a timber is of value for a particular purpose when the commercially accessible amounts available in the forest are to a great extent unknown ; whilst working plans safeguarding the correct exploitation of the forests, as understood in India, have yet to be drawn up for the greater part of the areas under the Colonial Forest Services.

Science News a Century Ago

The Botanical Society

AT a meeting of the Botanical Society on April 20, 1838, a paper by A. Wallis was read on the genus *Myosotis*. The *Myosotis arvensis*, he said, is most usually found in cornfields, or other highly cultivated land, where it sometimes reaches a considerable height. The *Myosotis sylvatica* is mostly found in shady places, where it assumes a stouter form than *M. arvensis*; the bristles of the leaves are shorter and the leaves will generally be found longer than those of *M. arvensis*. There is another distinction also, for which neither soil nor locality would account; it is that the calyx of *M. sylvatica* is more deeply cleft than *M. arvensis*, and the tube of the corolla is longer in the former than in the latter, but he was inclined to doubt whether these were sufficient to justify a specific distinction. Admitting that a difference of soil operates so powerfully in producing such varied and perhaps permanent distinctions of character, it would become a subject worthy of attention how this peculiar operation takes place, and whether by close observation of soil and locality, we may not be able to establish geological laws.

Exploration of the Coast of North America

THE *Athenæum* of April 21, 1838, under the heading "Arctic Discovery Expedition", gave an account of the exploration of the northern coast of North America in 1837–38 by Peter Warren Dease and Thomas Simpson (1808–40), two of the staff of the Hudson's Bay Company. The expedition had been organized by Sir George Simpson (1792–1860), the administrator of the company. "Just half a century had elapsed since Alexander Mackenzie, in 1789, first descended the great river which so justly bears his name and reached the waters of the Polar Sea. Thirty-seven years later, in 1826, Franklin and Back followed Mackenzie's course to the mouth of the same river and coasted 370 miles to the westward tracing the northern shore of America till within 160 miles of Port Barrow, which had been reached only four days after Franklin was obliged to return. The intermediate portion has remained a blank on our maps till the present week brought us the gratifying news of an expedition headed by Messrs. Dease and Simpson . . . having successfully traced the unexplored country between Point Barrow and Franklin's farthest; and thus a continuous line of 60 degrees in extent from Point Turnagain on the east to Behring's Strait on the west has been explored by British hardihood and perseverance." Point Barrow had been reached in 1826 by Elson during Beechey's expedition to the North Pacific in the *Blossom*. Dease and Simpson had spent the winter of 1836–37 at Fort Chipewayan on Lake Athabasca and on the opening of navigation had descended the Slave River and Mackenzie River and had reached the ocean by the most northerly mouth of the latter.

Harper and Joyce's Heating Stove

WHEN Dr. Neil Arnott's method of heating rooms was attracting attention, considerable interest was aroused by the exhibition at the Jerusalem Coffee House of a stove invented by Harper and Joyce designed to burn prepared charcoal which it was claimed gave out no smell and did not vitiate the atmosphere. It was the subject of a lecture by Prof. Everitt before a well-attended meeting of the Westminster Medical Society on April 21, 1838, and it was also described before the Paris Academy of Sciences by Gay Lussac. In his report, Gay Lussac said: "Much has been said of the wonderful nature of this process that with an expenditure of fifty or sixty centimes [5*d*. or 6*d*.] in properly prepared charcoal, a vast apartment may be maintained at an agreeable temperature for twenty-four hours, and moreover that the carbonic acid produced by the combustion is not diffused in the apartment, being absorbed by the carbonate of soda with which the charcoal is impregnated, the danger of suffocation therefore no longer to be dreaded from this method of heating. This much boasted process has appeared to me to be deserving of my examination; and in making the results known, I believe I am doing a duty to the public and performing a duty incumbent on me. . . . The elegant apparatus in which the charcoal is burned, is a true brazier, diffusing all the products of combustion into the apartment where it is placed, and it is from these circumstances that the asserted economy rises. This economy cannot be disputed, but it should not be forgotten that it is gained at the expense of vitiating the air of the apartment."

Medical Biography

THE issue of the *Gentleman's Magazine* of April 1838 contains the following review of the first part of the "Medical Portrait Gallery" by Thomas Joseph Pettigrew which had recently appeared: "The author advances the claims of this work by stating the general deficiency of Medical Biography, and by remarking that the history of the Progress of Medicine cannot be more agreeably displayed than in a detail of the researches of the most celebrated professional men, who have successfully toiled in the pursuit of Science. That this range of view will be most comprehensive is shown by the subjects comprised in the first number: Esculapius (from an antique whole-length statue); Sir Henry Halford; and Albinus, a very learned German of the last century. Of the engravings it is sufficient to say that the style of their execution is guaranteed, from being executed under the now well-experienced superintendence of Messrs. Fisher, of Newgate Street. In the accompanying Memoirs Mr. Pettigrew has added to his already well-earned fame as a medical historian and antiquary.

Medieval Mummy

THE *Gentleman's Magazine* of April 1838 contains the following information: "Among the curiosities recently added to the Museum of the Royal Society of Northern Antiquities at Copenhagen there is one of a singular nature and of great historical interest. It is the mummy of a female, found in a peat bog near Haraldskioer in Jutland, completely sunk in the soft ground, and fastened to a stake by means of clamps and hooks. The fragments of clothing that remain on the mummy enable the skilful antiquaries of the north to calculate with tolerable certainty that it belongs to the last period of paganism, and M. Petersen has endeavoured in an able historical essay to prove that the mummy is the body of Gunhilda, Queen of Norway, whom King Harald Bloatend enticed by promises of marriage to come to Denmark in 965 where he put her to death by sinking her in a bog."

Societies and Academies

London

Royal Society (*Proc.*, A, 165, No. 920, 1–160).

J. E. Lennard-Jones and A. F. Devonshire: Critical phenomena in gases. (2) Vapour pressures and boiling points.

P. M. S. Blackett: The nature of the penetrating component of cosmic rays.

D. Porret and C. F. Goodeve: The continuous absorption spectra of alkyl iodides and alkyl bromides and their quantal interpretation.

C. Corin and G. B. B. M. Sutherland: The infra-red absorption spectrum of methylene chloride.

S. Tomotika: On the velocity and temperature distributions in the turbulent wake behind a heated body of revolution.

S. Tomotika: Application of the modified vorticity transport theory to the turbulent spreading of a jet of air.

L. F. G. Simmons and C. Salter: An experimental determination of the spectrum of turbulence.

C. A. Coulson and W. E. Duncanson: Comparison of wave-functions for HeH^{++} and HeH^{+}.

E. H. S. Burhop, R. D. Hill and A. A. Townsend: The production of gamma-rays by neutrons.

F. L. Arnot and Marjorie B. M'Ewen: The formation of mercury molecules (2).

M. C. Johnson and A. F. Henson: Oscillography of adsorption phenomena. (3) Rates of deposition of oxygen upon tungsten.

Paris

Academy of Sciences, February 14 (*C.R.*, 206, 465–544).

Gaston Julia: The inversion of limited linear operators belonging to the third and fourth classes of Tœplitz.

Ernest Esclangon: The rotation of the galaxy.

Dimitri Riabouchinsky: Approximate equations of the three-dimensional movements of a perfect compressible fluid.

Stanislas Christian Zaremba: Kronecker's index.

Michel Ghermanescu: The exceptional combinations of integral functions.

Mlle. Alice Roth: The radial limits of integral functions.

Michel Scherer: An arrangement allowing the simultaneous measurement of reactions on two juxtaposed wings.

Léon Rebuffé: Two limit laws concerning the velocity of rebound and absorbed energy, in the case of the shock of a hard body on a soft metal.

Marcel Peschard: The spontaneous inflammation of hydrocarbons mixed with oxygen and its relations with the octane index.

Louis Goldstein: The theory of sprays of protons and of neutrons.

Georges Durand: The application of the mass-luminosity relation to the calculation of the parallaxes of double stars with eclipses.

Junior Gauzit: The presence of the first positive group of nitrogen in the spectrum of Finsler's comet (1937*f*).

Jean Roubaud-Valette: The expression of physical magnitudes as a function of new magnitudes belonging to a sub-space.

Albert Pérard: A method for the absolute determination of light wave-lengths as a function of the metric unit.

Paul Renaud and Georges Costeanu: The distribution in direction of steam issuing from a capillary.

Constantin Salceanu and Corneliu Istraty: Acoustic resonance spectra of liquids.

Jean Paul Cance: A new method of measuring the velocity of sound in liquids by ultra-sound capillary interference.

Pierre Vernotte: The division of the flux of heat in double-wall methods.

Jean Villey: Adiabatic compression with *remisage*.

Oleg Yadoff: The removal of electric charges by means of a high velocity jet of air.

Pierre Barchewitz: The complexity of the (CH=) bands of benzene derivatives. Discussion of the conclusions to be drawn from the study of the infra-red and Raman spectra of benzene and its derivatives. The senary symmetry of benzene is not in contradiction with a ternary symmetry in the distribution of the electric charges: on the contrary, it confirms it.

Charles F. Squire: The thermal variation of the Cotton-Moulton constant for the liquid aromatic hydrocarbons.

Maurice Henri Pirenne: The diffraction of the X-rays for silicochloroform. The geometrical structure of the molecule $SiHCl_3$. The valency angle is within two or three degrees of the angle of a regular tetrahedron, and in agreement with the view of G. Urbain the $SiCl_3$ group admits of a plane structure.

André Boullé: Calcium trimetaphosphate. Calcium trimetaphosphate has been prepared by the reaction of sodium chloride with silver trimetaphosphate. This salt has been characterized by its composition, behaviour on heating and X-ray spectrum.

Albert Portevin and André Leroy: Methods of estimation with microsamples, and applications to metallurgical studies. Details of methods of determining manganese, phosphorus and chromium in 1 mgm. samples of steel.

Henri Wahl: Methyl β_1-methoxy-β_2-naphthoylacetate.

Boris Owodenko, Henri Termier and Gaston Delépine: The presence of the Silurian and of the Devonian to the south of Naima (Oudja, Eastern Morocco).

Gonzague Dubar: The formation of folds at the Aalemian and Bajocian in the Haut-Atlas of Midelt.

Hubert Garrique and Henri Camichel: The aurora borealis of January 25, 1938, observed from the Pic du Midi.

Henri Marcelet: The presence of a C_{18} aldehyde-alcohol in olive pulp.

Raoul Lecoq and Roger Duffau: Cure of acute glucidic alimentary lack of equilibrium in the pigeon and its repercussion on muscular glucidic metabolism.

Serge Tchakhotine: Heredity and leucocytic proportion of the blood in mice.

Jean Jacques Pérez and Georges Sandor: The solubility optimum and isoionic point of the psuedoglobulins of horse serum.

Albert Berthelot and Mlle. Germaine Amoureux: The formation of 3-indolacetic acid in the action of *Bacterium tumefaciens* on tryptophane.

Mme. Marguerite Lwoff: Hæmatin and ascorbic acid: growth factors for the flagellate *Schizotrypanum cruzi*.

Amsterdam

Royal Netherlands Academy (*Proc.*, 41, No. 2, Feb. 1938).

J. Böeseken : Oxides of thio-urea. (3) Chemical and physico-chemical properties of the dioxide and trioxide.

J. G. van der Corput : Goldbach's hypothesis.

F. K. Th. van Iterson : Clarification of coal-washery effluent. The chemical method of flocculation employed in the Dutch State colleries in Limburg.

W. H. Keesom and K. W. Taconis : Structure of solid helium. Solid helium at 37 atm. pressure and 1·54° K. has a hexagonal structure.

W. H. Keesom and P. H. van Laer : Measurements of atomic heats of tin in the supraconductive and in the non-supraconductive state.

J. G. van der Corput : Two, three or four primes. (3).

R. Weitzenböck : Trivectors. (4).

W. van der Woude : Certain linear constructions and a well-known configuration

F. M. Jaeger, J. A. Bottema and E. Rosenbohm : The exact measurement of the specific heats of solid metals at high temperatures : (29). Specific heats, electrical resistance, thermo-electric behaviour and thermal expansion of neodymium in connexion with its allotropic changes.

E. Dubois : The mandible recently described and attributed to *Pithecanthropus* by G. H. R. von Kœnigswald, compared with the mandible of *Pithecanthropus erectus* described in 1924 by E. Dubois. The conclusion is drawn that the mandible in question must be attributed to *Javanthropus* (*Homo soloensis*) and not to *Pithecanthropus*.

O. Posthumus : Some remarks on the stellar morphology of *Knorripteris Jutieri* Bertrand and on its systematic position.

C. S. Meyer : Some integral representations of the Lommel function $S_{\mu\nu}(Z)_2$.

J. Haantjes : The induced covariant derivative for spinors.

Je Oortwijn Botjes : Induction of polarity by geotropic stimulation in tomato plants lacking growth substance owing to being kept in the dark.

J. H. G. Ferman : A new theory of the correlative inhibition of lateral buds and shoots.

Th. E. de Jonge-Cohen : Doubling of the front teeth.

G. H. R. von Kœnigswald : A new *Pithecanthropus* skull. Description of the skull discovered on August 13, 1937, near Kampong Bapang in the Dutch East Indies.

Tokyo

Imperial Academy (*Proc.*, 14, No. 1, 1–26, January 1938).

Masao Sugawara : An invariant property of Siegel's modular function.

Mankiti Hasegawa and Yûita Tamura : The regular progressive changes of the magnetic field of diurnal variations of terrestrial magnetism. (2) It is concluded that the zonal variations are the principal part of the solar diurnal variations of terrestrial magnetism.

Waro Nakahara, Fumito Inukai and Saburo Ugami : Factor L (vitamin L) requirements for lactation in pregnant rats. It is concluded that factor L (vitamins L_1 and L_2) is necessary for establishing normal lactation, but once established the factor L requirement for the second lactation may become smaller.

Shinkichi Yoshimura : Limnology of two lakes on the oceanic island, Kita-Daitô-Zima. The two lakes, Aka-ike and Oo-ike, though they are in the interior basin of an island of coral limestone, are considered a type between eutrophic and dyotrophic.

Masuzo Uéno : Plankton of the lakes in Kita-Daitô-Zima.

Sanshi Imai : Third note on *Elaphomyces* and fungus-inhabiting *Cordyceps* in Japan. Three fungi, new to Japan, are described.

Mamori Ichikawa : Induction of gills in *Triturus pyrrhogaster*.

Haruo Kinosita : Chronaxy of individual fibres in nerve.

Vienna

Academy of Sciences, January 13.

K. Strubecker : Theory of circular quadratic complexes.

H. Güntert : Development of the folds of the mucous membrane of the intestine of *Salmo irideus* Gibb.

F. Urbach and A. Wolinski : Spontaneous change of the latent photographic image. If a photographic plate is illuminated by red light during its exposure to actinic light, the latent image is partially destroyed. This effect is much smaller if there is an interval between the formation of the latent image and its exposure to red light. It is concluded that the photo-chemical reaction products are unstable when first formed but become stabilized with lapse of time. The course of this stabilization has been followed over 20 hours.

A. and R. Skrabal : Kinetics of the hypochlorite and hypobromite reactions. The formation of chlorate in hypochlorite solution and of bromate in bromine bleaching solution has been studied. Among other results, the dissociation constant of hypobromous acid at 25° has been determined as 2×10^{-11}.

E. Abel and F. Fabian : Some halogen equilibria in heavy water.

O. Reithofer : New Tertiary outcrop at Wórgl in the Unterinntal.

January 20.

Elisabeth Rona and J. Schintlmeister : α-Rays of mesothorium 2. A study of differential absorption curves by means of proportional counters shows that if mesothorium emits any α-rays, the branching ratio between α-rays and β-rays is less than 2×10^{-4}.

O. Peczenik : Antagonistic effect of thyroxine and of diiodotyrosine on the heart-depressing action of pitressin.

J. W. Breitenbach : Thermal polymerization of styrol.

Zdenko Herrmann : Components of the Leclanché cell (2). The role of the soot.

E. Jusa and A. von Janovich : Azo-colours from aryl esters of 2-oxy-3-naphthoic acid and of 1-oxy-2-naphthoic acid.

H. Dostal : Elastic properties of solids of high molecular weight.

G. Flumiani and V. Bajic : Synthesis of oxy-anthraquinone. A new synthesis of metal salts of oxyanthraquinone (1).

O. Burkard and L. Kahovec : Studies of the Raman effect. (82) Nitrogenous substances. (10) α-Aminopropionic acid, α-oxypropionic acid and their esters.

Forthcoming Event

Thursday, April 21

Royal Aeronautical Society (at the Institution of Mechanical Engineers, Storey's Gate, S.W.1), at 6.30.—Prof. J. E. Younger: "High Altitude Flying".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Lecturer in Engineering in the Swansea Technical College—The Director of Education, The Guildhall, Swansea (April 21).

Senior Technical Officer at the Air Ministry Headquarters—The Secretary, Air Ministry, S 2 (d), Adastral House, Kingsway, London, W C.2 (April 22).

Instructor in Automobile Engineering in the North Gloucestershire Technical College, Cheltenham—The Secretary (April 25).

Lecturer in Mechanical Engineering in the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (April 30).

Assistant Archæologist in the Ordnance Survey Department—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (April 30).

Professor of Anatomy in the London Hospital Medical College—The Academic Registrar, University of London, Senate House, W.C.1 (May 3).

Assistant Lecturer in Chemistry in the Royal Agricultural College, Cirencester—The Principal (May 16).

Assistant Lecturer in Chemistry in the Bradford Technical College—The Director of Education, Town Hall, Bradford (May 14).

Lecturer in Physiology and Hygiene in the Bergman Osterberg College, Dartford—The Principal.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Association for the Advancement of Science. The Radford Mather Lecture, 1937: Science and the Community. By the Rt. Hon. J. Ramsay MacDonald. Pp. 500–511. 1*s*. The Norman Lockyer Lecture: Beginnings of Town Life in Britain By Dr. R. E. M. Wheeler. Pp. 512–518. 6*d*. (London. British Association.) [213

Technical Publications of the International Tin Research and Development Council. Series B, No. 7: The Hot-Tinning of Fabricated Articles. By E. J Daniels. Pp. 12. (London International Tin Research and Development Council.) Free. [213

University of Bristol: Department of Agriculture and Horticulture. Bulletin No. 20 The Maintenance of Grassland for Poultry and the Value, Storage and Utilisation of Poultry Manure. By A. W. Ling and W. R. Muir. Pp. 23. (Bristol. The University.) [213

Ministry of Health. Report on the Work of the Central Midwives Board for the Year ended 31st March 1937. Pp. 19. (London: H.M. Stationery Office) 4*d*. net. [213

Report by the Food Council to the President of the Board of Trade for the Year 1937. Pp. iv+30. (London: H.M. Stationery Office.) 9*d*. net. [213

British Museum (Natural History). Instructions for Collectors, No. 2: Birds and their Eggs. Eighth edition Pp. 36. (London. British Museum (Natural History).) 4*d*. [233

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol 22. Pp. 818. (London: Society of Chemical Industry.) [233

Third Oxford Farming Conference, Taylor Institution, Oxford Jan. 4–7. Papers and Discussions. Pp. 157. (Oxford: The University.) [233

National Physical Laboratory. Report for the Year 1937. Pp. iv+150. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [303

Department of Scientific and Industrial Research. Welding of Steel Structures; Report of the Welding Panel of the Steel Structures Research Committee. Pp. xviii+326+15 plates. (London: H M. Stationery Office.) 6*s*. net. [44

British Electrical and Allied Industries Research Association Presidential Address. By Dr. C. C. Paterson Pp. 13. (London· British Electrical and Allied Industries Research Association.) [44

Rewards and Fairies: being the Second Frankland Oration of the Lancastrian Frankland Society, delivered by the President at Lancastor on the 14th January 1938. By Sir James Colquhoun Irvine. Pp. 15 Lancaster: Lancastrian Frankland Society) [44

Technical Publications of the International Tin Research and Development Council Series A, No 73 "Frostiness" in Plumber's Solder. By F A. Rivett. Pp. 11+3 plates Free. Series A, No. 74: Research on Thin Layers of Tin and other Metals, 4, Further Investigation on Corrosion by Oils. By P. J. Haringhuizen and D. A. Was. Pp. 9 Free. (London. International Tin Research and Development Council) [44

Ministry of Health. Circular 1675. Public Health (Imported Food) Regulations, 1937. Pp. 17. (London. H M. Stationery Office.) 3*d*. net. [44

Other Countries

Transactions of the Geological Society of South Africa. Vol. 40: Containing the Papers read during 1937. Edited by E. Mendelssohn. Pp iii+162+15 plates. Proceedings of the Geological Society of South Africa: Containing the Minutes of Meetings and the Discussions on Papers read during 1937. Edited by E. Mendelssohn. To Accompany Vol. 40 of the Transactions, January-December, 1937. Pp. lxiv. (Johannesburg. Geological Society of South Africa.) [213

Australasian Antarctic Expedition, 1911–1914. Scientific Reports, Series C Zoology and Botany Vol. 10, Part 3: Leeches. By Prof. J. P. Moore. Pp. 15+1 plate 2*s*. 6*d*. Vol. 10, Part 5: Parasitic Nematoda. By Prof. T. Harvey Johnston. Pp. 31. 3*s*. 6*d*. (Sydney: Government Printer) [213

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 6, No. 20. Spectrographic Studies of Nova Lacertae, 1936. By W. E Harper, J. A. Pearce, C. S. Beals, R. M Petrie and Andrew McKellar. Pp. 317–364. Vol. 6, No. 21: The Spectrographic Orbits of H. D. 109510 By R. M. Petrie. Pp. 365–368. Vol. 6, No. 22: The Spectrographic Orbit of H D. 214652. By Andrew McKellar. Pp. 369–374. (Victoria, B.C.. Dominion Astrophysical Observatory.) [213

Conserve Your Soil a Simple Guide to Erosion Control. Pp. 64. (Sydney and London: Bank of New South Wales.) Free. [223

Lord Rutherford of Nelson· a Tribute to New Zealand's Greatest Scientist By Dr. Charles M. Focken. Pp. 19. (Otago: The University.) [223

Australasian Antarctic Expedition, 1911–1914. Scientific Reports Series C· Zoology and Botany. Vol. 1, Part 2: Foraminifera. By Frederick Chapman and Walter James Parr. Pp 190+4 plates. 22*s*. 6*d*. Vol. 10, Part 2. Acanthocephala. By Prof. T. Harvey Johnston and Effie W. Best. Pp. 20. 2*s*. 6*d*. (Sydney: Government Printer.) [233

New Zealand: Department of Scientific and Industrial Research. Meteorological Observations for 1936. Prepared in the Meteorological Office, Wellington Pp 41. (Wellington Government Printer.) [233

The Economics of Sewage Utilization. a Paper read at the 29th Session of the Mysore Engineers' Association, Bangalore, on 17th December, 1937. By Dr. Gilbert J. Fowler. Pp. 18. (Bangalore City: Bangalore Press) [283

Commonwealth of Australia. Fourth Report of the Advisory Council on Nutrition. Pp. 34 (Canberra: Government Printer.) [303

Royal Agricultural Society, Egypt. Bulletin No. 34: A Study of some Aspects of the Fruiting of Cotton. By Dr. M. Aziz Fikry Pp. 44. (Cairo: Royal Agricultural Society.) [44

U S Department of the Interior: Office of Education. Bulletin No 22: List of Publications of the Office of Education, 1910–1936, including those of the former Federal Board for Vocational Education for 1917–1933 Pp. x+158. Project in Research in Universities, Pamphlet No 76: Successful Methods of Teaching English to Bilingual Children in Seattle Public Schools. By Prof Francis F. Powers and Marjorie Hetzler. Pp. vi+17. 10 cents. (Washington Government Printing Office.) [44

Engineering Foundation a Department of United Engineering Trustees, Inc Annual Report, from October 1, 1936, to September 30, 1937. Pp. 59. (New York. Engineering Foundation.) [44

U.S Department of Agriculture. Technical Bulletin No 594: The Chemical Composition of Soils and Colloids of the Norfolk and related Soil Series. By R. S. Holmes, W. E. Hearn and H. G. Byers. Pp. 34+1 plate. 25 cents. Miscellaneous Publication No 280· Bioclimatics; a Science of Life and Climate Relations. By Andrew Delmar Hopkins. Pp. iv+188+1 plate Circular No. 462. Low Temperature as a possible means of Controlling the Cigarette Beetle in Stored Tobacco. By M. C. Swingle. Pp 8. 5 cents. Technical Bulletin No 605: Deterioration of Paper as indicated by Gas Chamber Tests. By T. D. Jarrell, J. M. Hankins and F. B. Veitch. Pp. 22. (Washington: Government Printing Office.) 5 cents. [44

Scientific Publications of the Cleveland Museum of Natural History Vol 8, No. 1: The Dorsal Spine of *Cladoselache*; The Neurocranium and Jaws of *Cladoselache*. By Dr. John Edward Harris. Pp. 12+2 plates (Cleveland, Ohio: Museum of Natural History.) [44

Carnegie Endowment for International Peace. Annual Report for 1937 of the Division of Intercourse and Education. By Nicholas Murray Butler. Pp. 71+11 plates. (New York. Carnegie Endowment for International Peace.) [44

Le mouvement hélicoïdal des photons. Par Charles Léopold Mayer. Pp. 16. (Paris: Fondation pour les Sciences Physico-Chimiques) [44

Bulletin of the Hendry-Connell Research Foundation. No. 3: Cancer Research. Pp. 131. (Kingston, Ont Hendry-Connell Research Foundation.) [44

Dominion of Canada· Department of Transport, Division of Meteorological Services. Canadian Meteorological Memoirs, Vol. 1, No. 3: Relations between Interdiurnal Pressure and Temperature Variations in Troposphere and Stratosphere over North America. By Dr. B Haurwitz and W. E. Turnbull. Pp. 67–92. (Ottawa Government Printer.) [44

Baltische Geodatische Kommission. Sonderveroffentlichung Nr. 7: Messung der Basis Balaschov in Russland im Jahre 1935 Von U. Personen. Pp. 18. (Helsinki· Osakeyhtio Weilin and Goos Aktiebolag.) [44

Department of Education, Baroda State. Lecture Series 1936–37, Lecture No 2 Some Facts relating to Educative Employment. By Capt. J. W. Petavel. Pp. ii+14. (Baroda: State Press) 1 rupee. [44

Mitteilungen der Hamburger Sternwarte in Bergedorf. Band 7, Nr 45. Photometrische Elemente einiger Cephei-Veranderlichen. Von J. Hellerich. Pp. 253–282. (Bergedorf. Verlag der Sternwarte.) [44

Galapagos Observado Fitologicamente. By Prof. Misael Acosta Solis. Pp. 78+16 plates. (Quito Imp. de la Universidad Central.) [44

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Vol. 141 SATURDAY, APRIL 23, 1938 No. 3573

Medical Inventions and Discoveries

THE report of the Medical Research Council for the year 1936–37 recently issued* refers to the present unsatisfactory position in Great Britain of the medical treatment known as chemotherapy, which consists in the administration of chemical compounds synthesized in the laboratory and found to have specific actions on the infective organisms causing particular diseases in man and animals. The discovery and production of chemical compounds of value in this way have, the report states, "depended almost entirely on German science and industry, and still so depend", although the subject has special significance for the British Empire with its immense responsibility in tropical countries. Malaria, for example, still holds the premier place as a cause of premature death and inefficiency in the Empire, and it is estimated that in India alone at least 100,000,000 persons suffer from the disease each year, with a direct financial loss variously estimated at from £23,000,000 to £50,000,000 per annum, the indirect losses being still greater. The report then continues as follows:

> "Were the matter only one of prestige, the situation would be serious enough, but the financial aspect is also of much importance. Foreign firms have built up large organizations and have spent large sums of money to advance this aspect of therapeutics. They naturally, therefore, expect to derive substantial profit from any practical discoveries. Not only do they take out comprehensive patents to cover these chemical agents, but they do not as a rule grant licences for manufacture in this country; in case of war, therefore, the British Empire might be deprived of essential drugs, as in the case of salvarsan compounds in 1914."

The success of Germany in the field of research in chemotherapy has been dependent on a system in which the investigations have been made chiefly in large research establishments maintained by manufacturing firms which have employed hundreds of chemists and have persevered for years before achieving results capable of commercial development. In Great Britain, manufacturing chemists, it is stated in the report, "have not appeared willing to use their resources in this manner", the main interests of the larger firms having been in other directions, while the smaller firms have been either unable or unwilling to undertake research of this kind. The report continues, "in these circumstances, the only possibility of securing that this country took its proper part in the matter, in relation to its imperial responsibilities, was a national scheme supported from public funds." A commencement is therefore being made with such a national scheme supported from public funds, for a sum of £30,000 provided by Parliament has been allocated by the Council "for research in chemotherapy, in the first instance in respect of the cost of the new buildings required", and it is stated that such a scheme would attempt to follow with Government support the general line of action of a great commercial organization taking up this subject of research. Presumably the scheme would be under the control of the Council and, so far as is indicated in the report, would operate without the direct co-operation of industry.

It is not clear on what grounds the Council bases its opinion that in existing circumstances the *only* possibility of securing that Great Britain may take its proper part in the matter is such a national scheme supported from public funds. Presumably one of the grounds is the inference that because, as alleged, manufacturing chemists in this country "have not appeared willing to use their resources [for research] in this manner", they are now and will continue to be unwilling. There is, however, no substantial evidence in the report that the manufacturing chemists either have been or are at present unwilling to use their resources in this manner. On the other hand, evidence from other sources supports the opposite opinion, at least in so far as concerns certain manufacturing chemists, for in 1931 a scheme for the compulsory dedication of patents to the public and their administration by a State department was submitted to the Departmental Committee on the Patents and Designs Acts by a Joint Chemical Committee representing several chemical institutions, and it was stated that the scheme might be regarded as the expression of opinions held in common by most of those concerned in the practice of chemistry in Great Britain. It is clear, therefore, that in 1931 these manufacturing chemists were willing to co-operate, and there is no reason to think that they are less willing to do so to-day ; indeed, there is reason to believe from recent statements in the Press that they are not only willing but even anxious to co-operate.

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* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1936–7. (Cmd. 5671.) Pp. 195+xiv. (London: H.M. Stationery Office, 1938.) 3*s*. net.

There was, however, opposition to the scheme put forward by the Joint Chemical Committee, and the Departmental Committee reported that although no question considered by it had attracted more attention or been the subject of more conflicting evidence, the definite conclusion had been reached that no sufficient case had been made out for any compulsory dedication.

In view of this definite conclusion and of the lack of evidence to support the circumstances on which the Council bases its opinion as to the only possible scheme, it may be pointed out that there are now in operation in other countries at least two quite different schemes in each of which science and industry are co-operating with one another.

The first is a scheme for the voluntary dedication of medical patents, which is in existence both in Canada and in the United States. In Canada, the ownership of the insulin patent was placed in the hands of the University of Toronto, and has since been efficiently administered by that authority, and in many foundations in the United States there have been drawn up rules regulating the conditions under which patents may be dedicated to them. In the United States, during the past few years, there has been a growing recognition on the part of university administrators that only through the proper use of the patent system can the public benefit of certain of the inventions which are made in their laboratories be ensured and the undesirable aspects of patent exploitation avoided. It is felt in that country that mere publication of a scientific paper disclosing an invention does not prevent patenting of the invention by some individual with a hazy fragmentary prior record along the same general lines. The inventions may easily get into unscrupulous hands and the public may be exploited through this unforeseen result of a programme of institutional research. There is, however, no substantial evidence that opinion among medical men and manufacturing chemists in Great Britain would favour the adoption of a scheme for the voluntary dedication of medical patents.

The second scheme in which science and industry are co-operating is that which has already been established in Germany with such satisfactory results to that country and such unsatisfactory and even dangerous results to our own country. According to the report of the Medical Research Council, the discovery and production of compounds of value in chemotherapy have "depended almost entirely on German science and industry, and still so depend", and in the opinion of the Council the difference between the practice in Germany and the practice in Great Britain is that whereas in Germany large research establishments maintained by manufacturing firms have employed hundreds of chemists and have persevered for years before achieving results capable of commercial development, British manufacturing chemists have not appeared willing to use their resources in this way. There is, however, another important difference, produced by the fact that medical men in Great Britain have not readily given their co-operation to test a therapeutic agent that is the subject of proprietary rights. In the evidence submitted by the Medical Research Council to the Departmental Committee on the Patents and Designs Acts it is stated that :

> "There is not there [in Germany] the same feeling against the taking of patents by medical men, and many physicians attached to public hospitals and University Clinics are ready to investigate new remedies on behalf of a commercial patentee, on a footing similar to that of the consulting chemist."

It should be remembered also that manufacturing firms are placed under other serious limitations in respect of medical patents by the law of this country. For example, by Section 38A of the Patents and Designs Acts, 1907–1932, a medical patent must be of defined limited scope and "the Comptroller shall, unless he sees good reason to the contrary, grant to any person applying for the same, a licence" to use the invention; and again, by the Therapeutic Substances Act, 1925, a scheduled therapeutic substance may be manufactured only under licence, and a Joint Advisory Committee consisting of representatives of the Ministry of Health and medical and scientific bodies fixes the standards of purity, strength, etc.

In view of these facts, it is not clear either that the circumstances alleged by the Medical Research Council have a sufficiently firm foundation on which to base its opinion as to the only possible scheme, or that the scheme proposed is the one most likely to attain the desired end. Is it to be seriously contended that a scheme controlled solely by British science without the aid of British industry will be able to displace German science and industry, working in harmony, from the strong position in chemotherapy which they already hold in Great Britain? Would it not be better in making a forward step to try once again to follow the path which has led Germany to success through willing co-operation between science and industry, than to embark on an uncharted course controlled solely by science without the willing co-operation of industry? The immense responsibilities of the British Empire in tropical countries and the dangerous position of Great Britain in the event of war seem to make it imperative that, before any untried plan is proceeded with, every possible effort should be made by all the parties concerned—scientific men, medical men, and manufacturing chemists—to evolve a scheme of the kind which has already brought success to Germany, whereby the willing co-operation of science and industry will rectify our unsatisfactory peace-time position by rendering the country independent of foreign supplies of chemotherapeutic drugs.

Knowledge and World Progress

World Brain

By H. G. Wells. Pp. xvi+130. (London: Methuen and Co., Ltd., 1938.) 3*s*. 6*d*. net.

THIS, the latest of Mr. Wells's books, may well be the latest-but-one before this review appears, so swift is the rush of his ideas, so urgent the message which he has for a civilization clattering blindly towards chaos. Here, as in so much of his work, we have yet another contribution towards that orderly world-scheme so dear to the heart of the ever-young, wise and keenly interested recruit to the ranks of the septuagenarians. The essays collected in the hundred and thirty pages of this slight and engrossing volume comprise a Friday evening discourse delivered at the Royal Institution, a lecture given in America, a contribution to the Encyclopédie Française, the presidential address to Section L of the British Association on "The Informative Content of Education" and a series of appendices evoked by the comments of those sensitive souls ruffled by the more provocative parts of his addresses.

For provocative Mr. Wells is—and long may he remain so! To some he may, now and then, seem to lay more stress on the material than the spiritual factors that have contributed to the making of history. As when he tells us that "in the middle-nineteenth century all Europe thought that the United States must break up into a lawless confusion. The railway, the printing press, saved that." That is a literal truth. But the mind of Abraham Lincoln, a man as great as some of the strutting leaders of a later age are small, was surely the determining factor in the preservation of the Union.

These divagations, however, are but incidental, and in most of these addresses Mr. Wells seldom wanders far from his main theme—the gathering, indexing, digesting and clarifying of the sum total of present knowledge into an ever-changing, ever-growing World Encyclopædia, which shall not only serve the needs of the specialized student, but also shall give to the citizen of the nation of to-day something of the factual and critical knowledge necessary to make easy his progress towards citizenship of that world-federation to which he is, paradoxically enough, stumbling through a phase of intensified nationalism.

There never was a time in the history of mankind when it was more necessary that this ordered knowledge should be at the beck and call of all of us—when the elements of success are in the hands of those who can combine an emotional drive towards the light with an intellectual appreciation of the difference between the true and the false dawn.

There's the rub. The two elements must be present and, whereas the emotions are easily, too easily, aroused, it is the hardest task in the world to persuade men to think objectively. In his so-called reasoning on matters directly concerning his relations with his fellows, man for the most part is content to allow a series of fleeting images to pass before his mind. He stamps down those he dislikes, seizes on those that appeal to him and terms the process "coming to a reasoned judgment". The result may be seen in a conversation overheard just after the Austrian coup—a conversation which is, as near as may be, reported *literatim* :

A : "Thank heaven we'd no League of Nations functioning this week-end—we'd have been in the middle of a first-class war now."

B : "Don't you think it would be more accurate to say that if we'd had a League of Nations this situation would never have arisen ?"

A : "Not a bit of it. Anything like the League means that England's left to hold the baby—as we were when Wilson founded his blessed League, and then cleared out and let us down."

B : "Do you really feel that that's an accurate account of what Wilson did ?"

A : "Near enough. Anyway, we disarmed to the bone, to set a good example—and much notice anyone else took of us."

B : "Have you ever drawn curves of arms expenditure year by year to see if there was a dip in British expenditure that wasn't present in that of other countries ?"

A : "No—and I don't intend to. And if there wasn't a dip it was because money was spent in wages that should have been spent on ships."

There was more to the same tune.

And now remember that *A* is a well-to-do and competent man of business, multiply him by some millions, think of his like in other countries, and we see only too clearly that here is an immense mass of material not likely to be influenced in the slightest measure by the content of any World-Encyclopædia.

Not that there is need for despair on this account. Mr. Wells, himself perennially youthful, makes his appeal to youth and to those whose minds have not acquired an incurable wry-neck in the course of the process called education. Every year saved from war is a year gained to this end of education for world-citizenship. But what of the particulars of that education—how, in Rutherford's phrase, to "get on with it" ? In these brilliant and discursive addresses, Mr. Wells has sketched a general plan and has, very reasonably, not condescended to detail. Schemes may be over-elaborated and static on that account. In his own wise words, "If a thing is really to live it should grow, rather than be made." But a start must be made somewhere and somewhen. Is it possible, *now*, to provide John Smith at least with pointers that will direct him to objective, critical and unbiased information concerning—well, concerning a thousand-and-one matters about which he should be conversant—the causes of the world war, the reasons for the great depression, the tragic story of these wasted twenty years, the meaning of money, credit, world-trade, Bolshevism, Communism, Fascism—how many of those whose votes may decide the fate of the world have the beginnings of knowledge of topics bandied about on all political platforms ? If Mr. Wells would continue the good work he has initiated in the volume under review, he would add very sensibly to the heavy debt which the civilized world already owes him.

ALLAN FERGUSON.

Pliny Revived

The Mind of the Ancient World: a Consideration of Pliny's Natural History. By H. N. Wethered. Pp. xv + 302. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 12*s*. 6*d*. net.

THIS book is a good example of a process which will become more and more necessary as time goes on. There are masses of old literature, full of interest, much read and very important in their day, which it is impossible for us now to read in their entirety, but which it would be a grave loss to let die. Pliny was one of the finest characters of the ancient world, highly cultivated, very busy and useful in public service under his friend the Emperor Vespasian until A.D. 79, when he was suffocated in the eruption of Vesuvius. He gave the greater part of his too short life to incessant study and compiling his "Natural History", or "Survey of Nature", which was an encyclopædia of knowledge and legend about everything in the world of which men talked or had written in his time. This great book, which Humboldt thought surpassed in the richness of its contents any other ancient work, was translated at the beginning of the seventeenth century into delightful Elizabethan English, by Philemon Holland, a few years before Sir Walter Raleigh published his "History of the World".

Both books, famous and much enjoyed in their day, are now almost entirely neglected, and Mr. Wethered has had the happy idea of extracting the gems of Philemon Holland and connecting them by a very well-informed and sufficiently critical running commentary of his own, which gives us all the best of Pliny without allowing us either completely to discredit him or to accept all his amusing fables as gospel truth. The result is a very useful and an extremely interesting book. One's only criticism can be of its main title, for it cannot be said that Pliny's work adequately represents "The Mind of the Ancient World". He was not a serious thinker, but a compiler of everything, writing or gossip, which he came across. A book in which we find none of the philosophy or mathematics of the Greeks cannot properly be said to describe "the mind of the ancient world".

But for what it is—a gossiping encyclopædia of ancient lore—there is nothing comparable. The book is the source of most of the legends and best-known stories of Greece and Rome. Here is Cleopatra's pearl drunk off in a cup of "sharp vinegar" and Polycrates' sardonyx ring brought back to him in the body of a "mighty fish", and the dolphins that waited for the little boys and carried them on their backs and died for grief when they lost them; and a host of others. But it would be a great mistake to dismiss the general picture which Pliny gives us of the ancient world on account of his delightful credulity for interesting stories. Most of them are told just as good stories commonly believed and, though he is not a careful scientific observer, he sometimes intimates a want of credence for certain things. For the bulk of what he described he is as reliable as Herodotus and, of course, far more detailed. Herodotus, the father of history, has a story to tell and the personal and social details are incidental. Pliny sets out to paint a picture of the world and of men as he saw them and is the father of encyclopædists, even, one might say, of 'descriptive sociologists'. We gain from him a realization of the elaborate civilization and luxury of his times which we should not have acquired elsewhere; and he adds to his description a very proper moral indignation at much of what he describes. "What folly and madness in the devil's names is this", is the sort of exclamation which keeps falling from his lips when he describes the doings and the waste of men like Nero, who had just passed away.

Pliny is specially rich and valuable on two sides; one, the full description of plants and vegetables and the use made of them; the other, the work of painters, sculptors and artificers generally. In the former case, one is amazed at the wide and often very intelligent use made of herbs and vegetables by men of all classes. The lettuce was in as much repute as with us, and the cabbage much more so. Eighty-seven different remedies were attributed to the cabbage and scores of others to garlic, onions, asparagus and radish. But it is probably as the source of material information as to painters, sculptors and artificers of all sorts that Pliny has enlightened us most. The Seven Wonders of the World, and many other things still more wonderful as craftsmanship, are described in full and fascinating detail. The sorts of marble and of gems or colours stand out in vivid relief. He does not philosophize about the art but pictures the artists' work and gives the personal anecdotes about them that had been handed down.

On two other sides, if not philosophical, Pliny yet leaves a strong moral impression. One relates to the feelings of men generally in his time, the other to his own religious leanings. There was undoubtedly a much stronger sense for beauty than among ourselves, even in the case of men like Nero who were stained with every crime. Nero was passionately fond of certain gems and colours. Beautiful buildings, statues and decorations aroused far keener admiration in him and all of his time than they do with us. For himself, Pliny leaves us one or two immortal sayings, on the unity of Nature and the nature of the divine. He was no atheist, but he had no moral use for the mass of gods and goddesses of ancient mythology. "These beliefs, I say, are mere fooleries, little better than childish toys. Whereas in very truth a god unto a man is he that helps a man; and this is the true and direct pathway to everlasting glory. (Deus est mortali juvare mortalem, et haec ad aeternam gloriam via.)"

F. S. Marvin.

Animal Collecting

Animal Treasure

By Ivan T. Sanderson. Pp. 325. (London: Macmillan and Co., Ltd., 1937.) 12*s.* 6*d.* net.

"Animal Treasure" is not a chronological narrative of a sojourn in the wilderness, although naturally some regard has to be paid to the lapse of time. It is a most readable and lively account of some of the things seen and heard by the author and his two companions during a stay of about eleven months in the forest of the Cameroons and for the most part at a distance of about 250 miles from the coast.

There are many descriptions of the living and frequently unalarmed animals. One must use the latter qualification, since, for example, the lemur on p. 127 was, if not frightened, very angry, and the entire local mammalian fauna, including all the primates, on pp. 128–131 was suffering from the most diverse and undignified emotions. That Mr. Sanderson is as accomplished with his pencil as his pen is shown by the illustrations, the majority of which are a pleasure to the eye.

Through the liveliness of the text there is allowed to appear hints of the industry by which this expedition brought together a very large and varied collection of the smaller mammals, of reptiles and amphibians and of crustaceans and arachnids.

Mr. Sanderson was evidently on the best of terms with the native population and found them very valuable collectors and preparators. It may be permitted to remark that the taste for chitterlings is not a peculiarity of the Negro race (cf. p. 185). These delicacies are appreciated in the Argentine and the name has been known in English since 1280.

It is rather surprising to find a person with the sophistication which Mr. Sanderson at least suggests that he possesses allowing himself the naivety of attacks on Christians and Europeans. One cannot help feeling that but for these despised creatures the author's experiences from the time of his landing might have been quite different; it is surely a little ungrateful. But it is verging on impropriety for a professing man of science to regard any animal with the emotions Mr. Sanderson seems to feel for spiders, shrews and hawks. It is not the duty of a collector to kill and waste: the persistent killing of the hawks can have no excuse.

Mr. Sanderson, as a schoolboy, was disappointed in the old methods of collecting, but he does not clearly describe a new one. His own do not appear to have been particularly original, and it may reasonably be concluded that they were those which are in general use.

It may well be that the publishers have exceeded the author's intention by describing the book as "among the serious works of science" on the back of the jacket. This it certainly is not. Some of the statements have been seriously challenged by Mr. Arthur Loveridge in the *Scientific Monthly* of January 1938, and even if he is refuted, the fact remains that the zoological parts are so mixed up with general narrative and discourse as entirely to avert the idea of seriousness, and there is not even an index to enable the grain to be separated.

It will be interesting to see what new facts appear from Mr. Sanderson's field note-books in the reports on the collection which will doubtless be published.

Although there may be species of such rarity that examples of them would be welcome even if almost devoid of data, the idea of a new sort of collecting is an attractive one and may be considered in a little detail. A moment's consideration will show that what is really wanted is a strong effort in the field to fill in the gaps not only in the dead series in museums but also in our knowledge of the animal "in his habit as he lived". It is, of course, an ideal probably unattainable to expect that a complete picture can be made for every species, but if the field worker could find out beforehand what forms should be the objects of special concentration, much might be done. What is wanted is not only a long series of specimens of both sexes and all ages from which it can be shown what occurs in the way of growth and change and individual variation: with this should be coupled descriptions of the animal in life, even, if it is soft bodied, including its shape and of part at least of its physiology, not quite in the textbook meaning but with regard to the two survival functions, that of the individual—feeding and protection from destruction, and that of the race—method, time and place of breeding. With these might be linked observations on behaviour; not the reaction of the animal to interference, which is easily seen in the laboratory, but the manner in which it goes about its business and reacts to the stimuli provided by its environment. From such knowledge one may hope, for example, to be able to recognize apparent eccentricities of distribution in time or space as normal features of the routine of species. Further, is it inconceivable that some of the obscure problems of phylogeny might be illuminated by a study of the living creature? If descent show itself in hard or soft tissues, is it too much to expect that it will also be exhibited in the way in which they function?

It is possible that data exist for such 'descriptions' but they are seldom met, although in ornithology and entomology the tendency towards them exists. Specialists innumerable are constantly adding to the existing vast mass of knowledge, but they too seldom unite with a common goal in mind.

Some kind of intelligence, in the military sense of the word, is needed. It should be the function of a section of zoologists to correlate the information produced by the specialists. Although there may be a million species known, so that the first view of the task is appalling, the scientific spirit does not shrink on account of the magnitude of what lies before it, if the thing has to be done. In darker moments it seems that only by a union with the work of the field naturalist can zoology be saved from becoming a synonym for necrology, if one may introduce a new meaning for that word.

J. E. Hamilton.

Social Anthropology of North American Tribes:

Essays in Social Organization, Law and Religion. Presented to Prof. A. R. Radcliffe-Brown upon the occasion of his accepting the Chair of Social Anthropology at Oxford University. By Fred Eggan, William H. Gilbert, jun., J. Gilbert McAllister, Philleo Nash, Morris E. Opler, John H. Provinse, Sol Tax. Fred Eggan, editor. With an Introduction by Robert Redfield and a Bibliography of Prof. Radcliffe-Brown by Ina Corinne Brown. Pp. xvii + 456. (Chicago: University of Chicago Press; London: Cambridge University Press, 1937.) 13*s*. 6*d*. net.

THE announcement of the departure of Prof. A. R. Radcliffe-Brown from the University of Chicago to become the first professor of social anthropology at Oxford inspired certain of his pupils to produce this volume, commemorating his work for the study of social anthropology in the United States during the past five years.

As his colleague Dr. Robert Bedfield reminds us in an introductory appreciation, Prof. Radcliffe-Brown's theories of the method of social anthropology have become something of a storm centre in the United States. They aim at a scientific sociological methodology on the lines laid down in his presidential address to the Anthropological Section of the British Association at its London meeting, in contradistinction to the 'historical' view which has grown out of methods followed by Franz Boas, and the individualistic and psychological methods of E. Sapir and Margaret Mead. Hence this volume is something of both a demonstration and a manifesto. It certainly contains some interesting experiments in method which form a striking contrast to those familiar in the writings of American social anthropologists, and, furthermore, had already been applied to some of the material reviewed here.

Of the essays included in the volume—nine in all—perhaps the most instructive from the point of view of the student of method is that on "Some Problems of Social Organization" by Dr. Sol Tax. The author, after setting out some of the more general questions, for which it is the aim of social anthropology to provide a solution, attacks the kinship terminology of certain Indian tribes of California, who follow the so-called "Omaha" and "Crow" systems respectively. It is interesting to note, however, that in arriving at his conclusions as to the place of these systems as determinants in organization and behaviour, he felt constrained to depart so far from his teachers' strictly sociological concepts as to admit psychological factors.

Glossary of Physics

Compiled and edited by Prof. LeRoy D. Weld, with the collaboration of a large group of Consultant Physicists. Pp. x + 255. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 15*s*.

THE rapid development of physics during recent years has, of necessity, required a very large addition to its vocabulary. In reading the literature of a particular branch of the subject in which one has not specialized, one comes across unfamiliar terms; in such instances to have an accurate glossary to hand is of the greatest use. Prof. Weld and his collaborators deserve the warmest thanks for providing such a glossary. We can well believe that it was "impracticable to make sure of complete agreement among the various persons concerned on each of the many definitions and statements"; but although perhaps a few experts may not favour a definition here and there, the vast majority of physicists and those concerned with its manifold applications will find this an indispensable volume. A pleasing feature of the book is the inclusion of references in connexion with most of the terms, which enable the reader to gain supplementary information.

The book is well arranged and produced, and of convenient size; we hope that the demand for it will justify the issue of future editions at a price that the average physicist is more likely to be able to afford.

H. R. L.

The Theory of Continuous Structures and Arches

By Prof. Charles M. Spofford. Pp. xiii + 267 + 12 plates. (New York and London: McGraw-Hill Book Co. Inc., 1937.) 21*s*.

THE first chapter of this book deals with continuous structures, and the last is devoted to rigid frames. Apart from these, the text is mainly concerned with arch types, and the applications of the methods of arch analysis to bridge forms. The usual lines of theory are developed effectively. Applications are made with thoroughness and with an explanatory power and detail of evaluation that demonstrate a full knowledge of the problems of design of this class. Two-hinged arches of parabola and segmental types receive very full attention and the treatment of fixed arches is adequate in scope. There is an interesting presentation of the results of photo-electric researches on rigid frame forms and some instructive plates of bridge construction.

Although the treatment is somewhat less wide in scope than the title, the book is well planned and developed for advanced students of bridge theory and design.

Grundriss der allgemeinen Zoologie

Von Prof. Dr. Alfred Kuhn. Fünfte, verbesserte und vermehrte Auflage. Pp. ix + 272. (Leipzig: Georg Thieme, 1936.) 9.80 gold marks.

FORMER editions of this excellent text-book, with its comprehensive and well-balanced contents and clear illustrations, have been favourably noticed in Nature (112, 200; 1923: 129, 925; 1932). It need only be added that many changes in the text show that the fifth edition has been brought up to date. In some places, precision has been given to the already succinct descriptions of the characters of phyla, the section on development has been modified to meet modern views, and a short chapter upon the ecological distribution of animals includes a discussion upon the relationship of species in parasitism and symbiosis. We think it may still be said that there is no English book quite like this introduction in the success with which it lays, in so limited a space, a broad foundation in the morphology, physiology and development of the animal kingdom.

Gliding and Soaring Flight*

By Prof. D. Brunt

THE early history of gliding is the early history of flying in heavier-than-air machines of any kind. The machine was projected into the air either from a hill-top or from flat ground, and came down slowly while moving forward. Lilienthal described in his book on "Bird Flight as the Basis for Aviation" how in some of his earlier experiments in gliding over slopes the machine actually soared, or gained in height, being carried upward by the air current flowing up the slope. But the early pioneers soon became absorbed in the problem of developing a power unit, and the development of the petrol engine, by making the aeroplane possible, diverted attention from the possibilities of pure gliding. In Germany gliding was taken up as a sport soon after the Great War, and in 1922 the achievement of Martens in soaring for an hour gave a new impetus to the movement. The *Daily Mail* organized a gliding meeting at Itford Hill in 1922; but this failed to produce any permanent interest in gliding in England. It was only at the end of 1929, after the Germans had shown that the glider need not be bound to a hill-slope, but could soar under and into clouds, and could ride the front of an advancing storm, that interest was at last aroused in Great Britain, and that there came into existence a real British gliding movement. After undergoing the usual pangs of adolescence, this movement is now approaching the adult stage.

There has not been any very revolutionary change in the design of sailplanes in recent years, and it may be said that in appearance the modern sailplane resembles the power monoplane, without an engine, but with a more closely streamlined form. Differences occur in the wing-structures used, the strutted wing being generally lighter than the cantilever wing. Perhaps the most important change made in recent years has been in the direction of increasing the strength of the structure, in order to make it capable of standing the strains to which it may be subjected during flight in clouds. The stoutness of the fuselage is dictated, not by the demands of flight, but by the necessity of the structure being able to stand up to the strain of handling when on the ground.

In the early stages of training, the machine is launched by means of an elastic catapult, the ends being drawn by teams of men. Alternatively, the human power may be replaced by a horse or motor-car. Another method is to attach a cable to the front of the machine, and to wind it rapidly on a winch, thereby dragging the machine into the air, while another method is to tow the machine into the air behind an aeroplane. Sailplanes can fly at very low speeds without stalling, and consequently can be landed with safety in fairly small fields.

The modern sailplane has a sinking speed in still air of about 2–3 ft. per second, and so will soar in any vertical current the vertical component of which exceeds this modest value. The pilot of a soaring sailplane is in the position of an old lady trying to go down the up-escalator at a tube station, the escalator carrying her up faster than she can descend the steps.

For our present purpose we can define the problem of soaring flight as the problem of finding upward air currents of the necessary magnitude, that is, exceeding the sinking speed of the sailplane in still air, usually 2–3 ft. per second. For practical purposes, we can say that there are three classes of ascending currents in the atmosphere. First, when the wind blows against rising ground, it follows the contours of the ground, and if the upward component of the wind is sufficiently strong, soaring will be possible over the sloping ground. Secondly, when the air is unstable, convection currents may attain sufficient speed to make soaring possible. Thirdly, at the cold front in a depression, where a wedge of cold air pushes under a warm current, there is often sufficiently rapid ascent of the warm air to make soaring possible. Sometimes thunderstorms occur at cold fronts, and long flights have been achieved in the ascending currents in thunderstorms.

When the wind blows up the side of a hill the horizontal flow of the air is disturbed up to a height of about three times the height of the hill. A sailplane launched into the ascending current from the top of the hill can, by circling in the ascending current, attain a considerable height. If the pilot's aim is to make a flight of long duration, he can go to and fro above the ridge of the hill, and the duration of his flight is limited only by the duration of the wind in direction and strength, the pilot's physical endurance, or possibly the dangers of darkness. During the 1937 international competitions, two members of the English team, Messrs. Fox and Murray, flying the Falcon III two-seater, made a duration flight of 9 hours 48 minutes.

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*Friday evening discourse delivered at the Royal Institution on March 5.

Long-distance flights cannot be made by hill soaring alone, but even when long-distance flights are attempted, they usually start with a gain of height over a slope, and on the way across country any slopes facing into the wind direction may be used to maintain or increase height, while the pilot waits for other types of ascending currents to turn up.

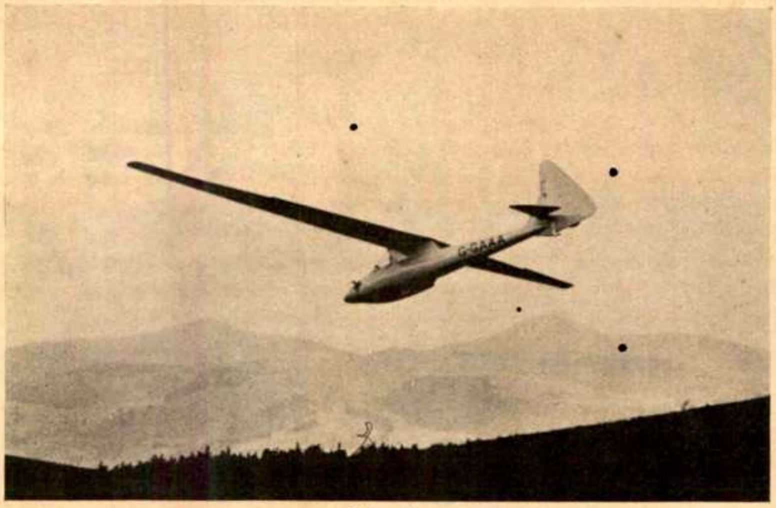

Fig. 2.
THE SAILPLANE *Hjordis* WHICH FLEW 104 MILES ON JULY 5, 1936.

The second type of ascending current, the convection current, occurs when the air is unstable, that is, top-heavy. Instability in the atmosphere requires a rate of decrease of temperature with height in excess of 5·6° F. per 1,000 ft. When this limit is surpassed, as is frequently the case when the sun is shining, and particularly on bright afternoons, convection currents (or 'thermals', to give them the name usually applied by the gliding men) are set up. Every convection current which carries warm air upward must be compensated by a descent of air somewhere. In other words, convection currents must possess some kind of structure.

In the laboratory it is easy to set up convection currents in a liquid or in a gas. The simplest illustration is afforded by pouring cheap gold paint into a shallow tray such as a mince-pie tray. The evaporation of the volatile liquid cools the upper layers, and so makes the liquid top-heavy. Looked at from above, the liquid is seen to be divided into a number of small cells, in each of which the liquid ascends at the centre, flows outward over the upper boundary, and descends at the margin of the cell. Similar effects can be readily produced in air. A convenient chamber for such experiments with air has a metal base, which can be heated electrically from below, and a glass top through which the motion can be observed, the motion being made visible by tobacco smoke. Such experiments may be regarded as reproducing conditions similar to those in the atmosphere when there is no wind. To simulate the effects of wind varying with height, the top glass plate must be capable of being moved across the chamber, dragging the air with it. It is then found that, if the instability is great, the bottom of the chamber being considerably warmer than the top, a slow motion of the top plate only distorts the shape of the cells obtained previously. If the bottom plate is not much warmer than the top plate, a slow motion of the top plate gives long rolls at right angles to the direction of motion of the plate. Such rolls are called transverse rolls. When the top plate is moved rapidly, the chamber is filled with long rolls in the direction of motion of the plate, and these are known as longitudinal rolls. The rolls, whether longitudinal or transverse, are in pairs, the two rolls in a pair

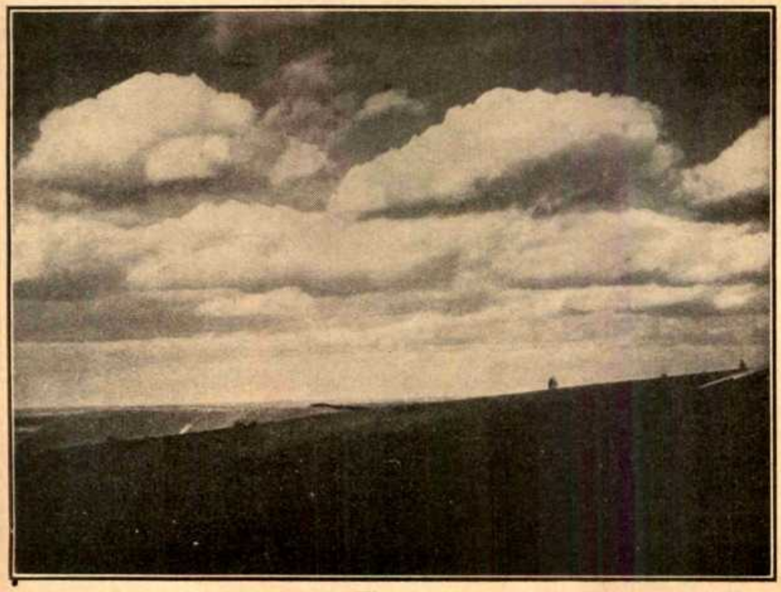

Fig. 1.
CUMULUS CLOUD CONSISTING OF A SERIES OF CUMULI JOINED UP IN ROWS.

spinning in opposite directions. Thus, when in the atmosphere conditions are unstable, the rolls of cloud formed by the upward motion of damp air will be at right angles to the wind if the wind speed varies only slowly with height, but along the wind direction if the wind speed varies rapidly with height. When damp air rises through a sufficient range of height, it produces cloud, and the cloud may be taken as an indication of the existence of the ascending current. If the wind does not vary with height, or if there is a calm, the clouds will usually be cumulus clouds, each forming the cap of an ascending current. When the wind increases rapidly with height, the cumulus clouds will form long irregular rolls (Fig. 1). Under any of these clouds the soaring pilot can find an ascending current, and under the long streaks of cumulus he can go the whole length of the cloud almost as readily as a car can go along a road. For this reason, such long cumulus clouds are generally known as 'cloud streets'.

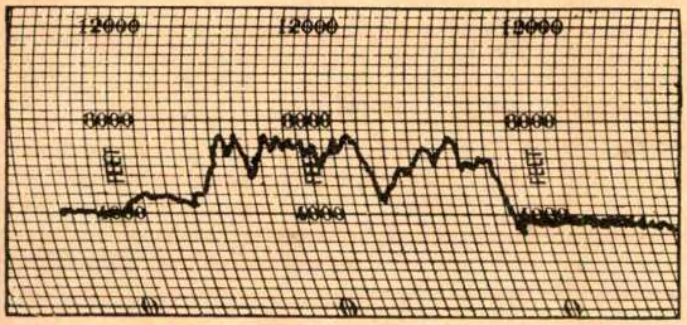

Fig. 3.

BAROGRAPH RECORD OF MR. PHILIP WILLS'S FLIGHT. THE FIGURES SHOW THE SCALE, NOT THE ACTUAL HEIGHT. THE LEVEL TRACINGS AT EITHER END WERE MADE BEFORE AND AFTER THE FLIGHT.

When the air is too dry to form cloud readily, it is not so easy for the soaring pilot to find the ascending currents. He then has to consider what types of ground are most readily heated by the sun, since it will be over the hottest ground that the ascending currents will form. Now it is possible to arrange types of ground in order of readiness with which they will heat up in the sun, as follows: sand, light soil over chalk, light loam, heavy loam, clay, water-logged soil, water. Any type of soil will heat up more readily when dry than when wet, more readily when bare than when grass-covered. The roofs of houses are heated more than grass fields, and the air trapped between the stalks of corn will be heated more than the freer air over a meadow. The air in woods will remain warm longer than air outside them, when the sun is low. Thus on a sunny day the pilot will look for thermals over villages, over large buildings, over any sandy or chalky patch surrounded by heavier soil, over cornfields surrounded by meadows. He will sometimes find thermals over land near the edge of any large body of water, and an asphalt road, which can heat up in the sun to as much as 25° F. warmer than surrounding fields, will very readily become a source of thermals when the sun shines on it. In the evening, thick woods on the side of a hill will produce thermals by the release of the warm air trapped within them during the day. Then the pilot will in the course of time find that there are certain spots in the neighbourhood of his usual soaring ground at which thermals are frequently formed.

Thus even in the absence of clouds, the sailplane pilot has certain principles to guide him. But, as Kronfeld once stated in a lecture at Darmstadt, the soaring pilot must fly with his head. By so doing he finds the thermal he needs. When once he gets into a thermal he can circle round in it until he has gained as much height as possible, during which time he will drift down with the wind. Alternatively, he can fly fast when he finds no ascending current, and slow down the moment he finds himself ascending, so as to gain as much height as possible in the ascending current.

As an example of what can be achieved, first consider that flight by Mr. Philip Wills on July 5, 1936, which holds the British distance record of 104 miles [see p. 745]. This flight was made in the sailplane *Hjordis* illustrated in Fig. 2. During the afternoon the sky showed scattered clouds, with short cloud streets here and there, a mile or two long and in series staggered relative to each other. The barograph chart (Fig. 3) shows how the pilot had to struggle to maintain height. The cloud base was very constant, at a height of about 3,600 ft., and so the pilot could never afford to lose much height. The lowest point on the chart, showing a height of about 400 ft. above the height of launch at Dunstable, and a height of about 800 ft. above the ground then immediately below, appeared to make a landing imminent, but at the critical moment a slight lift was found, and in 15 minutes the sailplane had gained 2,000 ft. This is an example of a flight made by circling in thermals, and staying in them as long as height was being gained.

The weather chart on that day showed no special indication that convection would be unusually active. There appear to be relatively few days on which it would be impossible for a sailplane to make a flight, if once it had achieved sufficient height to be able to wait for thermals to turn up. Distance flights are rarer than they need be in England because most of the soaring sites from which a start can be made have their soaring slopes facing westward into the prevailing wind, and so a start cannot be readily made when the wind is not westerly. Longer flights could frequently be achieved if the start were made by aero-towing.

The alternative to circling in thermals, variation of speed so as to go slowly in thermals, and fast when out of them, is exemplified by the flight from Berlin to Kiel, carried out by Ludwig Rotter on August 12, 1936. Rotter's sailplane, the *Nemere*, which has a sinking speed in still air of only 2 ft. per second, can fly at 87 miles per hour. During nearly the whole of the flight, the speed was maintained at 75–87 m.p.h., being reduced to 37 m.p.h. when flying through thermals. It was only in the later stages of the flight that the pilot did any circling in thermals. There was little cloud in the sky, but Rotter's barograph record shows that he was never in much danger of having to land from the time he was launched by aeroplane tow at a height of 1565 ft. The distance achieved was 203 miles, and the landing point was 138 miles off the direct line of the wind from Berlin. This flight illustrates the ability of a sailplane to travel across wind. Within the limits allowed by the strength of the machine, a sailplane can travel at any speed by gliding downward at a sufficiently steep angle. Thus by sacrificing height it can even travel against the wind, but it is not possible to achieve any considerable distance against the wind unless ascending currents are frequent and vigorous.

During a flight in South Africa, Mr. Philip Wills found that at times the convection currents were astonishingly vigorous, on one flight a height of 5400 ft. being gained in less than seven minutes. Wills has described how he shared thermals with the vultures, who treated him as one of themselves, flying in formation with him. It appears that the vultures partition the ground, each bird taking a territory of about a half-mile square, and that their existence is devoted to the search for two things, ascending currents, and food on the ground.

There remains to be discussed the third type of ascending current in the atmosphere, at the cold front in a depression. The Norwegian scheme of the anatomy of a depression shows on the weather chart a warm sector, separated from the cold air in the rear of the depression by a line which is known as the 'cold front'. This line is simply the intersection with the earth's surface of the upper boundary of the cold air, which lies in the form of a wedge with its nose some distance above the ground. The cold air pushes under the warm air, and forces it to rise over the nose, and, in some depressions at least, some of the warm air becomes unstable, so that it then rises freely to great heights, often giving a cloud which extends as high as 20,000 ft. The ascending current is often sufficiently vigorous to lift a sailplane to great heights, and once a sailplane has got into this current, it can fly along the direction of the front while being carried along with the front in its drift across country. Some remarkable flights have been achieved in this way.

We may note in passing that the fact that gliding is possible at a cold front, at heights of many thousands of feet, throws some light on the meteorology of the cold front. The slope of the upper boundary of the cold air averages about 1 in 50, and since we may assume that the ascending current must mount at a rate of at least 5 ft. per second if a sailplane is to gain height at a reasonable rate, it follows that if the ascending air were merely flowing up the slope of the upper boundary of the cold air, it would have a speed of 250 ft. per second, or about 166 m.p.h. This is far in excess of the winds in which cold front flights have been carried out, and so we may conclude that the ascending currents in which the flights were made were not due to ascent up the slope of the wedge. An examination of upper air temperatures measured just in advance of the cold front has shown that in some depressions the air is in such a state that if pushed upward through a relatively small distance, it will then rise freely.

When a sailplane pilot soars into the ascending currents below cumulus clouds, or near a cold front, he does not always find it easy to go just where he wishes. He is frequently drawn into the cloud, whether he wishes to enter it or not. Inside a cloud the air currents are frequently very irregular and violent, and the machine needs to be stoutly built if it is to stand this rough treatment. Further, the machine must then be piloted by the use of instruments which show any deviation from the horizontal, otherwise there is a risk of its coming out of the cloud in a nose-dive, or even upside down.

During the 1937 international competitions in Germany an English pilot, Flight Lieut. Watt, achieved a gain of height of 8,000 ft. in a cloud, taking about one and a half hours to do so. This is probably the best achievement in cloud flying which stands to the credit of a British sailplane pilot. Cloud flying has for some years been part of the normal advanced training of German pilots, but in Great Britain it is a recent development.

In Great Britain, gliding and soaring flight is purely a sport, while in Germany and Poland it is part of the normal early training of the power-plane pilot. In the latter countries, gliding and soaring flight is highly organized. It is perhaps invidious to make a direct comparison between the achievements of British and Continental sailplane pilots. The longer period during which gliding has been organized in Germany and other Continental countries, added to the fact that far stronger financial support is given by the Government in these countries than in Great Britain, makes a direct comparison at the present time a little unfair to British gliding. A comparison of distances achieved is particularly misleading, since Great Britain is, after all, a small country. For example, starting from Dunstable with a westerly or south-westerly wind, it is impossible to outdistance Wills's record flight of 104 miles by more than a few miles at most. At the international competitions last year, out of 297 launches for distance flights forty flights exceeded 100 miles; on the first day of the competitions three competitors flew from the Wasserkuppe to Hamburg, a distance of 351 kilometres (218 miles). Again, at the Polish National Competitions in 1937, the distance flights *averaged* more than 60 miles, the longest flight being nearly 200 miles. These competitions were held in the flat country in the north-west of Poland, in order to test the possibilities of soaring in flat country with launching by aero-towing up to heights of 1600–2000 ft.

The world's distance record for cross-country soaring is held by a Russian pilot, Rastorguyev, who set up three new records consecutively, of 335, 374 and 405 miles, all made during May 1937.

Enough has been said to show that long-distance flights can be made in sailplanes without serious difficulty. Gliding is a safe and healthy sport, and forms a useful preparation for training in power-plane flying. It also offers a means of adding to our knowledge of the processes of convection in the atmosphere, the glider being the only instrument which can be used for a thorough investigation of convection currents. While this may not help in the problem of forecasting to-morrow's weather, it is difficult to believe that increased knowledge will not eventually lead to increased wisdom.

Science, Logic and Philosophy*

By Dr. Harold Jeffreys, F.R.S.

SO long as an idealist confines himself to the description of sensations and to the construction of his ideal world, he can dispense with the theory of probability, but at the cost of having to reconstruct his world with every observation that does not happen to fit his laws exactly. An idealist that does not accept the theory of probability could expect the sun to rise in the west to-morrow, and nobody believing otherwise could make the slightest contact with him such as could alter his opinion. But he has no basis for inferring new sensations without it, because an infinite number of laws can always be made to fit any finite number of data. Without some rule for selecting the most suitable laws there is no reason to prefer any one prediction to any other, whether one is an idealist or a realist.

The naive realist is in an even worse position, because his strict causality leaves him with no margin of uncertainty at all; any random variation must either lead to a complete reconstruction of the laws, to a causal theory to account for the random variation itself, or to abandonment of science altogether. The first and third alternatives are seldom adopted; and the second merely points to some hypothetical causes as explanation—which is no explanation at all (1, pp. 244–248).

I conclude that naive realism as a scientific philosophy is simply wrong because it will not work in practice. It requires that we should know everything before we can say anything. Idealism and critical realism will work; the latter demands the notion of probability in any case; idealism also requires it if any inferences beyond the original data are to be made. Accepting the theory of probability, we can test the need to introduce any new parameter by comparison with the observations. The theory therefore gives an account of the actual process of successive approximation, the outstanding variation at any stage being taken as random until there is evidence to the contrary. This variation is as essential a part of the law as the systematic part. Thus we have the statement of Ockham's razor, in the form: Variation is to be taken as random until the contrary is shown[2]. This is the form needed for scientific purposes*.

The term 'unobservable', discussed in Prof. Dingle's recent article[3], is itself a legacy from naive realism. An observation, strictly, is only a sensation. Nobody means that we should reject everything but sensations. But as soon as we go beyond sensation we are making inferences. When we say that we observe an object we mean that we have, or have had, a series of sensations that are co-ordinated by imagining or postulating an object with assigned properties. The acceptance of a concept with its properties depends on the verification of the inferences that it leads to; that is, it is required that our sensations with it would be different from those without it. Hence the verifiable content of the hypothesis reduces simply to one or more new parameters in a law. This is dealt with completely by the theory of probability, and for purposes of inference nothing more is needed than the law itself. If we restrict ourselves to the inference of future sensations, the concept has done its work and serves no other purpose. This would be a possible idealist attitude. If we are realists and think that our concepts have something to do with an observable world (subject to the critical realist's willingness to change his mind if necessary) we may consider the law as a justification of the reality of the concept. But observability of a concept can mean nothing but the statement that the new parameters suggested by it are significantly different from those without it. Thus the theory of probability takes the rejection of unobservables in its stride. It gives an answer to the question whether any parameter is more probably present than not, given the actual data. To consider further data that we have not is mere waste of time. We need not say that so-and-so *must be unobservable*; we say that in fact, with the data at present at our disposal, it *is unobserved*, and that if we try to take it into account we shall probably lose accuracy.

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*Continued from p. 676.

* It incidentally solves the problem of "scientific caution" Everybody agrees about the need for caution, but people differ about what caution means. Granting the possibility of inference from experience in any circumstances at all, we must begin with the hypothesis of randomness and test successive possible modifications of it. It is sometimes said that it is dangerous to apply a law far beyond the original data, but that is the best possible way to find out whether any modification is needed.

We now come to the alleged use of the principle of the rejection of unobservables in relativity and in quantum theory. Relativity (up to 1920 or so, at any rate) did not involve any new parameters; the velocity of light, the constant of gravitation, the mass of the sun and so on were all required by previous theories. It made changes in the laws but left them expressed in terms of the same parameters. The reason for abandoning the old theory was not that it involved unobservables such as absolute velocity or simultaneity; it was that this theory made positive predictions that turned out to be in disagreement with observation. The rejection of absolute velocity was not *a priori*, whatever later writers may have maintained; what was done in the special theory was to alter the laws of measurement and light so that they would agree with observation. The general theory, in its original form, was obtained by a natural analogy with Newtonian dynamics. The coefficients g_{ij} were seen to play the part of the Newtonian potential U. Far from matter all second derivatives of the latter vanish; near to matter the contracted Cartesian tensor $\nabla^2 U$ vanishes, but the separate components do not; inside matter $\nabla^2 U$ does not vanish.

Einstein proceeded by analogy. He found a second-order tensor that should vanish far from matter, contracted it to get the differential equations satisfied near matter, and said that these equations will not hold inside matter. Given, what was already established, that the Euclid-Newton system needed modification, this was the natural procedure to try. But it goes straight to the laws connecting measures; there was no philosophical necessity about it. The correctness of the law does not depend on any *a priori* arguments, which merely showed that it was worth considering, but on the fact that it required no new parameters and gave agreement with observation where the previous one failed (apart from one discrepancy, the node of Venus, which seems inexplicable by either theory). Insistence on the alleged philosophical grounds for the theory has led to their being challenged, and it has been a tragedy that arguments about a wholly imaginary philosophical basis have led to almost total neglect of the observational basis. The latter is, in fact, appreciably stronger than is provided by the mere verification, as I showed in Chapters vii–ix of "Scientific Inference". Starting entirely from observed data and proceeding by generalization of laws, introducing new parameters only when observation showed them to be necessary, I showed that it was possible by successive approximation to build up Euclidean mensuration, Newtonian dynamics, and the special and general theories of relativity; and that the form of the Einsteinian ds^2 is completely determined near the sun by observation alone. No further hypothesis is needed, and some of those made by Einstein are replaced by others more closely related to laws already adopted or by experimental facts. The object of the work was to see whether the observed agreement could be regarded as accidental; that is, whether any other possible laws could have given the same inferences in the range of magnitudes available; and it was found that any other form would require the introduction of an enormous coefficient as a new parameter. So far as any law can be proved by observation, Einstein's law is proved within the solar system.

The rejection of unobservables in the quantum theory, so far as I can understand it, seems to be merely a spring-cleaning. The older theories here involved many unobservable quantities, and left many observable ones unco-ordinated. It was apparently impossible to see the wood for the trees on account of the complication of the concepts, and some of the postulates were certainly wrong, since they led to conclusions inconsistent with observation. The modern quantum theories have begun by direct and successful attempts to co-ordinate what we know, without attending to the details of any deeper interpretation, and as a matter of method I think that their procedure is right. I should disagree, however, with the elevation of the rejection of unobservables into a magic philosophical principle. I do not claim any special credit for the fact that I tidy my room up when I begin to have difficulties in finding things; and in the quantum theory the important forward step did not come from the rejection of unobservables but from the subsequent recognition of formal relations. The relations are not inferred from a principle that so-and-so must be unobservable (and indeed they contain new unobservables of their own, which have to be eliminated before anything verifiable is reached), but are guessed by analogy and asserted because their consequences agree with observation, just like Einstein's law of gravitation. Here, however, the difficulty that I thought worth investigating in the latter is actively present, since different quantum theories at present do give the same observable results.

In this theory, the uncertainty principle has no sensational importance. It merely fixes a lower limit to the uncertainty that we should have with the most accurate types of observation that modern physics suggests; anybody not already blinded to the facts by naive realism and traditional deductive logic would have known that there is no such thing as a quantitative law that fits observations with absolute accuracy. The Heisenberg uncertainty is no new discovery in principle, but an estimate of a lower limit to the old uncertainty, which was never neglected except by misplaced optimism.

Many biologists speak respectfully of determinism, apparently because physicists do. One might have expected the nature of their data to save them from this. I think, however, that they have confused determinism with the possibility of making inferences at all; the test of a hypothesis in biology as in physics is the improvement of approximation, and the theory of probability is equally available for this purpose.

The theory of probability thus enables us to solve many of the major problems of scientific method, which are beyond the scope of traditional logic. It gives a formal account of the actual process of learning; it makes it possible to test laws by observation without making either the unnecessary assumption that laws can be found to fit observations exactly, or the certainly false one that the laws known to us at present do; it solves the problem of the rejection of unobservables; and it removes the paradoxical appearance of the uncertainty principle. It also provides an answer to the difficulty of the excluded middle, that is, that an unconsidered hypothesis may be the true one. When a law has been applied to a large body of data without any systematic discrepancy being detected, it leads to the result that the probability of a further inference from the law approaches certainty whether the law is true or not. In the usual language this would mean that the 'true' law differs so little from the adopted one that the two have been indistinguishable hitherto, and therefore will probably continue to be indistinguishable; thus the adopted one will probably continue to give correct inferences with the uncertainty stated in it. The better the verification of a law, the harder it will be to think of a valid alternative. The theory therefore makes it possible to modify a law that has stood criticism for centuries without the need to suppose that its originator and his followers were useless blunderers. At the same time it gives an answer to the problem of 'scientific caution'; this is best achieved by asserting no more parameters than are found significant, stating the results with the uncertainty found from the observations, and applying the law as far as possible beyond the original data (still allowing for the uncertainty of its parameters) until a discrepancy is revealed, if ever. It admits the whole of human experience as valid data, and any clearly stated hypothesis is worth testing. If the tests are found to reveal significant differences between people, it is still possible to proceed to study these differences and compare them with other data; psychology is admitted as a legitimate science.

We now return to the question of realism versus idealism; all the above considerations are applicable whichever we adopt. My belief in other people's personalities appears to be a generalization from experience of the usual type, and it leads to inferences about their behaviour, so many of which are confirmed that the natural procedure is to accept the existence as genuine while possibly proceeding to study the differences. In the question discussed at the beginning of this article I should say that the realist is definitely right. The belief in a material world is on a different footing, since while I seem to be immediately aware of my own personality, any object, even my own body, is known to me only through sensations. If I was an idealist I should say that I had invented it to give an account of my sensations; as I am a realist I think that I mean something more than that, but I admit that I find it very difficult to say what. In studying seismology I definitely believe that I am finding out something about the interior of the earth and not merely making predictions about future observations. But in either case the rival hypotheses could be tested only through the sensations predicted from them, and these by construction are identical. Thus apparently the theory of probability makes no decision whatever between critical realism and critical idealism, if the latter is taken as admitting other personalities ; both are legitimate hypotheses with probability $\frac{1}{2}$, and I can see no type of evidence that could alter this. I am speaking, of course, of the definite idealism that says that the world *is* nothing but an invention ; the indefinite idealism that merely says that it *may* be is the statement 'either definite idealism or realism is true', and cannot be used to deny realism. In any case it does not make the slightest practical difference which we adopt.

[1] Jeffreys, "Scientific Inference", 1937.

[2] Jeffreys, *Proc. Roy. Soc.*, A, 162, 490 (1937).

[3] Dingle, NATURE, 141, 21–28 (1938).

Cambridge Meeting of the British Association

THERE can be no doubt that the British Association, adaptable though it is to various environments, is most at home in an academic setting. This year's meeting in Cambridge ought, therefore, to be unusually happy, and the preliminary programme just issued affords prospects of this by more than one implication. Thirteen of the colleges—in addition to Emmanuel, where the secretariat will be housed—offer men the chance to return for a short space to the pleasures of college life ; Cheshunt College will be open for women, and other houses (including Girton) will accommodate both sexes. In addition to the University reception in the Senate House and Old Schools, conversaziones, pleasantly specified as 'informal', are announced in Trinity and St. John's, and the Mayor and Mayoress of Cambridge must surely be introducing a new and welcome feature into British Association programmes by inviting members to a sherry party, to be held in Emmanuel. It is to be hoped that the unusually early date of the meeting, August 17–24, dictated as it is by the convenience of the colleges and other authorities, will not dismay any of those who contemplate being present : it may be recalled in this connexion that the last Cambridge meeting, in 1904, took place at exactly the same time, but had nevertheless an attendance of 2,789, a figure far above the average for that period.

The presidential address, by Lord Rayleigh, will deal with "Natural Vision aided by Science", and a few lines which indicate its content may be quoted as an unusual but arresting feature in the programme. "The address," it is stated, "will show how, taking the eye as a prototype, most of the observational methods of modern science may be regarded as derived from it by successive modifications. A further part of the Address will deal with science and warfare, and will be directed to show that the relation between them is of the nature of an accidental by-product, and has in no sense been the primary goal of investigation."

The subjects of sectional presidents' addresses are announced as follows :

Section A (Mathematical and Physical Sciences) : Dr. C. G. Darwin, "Fundamentals in Physical Theory" ; Section B (Chemistry) : Prof. C. S. Gibson, "Recent Investigations in the Chemistry of Gold" ; Section C (Geology) : Prof H. H. Swinnerton, "Development and Evolution" ; Section D (Zoology) : Dr. S. W. Kemp, "The Future Development of Oceanography ; Section E (Geography) : Prof. T. Griffith Taylor, "Correlations and Culture, a Study of Technique" ; Section F (Economics) : Mr. R. F. Harrod, "Scope and Methods of Economics" ; Section G (Engineering) : Prof. R. V. Southwell, "The Changing Outlook of Engineering Science" ; Section H (Anthropology) : Prof. V. Gordon Childe, "The Orient and Europe" ; Section J (Psychology) : Dr. R. H. Thouless, "Eye and Brain as Factors in Visual Perception" ; Section K (Botany) : Prof. W. Stiles, "The General Physiology of the Plant Cell and its Importance for Pure and Applied Botany" ; Section L (Education) : Mr. J. Sargent, "The Proper Function of Administration in Public Education" ; Section M (Agriculture) : Prof. R. G. Stapledon, "Lay Farming".

Section I (Physiology) will not hold separate meetings, owing to the unfortunate clash of date between the British Association and the International Physiological Congress at Zurich. It seems strange that no mechanism to prevent such collisions has ever been devised.

The sectional programmes, even at this early stage, promise at least as diverse interest as usual. By way of examples among many subjects : Section A will deal with nuclear physics, high-altitude cosmic ray work, very low temperatures, and seismology. Section B promises a notable lecture-demonstration on gold films and their applications. Section C, among other subjects, will deal with the water supply of the county of London. Sections D and K will meet jointly to discuss the mechanism of evolution. Section G will consider problems of road and air transport, and will devote a special period to papers by junior workers. Section J will co-operate with Section D on questions of sense perception and the evolution of colour and pattern, and with Section L on the effect of the cinema and wireless on the life of the school child. Section L will discuss "Education for a Changing Society" in various aspects. Section M will consider agriculture in relation to national employment, soil conservation and enhancement of fertility, and crop and animal production.

The Conference of Delegates of Corresponding Societies will meet under the presidency of the Earl of Onslow, who in his address will discuss national parks, a subject to which the Association has properly given much attention. The evening discourses will be given by Dr. H. Godwin on the "History of the Fens", and by Prof. M. L. Oliphant on the "Contribution of the Electrical Engineer to Modern Physics". Of these, Dr. Godwin's discourse will be given on the Friday, thus appropriately preceding the Saturday excursions which will no doubt give many members a sight of the Fenland.

For the rest, full advantage will be taken of the exceptional opportunities offered by the various laboratories for exhibits and demonstrations, and certain special exhibits also are announced. Old scientific instruments will be shown under the auspices of the Cambridge Philosophical Society. There will be an exhibition illustrating the genetics of colour. It is proposed to have an exhibition of works of art by members of the Association—a feature, so far as records go, quite new to the programme. Members who would be willing to exhibit are asked to communicate with Mr. E. N. Willmer, St John's College, Cambridge. Photographs taken by members of the recent scientific delegation in India will be shown. It is intended also that two lectures shall be given on the work of the delegation, of which it is hoped that one will be by Sir James Jeans, who led the delegation as president of the Indian Science Congress.

Provision for excursions is as ample as ever: the range extends from Sandringham on one hand to the Gliding Club at Dunstable and Tring Museum on the other, and opportunity will be afforded for visits to points of beauty and interest in Cambridge itself.

News and Views

Prof. Max Planck, For. Mem. R.S.

Prof. Max Planck, originator of the quantum theory and emeritus professor of theoretical physics in the University of Berlin, will celebrate his eightieth birthday on April 23. Planck's work had a singularly direct influence on the development of modern physical theory. Beginning with purely thermodynamical studies—which have been embodied in his well-known text-book on thermodynamics—he soon applied both the descriptive and the statistical methods of thermodynamics to radiation, and was successful in finding a formula for the spectral energy distribution of black-body radiation which fitted the measurements and which could be deduced on the assumption that radiation is transferred from matter in quanta of energy proportional to the frequency ν. Successive editions of Planck's book "Warmestrahlung" show the development and variation of the original theory, of which the underlying physical idea remained for many years a mystery to physicists, although Planck's constant h was found to enter into various relations between radiation and matter, for example, in the photo-effect. It was not until Bohr explained the laws of spectral emission of atoms by a two-fold application of Planck's constant that this latter was recognized as fundamental for all kinds of atomic action.

In all this rapid development, Planck took a prominent, if cautious, part, with the result that his publications have long been considered as classics of German physical literature. His judgment largely influenced the development of contemporary physics. When Einstein's principle of relativity showed the way out of the axiomatic and other difficulties of electrodynamics, it was Planck who took up the idea and carried it through for mechanics and thermodynamics. Although many honours have been conferred on Planck, including the Nobel Prize in Physics in 1918 and the Copley Medal of the Royal Society in 1929, they have failed to spoil his simple and unpretentious ways. Confronted with the difficulties of the monetary inflation in Germany, Planck did not mind travelling a whole night on the railway in the old fourth class, in order to get to the Alps which he loved from his youth and in which a dolomite peak bears his name as the first to have climbed it. The German Physical Society is giving a banquet in the Harnackhaus on April 22 to celebrate Planck's birthday.

Sir Charles Peers, C.B.E., F.B.A.

The gold medal of the Royal Society of Antiquaries of London has been awarded to Sir Charles R. Peers in recognition of his services to archæology in Great Britain. This medal, generally accepted as the highest award in archæology in Great Britain, has been awarded on three occasions only, the first recipient being Sir Arthur Evans, who was followed by the Abbé Breuil and then Sir Aurel Stein. Sir Charles Peers, who was educated at Charterhouse and King's College, Cambridge, and is by profession an architect, was appointed inspector of ancient monuments under the Board (now Office) of Works in 1910. His appointment was the result of prolonged agitation by archæologists and others interested in the preservation of antiquities in Great Britain. It marks an epoch in the history of British archæology. The inspectorship had been vacant since the death of General Pitt-Rivers in 1900, while the Ancient Monuments Acts, of which the first was passed in 1882, had long been virtually a dead letter. In 1913, three years after Sir Charles's appointment, a consolidating and amending Act was passed, which much enlarged the powers of the Commissioners, and he was given the standing and title of chief inspector of ancient monuments.

Largely through Sir Charles's activity, notwithstanding the interruption of the Great War, the growth of a public opinion in favour of the preservation of antiquities was fostered and the functions and duties of the Office of Works as the guardian of the nation's interests in its antiquities rendered familiar to a degree which made it possible still further to strengthen the powers of the Department, also recognized in the Town Planning Acts, by the further amending Ancient Monuments Act of 1930. Although Sir Charles retired in 1933, after receiving the honour of knighthood in 1931, he has since then still taken an active part in archæological administration. He continues to be a member of the Advisory Boards on Ancient Monuments of England, Wales, and Scotland, sits on the Royal Commission on Historical Monuments, as well as on the Standing Committee on Museums, and is an elected trustee of the British and the London Museums. In 1933 he was awarded the Royal Gold Medal of the Royal Institute of British Architects.

Dr. A. E. Dunstan

The Council of the Institution of Petroleum Technologists has awarded the Redwood Medal of the Institution to Dr. A. E. Dunstan in recognition of his distinguished services to the science and technology of petroleum. The medal was presented on April 12. Dr. A. E. Dunstan was born at Sheffield in 1878. In 1899 he entered the Royal College of Science, South Kensington. Later on he studied at University College, London, under Ramsay and at East London College under Hewitt. At University College, Dr. Dunstan collaborated with Trouton on investigations into the correlation of physical properties and chemical constitution. He had already published work on viscosity-concentration curves of mixtures. This work was continued at University College and elsewhere, and formed the subject of his thesis in 1910 for the degree of D.Sc. In the meantime, he had communicated numerous papers to the Chemical Society on the problems of viscosity in collaboration with Thole, Wilson, Hunt, Stubbs and others. From 1905 until 1915 Dr. Dunstan was head of the Chemical Department, East Ham Technical College. In 1915 he joined the Anglo-Persian Oil Company. From that time dates the important series of researches on the chemistry and refining of petroleum with which Dr. Dunstan's name is particularly associated. The first important paper relating specifically to the petroleum industry was presented to the Institution in 1916 by Dunstan, Lomax and Thole, and dealt with the pyrogenesis of hydrocarbons. It described the evolution of the process of cracking and of the principles underlying it. A period of intensive research followed on the chemistry of refining processes, during which experimental work was carried out at Abadan and Sunbury. Dr. Dunstan is chief chemist of the Anglo-Iranian Oil Company and a director of National Oil Refineries, Ltd. He was president of the Institution of Petroleum Technologists in 1929–31 and has been honorary editor of the Institution's publications since 1920.

The Magnetic Storm of April 16

The magnetic storm which occurred during the Easter week-end appears to have been one of the most violent ever recorded. Particulars of the disturbance have been supplied to Nature from the Abinger magnetic station of the Royal Observatory, Greenwich, and from Edinburgh. The storm, as recorded at Abinger, considerably exceeded that of January 25 of this year both in range and in intensity. At intervals the photographic traces are difficult to follow on account of the rapidity of change in the earth's magnetic field. Beginning at 5 h. 48 m. U.T. with a sudden sweep of 45′ in declination, the storm almost immediately attained dimensions sufficient to place it among the "great" storms of the past hundred years. Only the salient features are at present available. These may be summarized as follows: The period of most intense activity was from 6 h. to 8 h. U.T. and the storm had virtually ceased by 16½ h. The whole range in the vertical component of the field was approximately 500 γ—not very remarkable except for the short interval of fifteen minutes during which it occurred—between 7 h. 35 m. and 7 h. 50 m. The ranges in declination and horizontal intensity are at present subject to reservation. On account of the rapidity of change some doubt exists as to the identification of the auxiliary traces which are brought into the record in lieu of the displaced ordinary trace when large ranges occur. A tentative estimate of 5° in declination and 2250 γ in horizontal intensity (that is, nearly one eighth of the whole) has been made by the assistant in charge of the Abinger station.

WRITING on April 19, Dr. A. H. R. Goldie, superintendent (Scotland) Meteorological Office, says: "The storm commenced at 5 h. 48 m. G.M.T. on April 16, and from the very disturbed traces of the magnetographs at the observatories of Lerwick and Eskdalemuir the following ranges in the magnetic elements on that day have been measured:

Lerwick Horizontal Force, 2980 γ (1 γ = 10^{-5} c.g.s. units).
Vertical Force, 1386 γ.
Declination, 5° 47′, equivalent to 1450 γ in the component of force perpendicular to the magnetic meridian.
Eskdalemuir Horizontal Force, 1672 γ.
Vertical Force, 1165γ.
Declination, 6° 25′, equivalent to 1850 γ in the component of force perpendicular to the magnetic meridian."

The storm was probably a sequel to the solar disturbance represented by the large sunspot group which crossed the sun's meridian on April 14·1 U.T. (see NATURE, April 16, p. 683).

Aurora Australis on January 22

A COMMUNICATION from the Commonwealth Solar Observatory, Canberra, published on p. 746, refers to an auroral display observed in Australia on January 22, and the solar eruptions and magnetic storms associated with it and with the brilliant display in Europe on January 25–26. Mr. John Gregory, writing from 11 Bennett Street, Perth, Western Australia, describes the aurora of January 22 as seen by him between 8.45 p.m. and 10 p.m. from Busselton, situated on the west coast of Western Australia, a few miles north of latitude 34° S. Throughout the display, short-wave reception from London was perfect and there was little interference in the broadcast from Perth. Referring to the suggestion that auroræ are sometimes accompanied by audible sounds, Mr. Gregory remarks: "I have witnessed many dazzling displays of Aurora Borealis on the Canadian prairies, in the stillness of remote farming areas, but was never able to detect sounds that could confidently be associated with the lights. The slight mysterious crackling sounds one might hear during a display could be heard on almost any cold night, even when the aurora was entirely quiescent."

Curious Effects of Globular Lightning

ON December 6 about 4.30 p.m., a ball of lightning was seen falling at an angle of about 30° to the horizon near Ardglass, Co. Down. It was accompanied by a glare and a loud noise, and on striking the ground there was a burst of flame from the point of impact, followed by a loud explosion. The spot where it fell was examined by Mr. J. A. S. Stendall, of the Belfast Municipal Museum, Miss M. Gafflkin, and Mr. F. Addey, who has kindly supplied all information collected from those who saw the phenomenon. The stem of a hawthorn tree ten inches in diameter had been cut through, and branches had been scattered around, one being thrown 100 yards away from the tree. The bank of a dry ditch had been struck, the point of impact showing clearly from the crushed soil, and fragments of clay were found forty yards away. Excavations were made, as it was believed at first that a meteorite had fallen, but no trace of such could be found at a depth of five feet. At the time of the appearance of the lightning a similar phenomenon was seen at a place six miles away in a north-north-west direction. People described this as accompanied by "a shattering blast which shook the whole countryside". A large crater was found in the mud of a river bank near the scene, but this was quickly covered by the tide and could not be seen when the spot was visited later. The portion covered by the impact could not have been localized to the area of the crater because one person, hearing the explosion, went out and saw sparks jumping off the macadam of the roadway. Mr. Addey suspected a meteorite which had disintegrated, as two balls of globular lightning, separated by six miles, occurring at the same instant, would be rather a rare phenomenon. The fact that a thunderstorm was in progress at the time near Belfast and Lisburn, combined with the fact that there was a partial failure of the electric light in the district, is almost conclusive evidence that the phenomenon was globular lightning.

Tring Museum

THE bequest of the zoological collections at Tring by the late Lord Rothschild is the largest single benefaction both in quantity of specimens and in scientific importance that the British Museum has ever received. The collection may be considered as in two parts, one open to the public and the other reserved for study. In the first section, a general zoological series, are many notable specimens such as the long series of giant tortoises or the superb set of Struthious birds, probably the finest in existence and containing many types. The gorillas and other primates are of equal importance and, in addition, there are specimens of rare or recently extinct animals such as the quagga and fine series of rare marsupials and monotremes. The condition of all these specimens and their taxidermy is of the best. The most important section of the study collections is undoubtedly the enormous series, some two millions, of Lepidoptera. The long series of individual species has yielded, and will continue to yield, much information of scientific value. These Lepidoptera include about six thousand type specimens, a fact which by itself would make this bequest one of outstanding importance to the British Museum. There is likewise an extensive library of zoological, entomological and botanical books comprising about thirty thousand volumes in all. Many of these books are of great rarity. This addition of the Tring Museum will lead, no doubt, to important extensions in the scope of systematic research. Hitherto systematists have too often been hampered by having to work with too short series of specimens. The late Lord Rothschild was alive to this weakness in the founda-

(*Continued on p.* 743)

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Social Relations of Science

"SCIENCE and its applications are not only transforming the physical and mental environment of men, but are adding greatly to the complexities of the social, economic and political relations among them". This passage from a resolution of the Council of the American Association for the Advancement of Science, published in NATURE of January 22, is representative of the widespread growth of interest, in recent times, in the social relations of science. The American Association has resolved to take as one of its objectives an examination of the profound effects of science upon society. This resolve seems to have been partly inspired by the movement, started several years ago, to make the British Association the platform in Great Britain for the discussion of social problems which science had helped to create and might help to solve.

Alongside these national movements, international action on the same subject has been taken by the International Council of Scientific Unions (I.C.S.U.). This important body, partly at the instance of the Academy of Sciences of Amsterdam, set up in 1937 a Committee on Science and its Social Relations (C.S.S.R.), as reported in NATURE of April 24 and May 22, 1937 (139, 689, 869). This Committee is charged to survey the influence of science on the world picture as well as on the material side of human life and society; it is to review science and its applications as a whole, and to promote the study of their social influence. Its initial plan is to prepare a report, with bibliographical material, to be presented at the next meeting of the I.C.S.U. in 1940, and thereafter, it is hoped, to be printed for wide circulation.

The collection of data on which the Committee on Science and its Social Relations will base this report is to be obtained from three sources: from national correspondents appointed by national academies or research councils, who will provide information on the national aspects of the social relations of science; from correspondents appointed by international bodies dealing with the several branches of science, who will report from the point of view of their particular sciences; and from individual correspondents having special interest in, or knowledge of, these matters. The appointed correspondents will in many cases find it desirable to enlist the aid of national or international groups of interested men of science, because the field of inquiry, especially for the national correspondents, is too wide to be covered by the knowledge of any single person. It is hoped that by this wide co-operation a report of great interest will be produced, though the difficulties to be faced in compiling it are obviously considerable.

To guide their correspondents in the collection and supply of information, the C.S.S.R. has drawn up a series of fairly detailed questionnaires, one for national correspondents, and others for the several branches of science on which the international scientific unions will report. It is hoped that the consideration and answering of these inquiries will play a useful part in stimulating and clarifying thought in scientific circles all over the world, on the social relations of science; and that the C.S.S.R. will receive from its many correspondents the support without which its efforts cannot but fall short of the great needs and opportunities before it.

The connexion of the C.S.S.R. with such important and established bodies as the International Council of Scientific Unions, the various international scientific unions themselves, and, still more, with the (in most cases) much older national academies, gives it a representative position which could scarcely otherwise be obtained. These connexions in turn impose a duty on the Committee to make its work as scientific in spirit as possible, and in no way to compromise or misrepresent its parent bodies by partisan views or statements. In particular, the C.S.S.R. is not to be, or to be regarded as, a propagandist body; its functions are to survey, to study, to report.

It is excellent that the national academies and international scientific unions should take part in setting up and helping the work of such a body as the C.S.S.R., but the preparation of a condensed report of world-wide scope, to appear two years hence, and perhaps triennially thereafter, is far from sufficient to meet the need within each of the great nations, whose civilization is now largely based on science, for thought, discussion and publication on the social relations of science. Nor does it seem that in Great Britain the provision for such discussion, at the annual meetings of the British Association, is adequate. Further, national scientific academies, such as the Royal Society, probably do well to limit their discussions and publications to the natural sciences, without extending their functions into that great bordering region which the C.S.S.R. is charged to survey. Science itself has its controversies, sometimes keen despite the objectivity of the scientific method and spirit; in that border region beyond, though the like objectivity may be striven after, unity of opinion and agreement in discussion will certainly be more difficult to attain. It would seem best for both sides, therefore, that the arena for the discussion of the social relations of science should be separate from those in which the natural sciences are considered, though many representatives of each should be interested in both.

To be explicit, it has been suggested that in Great Britain (and the same applies to the other great nations) there should be a Society for the Study of the Social Relations of Science (S.R.S.), with a large individual membership, which should not be confined to men of science, though they should play the principal part in it. The Society should have its council, its regular meetings, its publications, and perhaps its committees for the study of selected questions It should receive, read, discuss, and, after consideration by suitable referees, publish papers submitted to it; it might arrange symposia (by the spoken and written word) on special subjects within its range. Its field of work would inevitably trench on questions that have a political importance, but its attitude towards papers submitted to it should be scientific and objective, and it should not in general express corporate opinions, but leave readers to accept or reject the statements in its publications, according to their view of the credit of the authors.

This research method and policy of publication have proved their success in serving science in general, as in the case of the Royal Society, and the many branches of science now organized in separate societies, too numerous to mention, there seems good prospect that a like success would attend the same method and policy applied to this new field. The S.R.S. would be a society for the advancement of knowledge, not a propagandist body for the advancement of science in the public councils and esteem (like the former British Science Guild) or for the advancement of professional scientific interests (like the Association of Scientific Workers). Despite the existence of such useful bodies as Political and Economic Planning and the Engineers' Study Group, which are doing valuable work on the social relations of science, it does not seem that they perform the functions that are suggested for the S.R.S. Questions of overlapping and other difficulties may present themselves, but public scientific opinion on these matters now seems to have reached a stage where the formation of such a society is appropriate.

With the object of obtaining representative opinions upon the subject of social repercussions of science, and the question of promoting their deliberate study by the formation of a new scientific society or otherwise, advance proofs of the above article were sent to a number of scientific workers and others, with a letter inviting the frank expression of their views. The replies received are published in succeeding pages of this Supplement, and are grouped under headings representing in a general way the fields of scientific work in which the correspondents are particularly interested. It will be observed that doubts are expressed as to the need of establishing a new scientific society, and suggestions are made that the desired objects might be obtained through co-operation with existing bodies. Notwithstanding this difference of opinion, it is evidently the decided view of a number of responsible scientific workers that steps should be taken to further the objective study of social relations of science in the hope that the knowledge obtained may make both science and society conscious of their common interests and responsibilities.

Representative Opinions

Sir William Bragg, O.M., K.B.E., P.R.S.

If we assume the truth of the statement at the head of the editorial discussion of the social relations of science, we must conclude that the proposal to form a society for the study of those relations is entirely reasonable ; and the statement is obviously true. The rapid and persistent growth of natural knowledge is something new in the history of the world. Its effects are very great, and there is, as yet, no organized attempt to correlate them. Attention is directed, now here, now there, to some remarkable consequence of the movement, sometimes with pride or gratitude, sometimes in fear. Both pride and fear are often mistaken. There is, in fact, much to be studied, and a society that sets about the task will probably arrive at results that will be interesting, and will be well worth the trouble taken to obtain them.

Sir F. Gowland Hopkins, O.M., F.R.S.

Science workers are often bidden just now to remember the complexities which science and its applications are adding to the world's problems, and to realize that it is their duty to help in shouldering the responsibilities involved. To-day, the situation must be considered no less from another point of view. Science itself is face to face with efforts, unfortunately only too successful, to impose on nations an artificial social structure of a kind which is definitely antagonistic to the progress of science, and in the long run, as history suggests, may even lead to its arrest.

I have often wondered, when laboratory workers, as such, are asked to take action, what precisely they can do beyond performing their duties as good citizens. It is clear that individuals can do little, and that experimental scientific workers immersed in research are ill qualified, when unaided, to take effective action of any kind. If solutions are to be found, the problems call for close study and careful analysis, and I venture to think that the effect of totalitarian policy upon scientific output should be continuously scrutinized and brought to notice.

It would seem that such tasks could be well undertaken by a society such as that proposed. It must, of course, establish international relations, and I think it would need the help of an information bureau. Its membership must certainly not be confined to the working men of science

Sociology and Economics

H. G. Wells

The essential difficulty in working out any special social functions for scientific men lies in the fact that, so far as the great majority of sciences go, the individual worker has no special aptitude for social organization. His time, his mental energy he owes to his special work. But this is less true of certain sciences than of others. It is less true, for example, of biology than of astronomy. It is less true of anthropology and psychology than of invertebrate anatomy. In the case of human ecology and social psychology, the man of science works in a field whose generalizations are almost immediately applicable to social organization. Every science insists upon integrity, explicitness and devotion to the extent of entire disinterestedness, and so the study and teaching of any science tends to brace the character and sweeten the social atmosphere. But it is through the pushing of the boundaries of science out into that field of rash generalizations and mischievous traditions known as human history, that the practical hope of mankind in science lies.

The S.R.S. claims the attention and frank criticism of every type of scientific mind, but if it is to operate efficiently it will have to create opportunities and support for an increasing number of social biologists and social psychologists. There is little advantage to be found in the distinguished experimentalist in physical science dissipating his time and genius in amateurish contributions to political and social theory. There is everything to be gained by a S.R.S. that will keep him in touch and co-operation with social scientific work and thought as intensive as his own.

Prof. John L. Myres, O.B.E., F.B.A.

Is the proposed Society for the Study of the Social Relations of Science to be yet another 'learned' society, or something else ?

In the natural sciences, physical and biological alike, there is no limit to the applicability of discoveries to human ends, economic and social, "transforming the physical and mental environment of men". Such applications are the concern primarily of individuals competent to supply admitted needs of their fellows, and eager to stimulate fresh needs ; next, of specific associations for the promotion of such enterprises, in medicine, engineering, various industries, and the like ; and ultimately of the citizens at large, and their organs of administration and policy, competent to use, abuse, or disuse. Philosopher-kings and totalitarian dictators presumably provide for inclusive survey of all applied science 'in the interest of the governed'. Like the centurion, they "say unto this man 'go' and he goeth" ; unlike him they are not "under authority" and nothing printed in Nature need affect their doings. In a 'free' country, what form does "King Solomon's House" assume ?

Clearly 'social relations' are not the business of the 'learned' societies. The less these are concerned with 'practical applications' or with practical restrictions, the better. For all these involve judgments of values—considerations political or moral, not scientific at all.

I have the same uneasiness about 'applied anthropology' as about 'applied' genetics, when undertaken by a 'learned' society; for 'learning' and life are fundamentally different. From the dentist to the destroyer, we all 'apply' gas. Some also 'apply' prayer, to avert pain and war. But these 'applications' concern neither chemists nor theologians.

Though the Committee on Science and its Social Relations is "charged" by the International Council of Scientific Unions, one of the greatest of 'learned' societies, and is, as stated, "not to be, or to be regarded as, a propagandist body", it is nevertheless expected to "play a useful part in stimulating and clarifying thought"; there are "great needs and opportunities before it"; and it is concerned (among other matters) with the "national aspects" of the social relations of science, which differ notoriously between one nation and another. But this is politics, not science.

The British Association, in addition to the "promotion of scientific enquiry" and of "intercourse between those who cultivate science", has among its objects "the removal of any disadvantages of a public kind which might impede its progress", and has often attempted this, and still oftener been urged to attempt it. But these functions are concurrent and distinct.

So too these current inquiries of the American Association are concerned with the "complexities of the social, economic, and political relations" among men, and are distinct from its function of discovery.

Is the proposed Society for the Study of the Social Relations of Science designed to be yet another 'learned' society, duplicating or supplementing the activities of the C.S.S.R. and the American Association? It "would be a society for the advancement of knowledge, not a propagandist body" like the British Science Guild or the Association of Scientific Workers. But also "it would inevitably trench on questions that have a political interest and importance", like the British and the American Associations. Its promoters should make up their minds whether it is to be a historical, or a philanthropic society; a society for the Study of Spilt Milk, or for Promoting the Good Will among the Stronger.

Prof. H. J. Fleure, F.R.S.

THE development of machinery has made productive capacity enormous and thus accentuated rivalries, while the increase of modern communications has made national frontiers a source of increased irritation, and the jostling of peoples has inspired fear for the future of cherished national traditions. Sources of machine-power, again, have changed, and some who look into the future are inclined to picture a world largely dependent on power-alcohol from cellulose, which means that relations of Europe to the warm lands will enter a new and difficult phase.

In other directions also, science is having far-reaching effects on thought. The idea of evolution working itself out in comparative religion and in psychology is beginning to have revolutionary influences on ethics and beliefs, effects as yet only dimly perceived by many leaders of religious organizations. Again, the accumulation of knowledge concerning ancient and modern China, India, Mesopotamia, Iran, Egypt, and so on, is altering into a sort of glorified provincialism the old habit of starting an argument concerning society with examples from classical Greece and leading on through Roman, medieval, renaissance and later periods. We are in the throes of as deep a change of both economy and thought as that which included the breakdown of the medieval church in north-western Europe and the voyages of discovery. Old bases of conduct, sources of social motive power, visions of the world, are changing, and there is a natural recrudescence of authoritarian ideas as a fear-insurance against chaos, or against the triumph of an equally authoritarian rival.

The change is in the main the effect of the impact of science, of the vision of truth as something to be sought, of the consequent view that all beliefs are provisional and that neither reason nor emotion gives us final conclusions. It therefore seems that scientific workers owe it to the community to see that they study the social relations of science. A recent election of a student of physiology as a professor of philosophy is a welcome indication of awareness of the change in thought that is beginning. If necessary, we must found a new society to study these matters, however difficult it may be to ensure reasonably unprejudiced discussion.

Might we not, however, try to encourage existing societies that study mankind in the broadest way to occupy the field? Anthropological and folk-lore societies, in co-operation with sociologists, historians and geographers, should realize increasingly that our own social life is material for study just as much as is that of distant peoples of the present and past. The influence of science on production, transport, population and its distribution, social motive power, and the springs of conduct and belief can all be considered as within the anthropological field, wherein have long worked many who know a great deal about lowly peoples and ancient society, and so can help us to know the rock whence we were hewn and the manner of the hewing. A conference of workers interested in the problem of the social relations of science is clearly called for, together with a consideration of the difficulties arising in our universities from the old division into faculties of arts and of science, which is becoming a hindrance and was never more than a practical convenience.

Prof. P. Sargant Florence

IT is often said that economists are blind to the impact of science upon society and that they are neglecting the changes that have come over industrial organization as a result of scientific invention. This may be true of the school of economists who argue from traditional assumptions carried over from an age when science *was* negligible. But it is impossible for any realistic economist trying to generalize from actual events to ignore the consequences of scientific progress. In my presidential address to Section F of the British Association last year, for example, I directed attention to the increase in the number of men per factory and to typical differences in the number of men per factory as between different industries. This general increase and this differentiation both appear to be correlated with technical factors, particularly the growth of mechanization. Mechanization measured by horse-power and overhead costs per man has increased generally, and in those industries where mechanization is greatest the number per factory tend to be greatest. The higher the mechanization of an industry, the larger is the size of its constituent parts.

Scientific invention has led to more machinery being installed. More machinery has led to more men being employed in one organization. In its turn this large grouping of men is leading to the invention of new sorts of social organization. More capital is needed to buy the machines; joint stock companies are formed to pool capital. The control of larger and larger groupings of machines, men and capital becomes increasingly difficult for the joint-stock shareholders, and the power over each company is put into the hands of boards of directors usually representing a minority of investors. The companies themselves become too small as units of control, and methods of concentrating control are devised such as interlocking directorates and holding companies.

By the time this stage has been reached, economic organization has become the concern of society as a whole. Consumers are faced with the possibility of monopolistic exploitation. Citizens are faced with dictatorship by high finance. In this pass, to study the social relations of science is the least society can do! The impact of science, though working indirectly through the economic mechanism, may well be overwhelming in its ultimate effect. Certainly we must be prepared, by the formation of such a society as the proposed S.R.S., to measure the force and direction of the impact. And I venture to think that the economic mechanism, such as I have outlined, through which science affects society, must be investigated particularly closely. For this a certain professional training in economics and the social sciences seems to me essential—a student of natural science cannot leap at it by the mere light of Nature! May I suggest, therefore, that an early task of the proposed S.R.S. be to find means for professional training in realistic methods of economic and social research?

Prof. H. A. Marquand

I AM enthusiastically in favour of the establishment of a Society for the Study of the Social Relations of Science. Students of social problems are often, like myself, childishly ignorant of the natural sciences. On the other hand, I have often heard very competent men of science utter childish opinions about social and economic questions of the day.

The need for co-operation and closer contact between the two branches of study has been admirably expounded in NATURE. I would only add that if the new society is formed, it should confine itself to persons fully qualified in the fields of study it hopes to unite. An immense amount of valuable time will be wasted if the numerous quacks, well-intentioned but untrained, who pose as authorities on economic and sociological questions are admitted.

The task before the new society is urgent; and it should not allow itself to be diverted from profitable lines of research by a sentimental desire to be 'fair' to all 'points of view'. Economists, in particular, will be quite prepared to recognize the authority of a duly appointed university teacher or fully qualified research worker in his own field of science. Let the men of science seek the co-operation—at least at first—only of persons similarly qualified in economics. It will be found that there is a large amount of agreement among them on fundamentals of analysis.

At a later stage, the findings of the society can be presented with real authority to the public. The public itself can then make its choice between the alternatives available—for there always will be alternatives in social policy. What the society can do is to ensure that the alternatives are thoroughly understood and that as many as possible of the data required to ensue the choice are scientifically prepared by fully competent persons.

Prof. Harold J. Laski

I THINK the idea of such a society as is suggested may prove of real value; few things are more important at the present time than the interchange of views between men of science and those who are concerned with the study of social phenomena. Their past separation has been a grave misfortune since (*a*) it has led to the neglect by scientific workers of the several implications of their own work, and (*b*) an inadequate knowledge by statesmen and by professional students of several organizations of the implications of scientific discovery. A body that might help in breaking down the existing barriers is, at least potentially, one that has important work to do.

It is, however, important, I think, to emphasize that such a society must occupy itself as well with ends and values as with the description of phenomena. Work like that of Sir John Orr has implications which go out into the realm of action; it emphasizes the need for scientific workers to give, as it were, the laboratory to life. The man of science is also a citizen. He has the responsibility of seeing that the conclusions he reaches are related to the purposes our social order is seeking to fulfil.

Prof. Morris Ginsberg

I SYMPATHIZE very strongly with the proposal to establish a society for the study of the social relations of science. I should, however, like to make a comment from the point of view of sociology. It is, it seems to me, very important that society itself should be studied scientifically, if the effects upon it of the achievements of the natural sciences are to be correctly interpreted. On one hand, science is itself a social product, and its evolution is shaped at least in part by social and economic forces, and these are matters for sociological inquiry. On the other hand—and this is in relation to the present proposal more important—the study of the effects of science on social relations requires not only a knowledge of science, but also of social relations.

Now, though in fundamentals the methods of science are the same whatever may be the field of inquiry, it is not be be assumed that the technique of the natural sciences can be applied forthwith to the field of social relations. The history of social thought offers abundant illustration, of which the most striking, perhaps, is the hypothesis of natural selection, of the disastrous consequences that have resulted from the application of scientific theories to social problems without direct examination of the sociological data.

If, therefore, as I hope, the society is established, I think that one of its functions should be to encourage the direct study of social facts, and that on its councils sociology should be adequately represented.

Alexander Farquharson

THE proposal for the development of new means for the study and discussion of the social relations of science will have, I am assured, widespread support among sociologists. To these, the subject is not new. Much thought has already been given to the social origins of science and to its social effects. It is, however, undeniable that a systematic and co-operative effort to examine these and similar problems would have fruitful results. In such an effort, students of both natural science and of sociology should take a full share. I hope that some historians of culture and some philosophers with a social outlook may also be ready to take part. It may, however, be suggested that use should be made both of the observational method of the scientific worker and the methods used by the historian and the social student in the study, through documentary evidence of past and present.

Psychology

Prof. C. Spearman, F.R.S.

AMONG the sciences at issue an important place can scarcely be denied to that of the mind. Indeed, seeing that this is a field which covers all knowing, feeling and doing, a plausible case might be made out for crediting this mental science with ruling everything in the world that possesses value as an end, and not merely—like the material sciences—as a means. In special degree, surely, this holds with regard to social values. In good enough accord with this *a priori* staked-out claim of psychology, we find in actual fact a more universal appeal to it for aid.

First of all the appellants came education. Not far behind was mental pathology. Later, but trying hard to make up for lost time, have been the calls to assist industry. Still more modern is the acute realization of the psychological basis of criminology. Last of all, perhaps, has been a lively call to solve the problems of polemology (*sit venia verbo*).

On the other hand, however, there are not a few sceptics who would make out that the promises of psychology are greater than its performances. Unfortunately, this charge does appear to have not a little foundation. Nevertheless, it can certainly be exaggerated. In many cases the social achievements of mental science stand out far beyond the reach of all legitimate cavil. Take, for example, the new developments of knowledge about individual mental differences. At the most conservative estimate, this knowledge would appear to be fundamental for all social organization and endeavour; from, say, confiding in M.P.s to sterilizing the unfit.

Here we arrive at one last critical point. Let us grant that mental, at least as much as material, science has vital relations to society. We have still to inquire why these relations should be thought to need special treatment, by committees, associations, and so forth. May not rather the relations be taken as already treated in an adequate manner by the two studies thus related, psychology and sociology ?

The answer would seem to be decidedly in the negative. Here, as in so many other branches of science, the application of one to another is apt to be a very delicate and difficult operation. A notorious illustration is furnished by the frequent complaint of physiologists, that they urgently need the aid of chemistry, but not such as is currently supplied by chemists. In their turn, psychologists stand in a very similar relation to physiologists. So likewise, it would seem, do sociologists to psychologists.

By all manner of means, then, let us get together. The whole situation, after all, is but an instance of the old saying that sciences grow where they meet. Accordingly the advent of the S.R.S. would seem to deserve a cordial welcome.

Prof. J. C. Flugel

THERE can, I think, be little doubt that a society such as is contemplated could perform a very useful function, a function indeed which, before long, we may come to look upon as indispensable. I imagine, however, that to fulfil this function properly the membership will have to be drawn in about equal proportions from scientific workers proper and from men engaged in the practical tasks of organization and administration in the most diverse spheres, not excluding that of politics.

As regards its individual members, the society will have a double task. On one hand it will foster the increasing sense of responsibility which scientific workers are beginning to feel for the social consequences of their discoveries : while in the executants it should cultivate a corresponding ideal for the full and proper use of science and—what is even more important—for the adoption of a scientific attitude in those fields, for example, of politics and economics, where traditional or emotional bias is only too apt to interfere with a calm and impartial investigation of relevant facts.

Society to-day is based on science, and it is becoming recognized that the social problems created by science can only be solved by yet further extensions and applications of scientific method. Those who make scientific discoveries and those who apply—or misapply—them should be looked upon as members of a team with a joint responsibility to the human race at large. The better the understanding between them and the closer their co-operation, the better it will be for them and for society. The man of affairs can suggest innumerable problems to the man of science, many of which can be dealt with by well-known existing scientific methods, while others will probably stimulate research in new and profitable directions. The man of science, on his part, will be helped to realize how much of human life is still muddled and unscientific, still awaiting the illumination which only science can bring. The co-operation of the two types of men in a single powerful body may eventually help to bring about a vast extension of the scientific field—with, of course, a corresponding increase in the number and influence of scientific workers themselves.

The society, I take it, will be no mere paper-reading association, though the interchange of views at meetings will be an essential task. It will also, as I envisage it, become, at least eventually, a consultative body to which politicians, social administrators and industrialists will naturally turn for help and information, and to which men of science also will apply for assistance in obtaining such social facilities as they may need for their work (and in the case of the human sciences such facilities may be of great importance).

As the work of the society proceeds, the establishment of special advisory committees—temporary or permanent—will probably be necessary, and in this connexion the society will possibly co-operate with, or incorporate, certain smaller and more specialist bodies already in existence. The main function of the society will, I take it, not be propagandist: nevertheless, it might undertake a certain amount of directly educational work in certain fields where a wider popular appreciation of scientific findings appears to be particularly urgent.

In founding the society, care will have to be taken not to define its constitution or functions with too rigid a precision: so that full advantage may be taken of that most precious characteristic of British institutions—their ability to evolve as circumstance or necessity requires.

Dr. Charles S. Myers, C.B.E., F.R.S.

In these days no one will welcome the formation of a new society unless it can be shown to serve a new and important purpose. But a Society for the Study of the Social Relations of Science does seem to meet a new need. If its council include representatives of the chief existing societies which are already concerned essentially with social affairs (for example, those bodies dealing with public health, applied psychology, ethnology, sociology, etc.), the S.R.S. will constitute a new body which will for the first time bring together in mutual sympathy and co-operation all interested in the various social implications of such 'human' sciences. But by the present proposal its sphere will be enormously widened, and become correspondingly more valuable by the inclusion of the 'purer' sciences of physics, chemistry, and biology, together with their applied aspects of engineering, pharmacology, etc.

This new society will not only encourage in research workers a fuller recognition of the actual and possible social implications of their work. Its activities will also impress on the general public the important social bearings of the physical and biological (including the 'human') branches of natural science, and will increase the national support of scientific research. I hope, therefore, that the S.R.S. will come into being, and I believe that it will serve a valuable scientific and social purpose.

Prof. F. C. Bartlett, F.R.S.

I should like wholeheartedly to support the proposal for the formation of a Society for the Study of the Social Relations of Science. Everybody now agrees that the impact of almost all branches of science upon social life is intense, and that the problems which arise as a result of this impact have a significance for the future of civilization, both national and international, which can scarcely be exaggerated. Most thinking people are coming to realize also that these problems are as amenable as any others to scientific study and direction.

There is at present no adequately constituted body which can co-ordinate the many sectional and specialized interests which are being attracted to a study of the social implications of particular branches of science; but without such co-ordination development is bound to be not only tardy, but also ill-balanced. I also agree completely with the view that the primary need at present is for the formation of a number of properly constituted national scientific groups for the study of the social relationships of science. The problems involved are so complex, so influenced by the established culture of differently organized national groups, that an international body alone cannot hope to cope with them, in the first instance with much promise of success.

I believe that the time is fully ripe, in Great Britain, for the establishment of a society with the constitution and aims described, and that such a body would perform a service of value for the nation, and ultimately for mankind.

Biology

Prof. A. V. Hill, O.B.E., F.R.S.

A notable example of the need to study the social relations of science is in the matter of public health. If guided scientifically, the present general interest in 'national fitness' may be the beginning of an altogether new outlook on human biology, destined to place the maintenance of health and the development of normal human faculties, as equal partners with medicine, in the place reserved at present for the treatment of disease. The scientific knowledge is already largely available: the social applications of it require public action which scientific workers alone cannot take, but in which they must be the guides of public opinion if the action taken is to be wise and effective. This is an international as much as a national problem, and one in which all kinds of co-operation, political, economic, moral, as well as scientific, are needed.

The obligations of scientific people in the matter of national defence will doubtless be referred to by others. Warfare, unfortunately, is not out of date, and it is certain that in the present state of the world its methods will be largely based on science. A free country in which the best scientific men were unwilling—from whatever motives—to co-operate in defence, would suffer from the grave disadvantage of having to employ the second best. Science in the free countries must be willing to play its part, or they may cease to be free: and—apart from anything else—if no freedom be left science will be deprived of its chief instrument, frank and open criticism. Already in countries which are not free it is difficult (at least for the non-expert) to discern what is truth and what is propaganda.

One of the problems certainly of the proposed society would be that of the use—or misuse—of scientific research and knowledge for purposes of war: but this problem is only part of a much larger one, that of the use of the common property of scientific knowledge for selfish purposes. The ethics of secrecy in research, of patenting discoveries of value to the public, of advertisement, of 'expert evidence', of permitting scientific quackery, of exploiting dangerous knowledge or selling dangerous drugs—all such matters are parts of the same problem, not always easy to solve: as indeed is that of using a reputation gained by scientific work, or reflected from the main body of scientific workers, for any sectional or selfish purpose. Medicine for thousands of years has had its standards of ethical behaviour, sometimes abused no doubt, but on the whole an enormous safeguard to the public and to medical men alike. Science needs similar acceptable standards, and one of the chief functions of the new society might be to consider the general question of scientific ethics.

Prof. John S. B. Stopford, F.R.S.

THE effects of the applications of science upon social relations are evident to all, and few will dispute the urgent need for the dispassionate study of the perplexing problems which have arisen. The present facilities for discussion of these problems and the provision for publication are clearly inadequate, and it would be disastrous to charge the national scientific academies with this work, although scientific workers cannot divest themselves, as individuals and citizens, of a responsibility. It would appear inevitable that the task can only be undertaken by such a new society as the one suggested.

The great difficulties appear to arise at that point, and some of the more important safeguards are stated in the preliminary editorial. The matter which the society will have to survey, study and report upon, is of such a nature that it will not always be easy to avoid propaganda and bias, and yet its success will depend to a large extent upon the most strict avoidance of even a suspicion of the intrusion of such things.

One doubt in my mind is whether a Society for the Study of the Social Relations of Science can not only adopt, but also maintain, the method and policy which has proved so successful in the case of the various scientific societies. The new field to be studied is so different that this question seems initially to be the vital one. Another doubt concerns the composition of the contemplated society. It seems doubtful whether men of science ought to take quite such a principal part as is suggested. The consequences of science are so varied and of such a kind that it is most important that the society should have the full benefit of the advice of many others competent to bring knowledge which does not fall within the experience of the scientific worker.

These and others are matters which of necessity will demand much thought, but I earnestly hope that serious consideration will be given to the proposal for the formation of a Society for the Study of the Social Relations of Science.

Prof. J. B. S. Haldane, F.R.S.

IT is obviously desirable that the social relations of science should be studied. But it is equally clear that such a study presents formidable difficulties, and I question whether, even though it does not express corporate opinions, the attitude of the proposed S.R.S. towards papers submitted to it will always succeed in being scientific and objective.

The choice of papers is to depend on "suitable referees". I do not envy them their task. They will have to avoid, on one hand partisanship, and on the other the temptation of rejecting communications voicing 'extreme' opinions merely because such opinions will be offensive to some readers or hearers.

I trust that one condition will be rigidly enforced. Membership should be individual, and no scientific society should be asked to nominate delegates. For example, the Genetical Society includes on its council members with very various opinions concerning eugenics and racial purity. If it were asked to nominate a delegate to the S.R.S., it would be inevitable that these opinions, as well as scientific achievement, would be considered in elections to its council, and a formidable blow would be struck at the society's scientific integrity.

But if this and other safeguards are carefully, and even pedantically, enforced, the S.R.S. may play a valuable part in bringing to light the relations between science and other social activities. I trust that the word "science" will not be too narrowly interpreted, and that anthropologists will be encouraged to discuss the development of technique in primitive societies and its impact on social structure and function. Only against such a background are we likely to view contemporary problems with any approach to objectivity. For the same reason, it is vital that the society should include members not merely engaged in the directive side of industry, but also in manual work. For it is clear that one of the main social consequences of scientific progress has been to alter the functions and status of manual workers.

If these and other conditions making for objectivity are fulfilled, I believe that the S.R.S. can perform a most valuable function. But if not, it may easily become a propagandist body, either for some particular theory, or more probably for the preservation, with trifling modifications, of our existing social system.

Sir Peter Chalmers Mitchell, C.B.E., F.R.S.

MY difficulty about the proposed new society is that the social relations of science cannot be studied in a scientific vacuum, but must be in an atmosphere daily becoming more inflamed by the opposition between the two views of society which, using the terms in the broadest sense, may be called the capitalistic and the socialistic. For example, the sudden discovery of a large-scale method of synthesizing starch or sugar might, and probably would, produce a panic in a capitalistic State, and be a welcome boon in a Marxian organization. But the new society certainly would be interesting, and would be rocked with dissension in exact proportion to the intellectual integrity of its members.

Prof. W. E. Le Gros Clark, F.R.S.

NEW developments in the history of science are only rarely due to the discovery of facts hitherto unknown or to the elucidation of new principles—more often they are the result of a conscious realization, sometimes quite abrupt, of relations and perspectives which have previously been unconsciously accepted or only dimly recognized in the background. But the general background must ultimately be taken into account in judging the implications of any line of scientific development, even though attention tends at first to be concentrated on the separate and more conspicuous details which are the immediate interest of the laboratory worker.

The social background has always been present in the history of science, playing an important part in directing the inquiries of the man of science along specific lines, and being itself also influenced by the results of his discoveries. It is possible now to look back and see quite clearly these interactions, of which the scientific workers of the time were themselves completely unaware. The conscious realization of the social relations of science, indeed, has only recently been generally acquired.

This has more than a theoretical interest, for it marks the first step towards their ultimate control. Herein many see an inspiration for the future. It is one of the achievements of modern psychiatry to have demonstrated that a mental attitude can only be adequately controlled when the individual becomes fully conscious of all the factors by which it is determined. This thesis is equally applicable to external situations. Consequently, having become aware that the social relations of science are really potent as an influence both on the development of science itself, and also on social evolution, it is now urgently necessary to develop as completely as possible our conscious appreciation of the processes underlying this reciprocal action.

This can only be achieved by an extensive analysis of the effects of the progress of scientific discovery on human society, and of social developments on scientific progress, in the past and present, with the object of determining precisely how these effects are brought about. The results of such an inquiry must be formulated with complete objectivity in order to provide a truly scientific foundation for the adequate control of the same processes in the future. That such control is, to say the least, highly desirable, will become more and more apparent as the inquiry proceeds.

Those exponents of social systems who are most eager to belittle the claims of science for representation in directing the destiny of mankind are precisely those who are making the fullest use of the achievements of the scientific worker in the pursuance of their own interests. The misapplication of scientific discovery in the promotion of social evils, no less than its justifiable employment for the true benefit of humanity, requires to be clearly and objectively expressed, as a necessary preliminary to securing proper recognition of the status of science in the social order. The proposal for the institution of a Society for the Study of the Social Relations of Science could scarcely come at a more appropriate moment, for such a society would provide the obvious mechanism for initiating the first step by scientific workers as a body in an attempt to carry out this ideal.

Prof. J. Graham Kerr, M.P., F.R.S.

I AM naturally much interested in the proposal to found in Great Britain a Society for the Study of the Social Relations of Science. The special relation to which I have endeavoured on many occasions during the last twenty years to direct attention is the application of science to the training of the citizen. The system of education as we know it to-day is the system that has come down to us from medieval times. Designed in those days for the training of the priesthood, and extending secondarily to the upper classes of the community, it was this system of training—in the main literary and cultural—that naturally became the system of education for the ordinary citizen, as the development of the art of printing made possible its diffusion through the community. Modern developments in education have been, in the main, improvements in technique, which have left its general framework untouched.

I had the advantage in my early days of acquiring intimate personal knowledge of a comparatively primitive race of men still in the nomadic hunting phases of communal evolution, and it was of extraordinary interest to compare their system of education with that of our Western civilization. With them the end aimed at and reached was fitness—bodily, mental and moral—to play their proper part as members of the community. Hard exercise and plain, sparse diet developed a hard, lean body of A1 quality. Games simulating war and the chase developed the senses to the highest pitch of acuity, and the mind to draw rapidly and correctly the proper conclusions from what was observed. Instruction by the grown-up members of the tribe instilled into the youthful mind the hard code of tribal ethics and discipline, infringement of which brought severe punishment.

What will, to my mind, be one of the most urgent tasks before the S.R.S. will be to tackle the problem of how we are to get the training of our citizens back to a system in which mere superficial culture is brought into proper proportion with, on one hand, such branches of intellectual training as skill in observation and in the thinking out of the correct conclusions, and, on the other hand, the development of physical fitness and moral discipline.

In this strange new world which has evolved during the past century or so—a world in which ideas, good or evil, are swiftly diffused through the community by printing, wireless, the cinema; in which security from pestilence is dependent entirely upon the advances of medical science; in which the very food supply depends upon the applications of science—in this strange new world the call is urgent for such an investigation of the social relations of science as is suggested, if indeed our civilization is to be saved.

Prof. J. A. Ryle

THE medical sciences, above all others, should keep continually in view their responsibilities in connexion with the maintenance of social relationships. Never before has the ground been so abundantly prepared for fruitful contributions on their part to social reorganization and human betterment. The 'time-lag' between discovery and application is often disturbing. This and the modern acceleration of discovery have made it necessary to envisage more effective measures for ensuring free intercourse between the scientific workers and the legislative councils of a country. A Society for the Study of the Social Relations of Science could clearly give valuable help in this direction.

In the preventive field of medicine particularly, requisite data for new and effective reforms are constantly coming to hand. In the matter of control of infection in its epidemic forms, most civilized States are already well advised. There remain, however, other sources of serious infection in the community, as in the case of the milk-borne diseases, which are now known to include the typhoid fevers, brucella abortus infections, and certain grave streptococcal diseases. For the mode of origin and transference of these, science has provided the evidence, and for their prevention the necessary instructions. With healthier and tested herds and compulsory pasteurization and bottling of milk a vast amount of sick-wastage and many hundreds of lives could be saved in Great Britain every year by means of legislation which should not present grave difficulties or inflict any commensurate hardship or alternative risks.

Much could be done to further the recognition and control of droplet infections. In institutions such as schools, hospitals, barracks and offices, these are responsible for a large and continuous sick-wastage and a high incidence of serious diseases, including scarlet fever, pneumonia, meningitis, septicæmia and otitis media. Spacing of beds, better ventilation and measures permitting earlier segregation of infected persons might call for heavy initial expenditure, but the eventual saving of time and labour, health and life, would make ample repayments.

Recent nutritional research has shown that, apart altogether from rickets (now becoming rare in its florid form in civilized States) and scurvy, beriberi, and pellagra (which are largely confined to poverty-stricken zones and native populations), there is in every country much widespread chronic ill-health and inefficiency directly attributable to subnormal diets. The growth and health of children in poor industrial areas and in the homes of many agricultural labourers are still seriously handicapped by protein and vitamin deficiencies, and under the same conditions young mothers frequently suffer from serious mineral deficiencies, especially in respect of iron. The evidence for this has been fully substantiated by social and dietary surveys on one hand, and by clinical and nutritional research on the other.

That such conditions should exist in a wealthy country suggests not only that the organization of society itself must become an even more urgent concern of the sociologists and politicians, but also that there are at present too many obstacles to the transmission of knowledge from the scientific workers to the legislature and to the community at large. In the genetic field knowledge has sufficiently advanced (given the assistance of better education both for the doctors and the public) to make practical measures both of positive and negative eugenics feasible, and this without any interference with the rights and liberties of the individual.

In brief, a more concerted attack upon all the diseases and disabilities, with their attendant loss of time and labour, which are attributable to endemic infections, malnutrition, inadequate light, air and exercise, and uncontrolled and uninstructed breeding, is overdue, and there can be no contradiction of the scientific evidence which declares it to be so.

Any organization which may assist the study of the social relations of the biological sciences and encourage the better application of new knowledge will be likely to receive the warm support of medical men in whatever branch of practice, education or research their work may lie.

Prof. F. A. E. Crew

NOTHING is more desirable—even necessary—in my opinion, than that some organization, with the structure and the functions of the suggested S.R.S., should at once be brought into being. Nothing could be more urgent, more opportune. But, for a number of reasons, I should like to see it grow into a section of the British Association, which I sometimes think now requires a fresh purpose.

It is generally accepted that the world we live in has been re-shaped by science; that our social structure is utterly dependent upon the creations that science has made possible; that there is no longer any question of a return to the domination of Nature; and that man must strive for the complete mastery over his environment, and must secure the power to control his own further evolution.

Scientific workers are enrolled in great numbers in the service of the community, for the reason that those who are in charge of our social evolution are persuaded that only through the further and more intensive application of science to human affairs can we hope to solve the many and complex problems of society. Those who work at the forge of some specialism in science are commonly aware of the possibilities concerning the use of the tools that they are fashioning, and are distressed when these are used not at all or else are employed unintelligently for unworthy purposes. While it is not to be expected that they themselves should be able to construct sound policies relating to human and social betterment, since in them thought is inclined to run in narrow grooves, and the treatment of the rest of life's interests tends to be somewhat superficial, yet from them and from them alone can come certain kinds of information of the greatest possible value, strong threads of ascertained knowledge which can be woven into the social fabric by such as there may be whose minds do not lack balance.

On the other hand, there is an educated public, keenly and anxiously aware of the quality and the promise of the contributions that science is making, eager for further information and understanding, and seriously interested in matters of government. The suggested S.R.S. could provide a meeting place for those men of science who gladly accept the view that science is an instrument which society is using for its own purposes, and for those who are interested in, or concerned with, statecraft, acknowledging that it is to science that we must look for any lasting contribution to the permanent advancement of man's well-being.

The hope of the future, I think, lies in the fact that the biological sciences have grown so large and needs must grow larger. In them is to be encountered knowledge that, intelligently used, will certainly remodel mankind and re-fashion society. But for the present these are largely neglected, for science is now encouraged mainly for economic reasons, and its fruits are used almost exclusively for economic ends. The S.R.S. would be serving a most useful purpose if it could act as an amplifier for the voice of the humanist, for nowadays this is drowned in the ceaseless noises of calculating men and machines.

Prof. E. J. Salisbury, F.R.S.

Any addition to the numerous societies that already exist would need ample justification; nevertheless it cannot be doubted that the contacts which scientific advance makes with the broader aspects of human affairs are often entirely neglected, despite their manifest importance. For example, though the social study of plants is by no means a new one, the importance of our knowledge of plant communities in relation to such matters as erosion and water supply is only just beginning to be recognized. The findings of the ecologist and plant physiologist have their significance for the student of amenities no less than for those concerned with the conservation of a shore-line or the maintenance of a national park. The dynamic character of communities of plants and animals, the changing nature of their balance of life, have important practical implications which are not only neglected but also often unrealized.

Here, indeed, as elsewhere, the gathering momentum of increasing specialization has its grave dangers unless accompanied by a correspondingly augmented synthesis of knowledge. The fostering of a balanced mental nutrition is perhaps the most important function which the universities should to-day perform, for they almost alone are the guardians of this synthesis of thought between one and another branch of pure knowledge. But there is no continually functioning body the special concern of which is to develop and maintain the cross-currents of knowledge in all their wider applications to human affairs. It may be justifiably asked whether there is not a real need for some body the main function of which would be to focus attention on the social implications of advances in science and, whilst meticulously avoiding any propagandist or political bias, would educate public opinion in these respects.

Dr. J. S. Huxley, F.R.S.

I am sure that the establishment of a Society for the Study of the Social Relations of Science would be of great value. At the moment, there is no common meeting ground for those interested in such problems, and the result is a scattering of aim and a lack of agreement as to method. As a matter of detail, it may be suggested that the meetings of such a society should not always be held in the same spot, but at different places, and perhaps often in conjunction with the meetings of other societies. One meeting each year might be held in relation to the British Association.

Just as the Royal Society has many other functions beyond that of meeting for the reading of papers and the holding of discussions, so this new society should from the outset contemplate a fuller scope. For example, we are at the moment without any accurate knowledge on many basic facts concerning the social relations of science. What research is actually being done in Great Britain, under what conditions, and how financed? Why are some branches of research relatively neglected? What are the observable trends in the nature of research, and what can be said as to its practical results and social effects?

Numerous questions also arise concerning such matters as the organization of scientific publication and abstracting services, and what might be called the 'public relations' aspect of science.

It would seem, therefore, as if such a society should aim (*a*) at having money for research grants at its disposal, (*b*) at the organization of an information bureau analogous to the Imperial bureaux already established for pure and applied sciences.

Dr. Joseph Needham

There can be no doubt that the proposal to set up an organization for the study of the social relations of science will be welcomed by wide circles of people, not only in science, but also in industry and all departments of public life. For such a step the time is more than ripe.

The 'ethical neutrality' which has often, no doubt rightly, been described by philosophers as part of the scientific method, has sometimes been interpreted as meaning that it is the duty of the scientific worker to hold no views, and entertain no hopes, about the social order in which his work is done. If the scientific worker were exempted from paying income tax and enjoyed neither municipal water nor police protection, if, in fact, he were isolated from society, abstractions of this kind might be true. But it is, of course, obvious that he is a citizen as well as a scientific worker, with a citizen's responsibilities; in Great Britain, indeed, a citizen of one of the world's oldest and greatest democracies. It is his duty, therefore, to make up his mind about the uses to which his work may be put, or the failure to utilize it, and to express his conclusions in no uncertain manner.

It seems, however, an excellent plan that the publications of the proposed organization should be quite objective, providing a forum where arguments on all sides can be clearly stated. On questions such as the 'frustration' of science, the suggested moratorium of discovery and technical application, the optimum conditions for organization of research, etc., there are various points of view. Differences between these may be major or minor. But at present there does seem to be a lack of the means of ventilating these discussions, nor is it beyond the bounds of possibility that should an overwhelming case be made out for a certain line of action by papers, for example, in the proposed journal, the organization itself might sponsor, or press for, such action.

In general, however, the awakening of scientific men and others to a sense of the social relevancy of their studies to the happiness and freedom of the people as a whole will be a great achievement.

Agriculture and Geology

Sir Daniel Hall, K.C.B., F.R.S.

The question at issue is whether it is worth while to promote the formation of a society to study the social relations of science. At the present time the man of science, perhaps more than anyone else, is conscious that the organization of society, national or international, is in need of guidance. He is also conscious that in such organization as exists, science is almost wholly ignored, though it is being used for ends which must eventually destroy science, on one hand for the intensification of the destructiveness of war, and on the other for the regimentation of public opinion and the suppression of free thought. Let us not mistake the omens—there exists in England to-day an intolerance of differing opinions and a desire to employ force against them, coupled with a contempt for science, except in its subordinate capacity to deliver 'goods', such as has never been known before in my lifetime. All the stupidities of the war-time are being revived in preparation of the war to come. What are the alternatives to the man of science? He can contrive his own personal escape, or he can join with others to promulgate his faith in the ultimate prevalence of reason and persuasion.

Can there be a society devoted to the scientific study of social relations? It may be asked, what else is a university? It should be such a society, but with all our gratitude for the free play of thought they contribute, universities actually take their colour from a relatively narrow range of society, and also in their faculties of law, literature, history and theology are trained the apologists for reaction and return to the past. In consequence, the men of science must constitute a university of their own, a research university which shall subject 'social relations' to scientific study. Such a university or society needs no buildings, but it does need money to pay its investigators. The men engaged in active scientific work can give guidance, stimulus and criticism in such a cause, but they cannot supply the time for the actual investigation.

The results may all seem futile enough—reports on subjects on which the political parties have already taken sides—but it will be proceeding by the only ultimate weapons science can use, by reason and persuasion.

Sir John Russell, O.B.E., F.R.S.

It is very important that the social relations of science should be more fully studied. During the past eighty years, both science and our social structure have developed enormously, and changed out of all recognition. How far the scientific developments have been responsible for the social changes it is impossible to say, but it is certain that they have had profound effects, both directly and indirectly.

These indirect effects of science are probably at a minimum in the totalitarian States, where the dictator plans the life of the nation, and allocates their respective roles to the different groups of the community. Social relations are thus reduced to their simplest form: the scientific worker has no occasion to concern himself with them, or indeed with anything more than the immediate results of his work, and the dictator can proceed at once to deal with any undesirable consequences.

In a democratic country like Great Britain, the problem is far more complex, and unless it is seriously studied it may yet prove the weakness that will bring democracy down with a crash, when confronted with the superior organization of a dictatorship. Science can give vast power to any small group of people who are in a position to use it, and they may use it either for good or for ill. Almost all scientific discovery can ultimately be put to evil use: even agricultural science, most blameless of all, has been perverted to the destruction of soils that had taken thousands of years to build up.

Some of the ultimate effects of scientific discoveries on human life have been very profound, though it would be unjust to attribute them wholly to science. Perhaps the most far reaching has been the moving away from religion as the basis of life and character that was so marked a feature of the older days. The firm belief in a just God who would redress in a future life the pains and sorrows suffered in this life undoubtedly gave our fathers a strong feeling of courage, hopefulness and optimism which many observers declare to be lacking to-day. This same belief also emphasized the responsibility of each individual for working out his own destiny, and so inspired a widespread spirit of self-reliance and sturdy individuality now much less common than it was.

Another important change has been the sweeping away of craftsmanship and the substitution of standardized machine products. It would be impossible now to build beautiful villages such as one can still find in the less known, and to use the house agents' word, 'unspoiled' parts of the countryside: and it is difficult to believe that the old craftsmen would have tolerated the blatant vulgarities proliferating in parts of Great Britain now being 'developed'.

A further consequence of the extension of the machine has been the segregation of a considerable class of people who are unsuited for industry, and who ask for nothing more than occasional unskilled work to eke out their doles, leaving them abundant leisure for the 'pictures' and football matches. They are found chiefly in the democratic countries, dictators having a short way of dealing with them, but they are a growing menace and likely to cause serious difficulties in the future.

It is safe to say that none of these developments was foreseen when science began its modern development, and certainly none was desired by the scientific workers. What further changes may be brought about and whether they are inevitable, could be discovered only by serious study, and it is eminently desirable that this should be undertaken.

Prof. P. G. H. Boswell, O.B.E., F.R.S.

Societies and committees seem to play such an active part in Western civilization that busy people may be expected to look askance at any proposal to re-orientate themselves in this respect. Yet, in the present state of human development, there can scarcely be any doubt as to the need for intensification and direction in the study of the social relations of science. Evidence of such need is seen, in fact, in the activities of the Engineers' Study Group, in the reactions of the sections of the British Association to the pressure of public opinion, and in the recent proposal of the Trades Union Congress to set up an advisory scientific committee. The question that at once presents itself is, can a new organization help forward the good work, or will progress be achieved better by the present haphazard method of disconnected discussion and dissemination by various publishing bodies?

If a Society for the Study of the Social Relations of Science could bring together results that would otherwise be scattered in sundry journals, one important plea for its establishment would be justified on the grounds of convenience. Then would arise the question of the scope of the society, a matter by no means easy to settle. Its scope, once agreed upon, would probably have to be circumscribed and quite likely in the direction of curbing the tendency to speculation which often plays a significant part in discussions of this sort. If, through the publication of papers concerned with the past, present, and possible future repercussions of science on social affairs, a balance could once be struck between unwise speculation and justifiable prevision, an important forward step would be taken. Foresight, as remarked by a well-known writer, is among the latest and most immature of mankind's attainments; certainly, from the moment early man turned from hunting to husbandry, the progress of human development (well expressed as "from the stone implement to the bank overdraft") has been characterized by increasing foresight and an urge to provide for the future. In the political sphere, the results likely to arise from individual or collective human action have necessarily long been the subject of careful thought, but this is not altogether true in regard to the results that may follow scientific discovery.

There seems, then, on the grounds of expediency alone, to be a definite case for the attempt to define the aims and activities of a proposed Society for the Study of the Social Relations of Science. The British Association is, of course, the singularly appropriate body at the present time to undertake this task, but various difficulties would require to be surmounted, including that of publication of original papers in full, if it took over the work of such a society itself.

Physics

Sir Henry Tizard, K.C.B., F.R.S.

There is nothing new in the fact that experiment and invention are transforming the habits of men and are adding to their problems. What is new is that we are all more aware of it, because the rate of change has been steadily increasing. Ease of communication, and the rapidity with which news can be conveyed throughout the world, emphasize the weak points in the social structure and tend to hide the good points. Bad news is, as a rule, better copy than good news. But can it seriously be argued that any section of society is worse off and living under worse conditions than a hundred years ago? Broadly speaking, the natural result of all scientific discovery has been greatly to improve the conditions of life and all our social relations, in spite of—or possibly even because of—the fact that scientific workers have been too busy doing their own jobs well to worry much about other people's.

Many men of science are, however, now taking a direct and vivid interest in the application of science to social problems. But it must be admitted that some of them go about the business in the wrong way. Many readers of Nature can think of scientific men who are most cautious in expressing opinions on scientific questions, who will always allow that there is a good deal to be said for the other man's point of view, who are content to settle the points of difference by careful experiment and study, but who appear, oddly enough, to have little hesitation in making loose and insufficiently considered statements on matters of great social and political importance. They are doing science a disservice, and they ought to be discouraged. A good way of discouraging them is to encourage the sane consideration of the big social problems of the future by scientific workers working in co-operation with other men.

For this reason I think it is well worth while to try the experiment of forming a society to advance knowledge by encouraging the discussion of social science, and by the publication of articles which have had the benefit of informed criticism before they are published. The forthcoming reports by the International Council of Scientific Unions will probably be of great interest, but of very little practical value. They will doubtless contain a mass of data which may eventually be used as a basis for a first-class work by a first-class historian, but they are most unlikely to form a trustworthy guide for national or international policy, or to help to an understanding of the future effects of science on society.

Prof. J. D. Bernal, F.R.S.

SCIENCE as a factor in modern society is uncontrolled; what it does and does not do is left largely to chance and to the operations of ill-understood factors. If we are to prevent it becoming uncontrollable and destructive of the very civilization it has built up, we must begin at least to understand how science and society interact. This is why I welcome the formation of the Society for the Study of the Social Relations of Science, and hope it may find a wide support among scientific workers.

The formation of such a society is a logical step. Science has grown so great that it must take cognizance of itself. We need to create a science of science. This means taking our own activity and the social environment with which it reacts as a new field of study. No existing scientific body could undertake such a task; their fields are already too well delimminated. The sociologists, economists and historians, on the other hand, although they see the wider aspects, cannot by themselves understand either the social implication of scientific or technical discovery or the social and economic conditions which are needed for their production. Only a broad body in which both sides could meet and pool their knowledge can lead to clarification and new understanding.

In the first place we want facts. We need to know the history of the relation of science to society, an aspect of history which has as yet scarcely been touched. Even more urgently do we need to know the present status of scientific research and teaching both in our own country and abroad. How many scientific workers are there? How are they financed? What do they do? How is their work co-ordinated and directed? How is it linked with the satisfaction of human needs and the removal of human evils? Until we have fairly adequate answers to these questions we have no basis for understanding the present or planning for the future. The answering of these questions, even setting them in an answerable form, is a task which should properly fall to the new society.

Research, discussion and publication would all have their place, and in that respect the S.R.S. would be fully analogous to any existing learned society. But the study of wholes is never such a simple and straightforward business as the study of parts, and it may well be that the exact modelling of the S.R.S. on existing learned societies may not be best adapted to the nature of the work it is to undertake. Only experience can decide, and it might perhaps be as well to defer the precise determination of its constitution until there has been the chance to consider the main outlines, and some of the preliminary work has been done.

Prof. P. M. S. Blackett, F.R.S.

THE suggestion that there should be formed a Society for the Study of the Social Relations of Science (S.R.S.) is greatly to be welcomed. One can see here the possibility of the growth of a society which may have a profound educative value. It is worth while, therefore, to consider at the outset some of the conditions that are likely to be necessary for this desirable end to be attained. Of course, these conditions themselves will probably be the subject of controversy. This emphasizes at once that the views expressed in communications to the society must essentially be controversial. If controversy be banned, sterility will certainly result. This raises difficulties in connexion with the proposed, and of course necessary, refereeing of papers. Though it is obviously essential to maintain a high standard in the presentation of the facts, it is equally essential to allow a wide freedom in the deductions from them. For the same social facts do not, in general, lead people of different political views to the same conclusions. If this is not admitted at the outset; if, on the contrary, following too closely the example of other learned societies dealing with more exact subjects, the S.R.S. strives after a pseudo-scientific unanimity of deduction from given social facts, then I fear little that is useful will be attained.

Closely related to this is the danger that the problem of the relationship of science and society will be too much simplified by over-emphasis on the brilliant achievements of scientific workers in their field, with the supposed incompetence of statesmen in theirs. This view is apt to lead to the naïve belief that it is only necessary to replace statesmen by men of science to put everything right—a fallacy which is quite often believed to-day, particularly by men of science.

On the positive side, it seems to me essential that the S.R.S. should have a strong historical bias, in the sense that the relationship between science and society should be considered historically in all its continually changing aspects. Special attention should be given to the reciprocal influence between social change and technical and scientific advance.

Consequently, the S.R.S. must be concerned as much with the impact of society on science, as of science on society: to separate the two is surely to miss an essential understanding of either. It is noticeable that the quotation from the resolution of the Council of the American Association for the Advancement of Science in the article on the suggested S.R.S. emphasizes only one side of this relationship.

If we are now to act usefully so as to remedy in the future our present discontents, we must not only know the facts of to-day, but we must also understand them; that is, we must know how the facts have come about. It is useful here to remember again the much quoted words of Descartes on the nature of things. "Leur nature est bien plus aisée à concevoir lorsqu'on les voit naître peu à peu en cette sorte lorsqu'on ne les considère que toutes faites."

Prof. F. A. Lindemann, F.R.S.

It is a commonplace to say that the whole circumstances of our civilization have been profoundly modified by invention based upon scientific progress. Everybody knows that greater changes were brought about during the reign of Queen Victoria than in the long interval between the coming of the Stuarts and the death of William IV. It is probably fair to say that the changes in the first twenty years of this century were as great as those which occurred in the last sixty years of the previous century; again, the last fifteen years have brought about changes greater even than those which marked the interval between the Boer War and the Treaty of Versailles.

When one observes the geometrical character of this progression and realizes the even more serious and, perhaps, sinister interventions which advances in the biological sciences almost certainly will render possible, one cannot but be anxious about the future. Our world picture has been fundamentally modified. Rightly or wrongly, the restraints of religion have been thereby to a great extent swept away. The facilities which science has provided have made it easy to substitute plausible, but superficial and often half-baked theories, and infect whole nations with beliefs and ideologies which in soberer times would have been scorned.

Whether a great deal can be done to prevent such abuses by the systematic study of the social relations of science it is not for me to say, but I am sure that all men of science will warmly welcome anything which could prevent the results of their researches being put to evil purposes, and will wish every success to any group or body of men working to that end.

Prof. H. Levy

A society for the study of the social relations of science is scientifically justifiable and socially urgent. Scientific workers, in the methods and criteria that they apply, in the range of their work, in the accumulating volume of discovery and invention that they bring forth, constitute a very distinctive section of social activity. They would be less than fully scientific if they were to remain ignorant of the social laws of change that they exemplify in their own group development. The proposal therefore implies a recognition of a shift in scientific interest from the physical and biological to the sociological. This shift has been stimulated by a sense of uneasiness prevalent to-day among scientific workers that all is not well with the way in which science is finding its application in social life. It has been argued that no scientific worker need concern himself with the social outcome of his work. Actually it is a fact that he does, and the proposal in question provides the evidence.

We are witnessing, therefore, a change in scientific focus, a change within science, the causes for which lie partly outside the narrow world of science itself. It raises again the important query, to what extent the trend of scientific development is or has always been conditioned by social forces. This constitutes one class of problem that falls within the scope of a society such as that proposed. The obverse of the picture presents the complementary problem in which science and technology as driving forces in social change have now become the causal agent, the effects of which are traceable in the social environment.

Both these studies argue the need for the exposure of social regularities of a qualitative and even of a quantitative nature, that are directly correlated with technological application. No scientific worker can deny that to clear up such issues is of first importance. No one of scientific temper can deny that many aspects of these problems form a fit and proper field for scientific study. The formation of a society charged with this specific task at a period of social uneasiness may well mark a significant departure in scientific work, as did the foundation of the Royal Society at the inception of the Industrial Revolution.

There are two difficulties that will have to be honestly faced from the beginning. First, it may be a very delicate matter on occasion to draw the line of demarcation between strictly scientific and strictly political issues in such a field. Those who turn their faces politically to the right or to the left have already formed convictions that they believe are scientifically well founded. It follows that the function of such a society must be like that of a sieve through which the scientific bases of such convictions must pass if they are to be other than mere prejudices. How, then, can this be achieved, if in fact many scientific workers, believing themselves unbiased politically, are perhaps unconscious of their own pre-judgments? In the face of this difficulty, I consider that the most suitable council for such a body would consist of a 'reasonable' group of scientifically minded people, along with 'right-' and 'left-wing' scientific men selected for their capacity to present a rational case, and for their power to subject papers presented to informed criticism. Acceptance or rejection of a paper would then depend on a capacity to convince the central section of the council of the validity of the contentions.

The second difficulty lies in the fact that the field of study would trench on those of sociologists and economists. The answer to this is that the task is a selective one, intimately bound up with the world of science, and that there is no evidence that economists or sociologists are particularly concerned with its specific problems. It may be that physicists, chemists, engineers, biologists, and mathematicians are better qualified for this special task, in the sense that they are more familiar with its technical details.

Finally, it is desirable, because of its nature, that the society should rest on as wide a membership as possible, while its influence should expand with the quality and authority of its publications.

Prof. A. Ferguson

ONE's first reaction to the proposal to add yet another to the set of letters that the unfortunate student of public affairs must memorize is one of automatic opposition; nor is that attitude modified after close consideration of the proposals put forward. That an urgent need exists for an organization which, without shirking controversial matters, shall examine and report on, in a purely objective and disinterested fashion, the social implications of advances in science, is to-day obvious to the point of being commonplace; and we can all join in wishing a fortunate outcome of the deliberations of the—what is the jargon ?—the C.S.S.R.

But is it necessary, or even advisable, to set up in Great Britain a new organization which shall be charged with the important and the urgent duties outlined ? What advantage is there, in these days when men's emotions continually run away with their reason, in founding an S.R.S. "with a large individual membership, which should not be confined to men of science, though they should play the principal part in it"? Youth has its generous enthusiasms—which are sometimes ill-regulated; and a young S.R.S., formed at a time when all sorts and conditions of rival propagandists are proclaiming, now and then with borborygmic rumblings, the virtues of their wares, might easily find itself taking a wrong turning. It is a difficult and nice business, in these excited days, to found a new society having such objects in view, and prepared to discuss them in an objective and judicial fashion.

There is at least one organization in existence which has the constitution adumbrated; which is alive to the consequences of the impact of science on a perplexed and unstable world; which is changing its alignment to meet the demands of the changing times; which has experience in the use of a mechanism capable of dealing with these problems more rapidly and more efficiently than that of a new and untried organization; which is not lacking in enthusiasm for the forwarding of world peace, and for an equitable social order; and at any rate is not likely to attempt to staunch a wound in the thigh by applying a tourniquet to the ankle.

The necessity for the existence of an organization which shall inquire, in an objective spirit, into the social relations of science is patent; it is obvious, too, that rapid, effective and well-informed action is called for; but it would be greatly to the advantage of all to consider the possibilities of the adaptations of mechanisms already in being, before adding yet another to the almost crushing burden of already existing societies.

Sir Richard Paget, Bt.

As Mr. Aldous Huxley has pointed out in "Ends and Means", the wise use of men's increased knowledge and power depends primarily on their ethical and philosophical outlook. From this point of view, the scientific problems for investigation are chiefly questions of psychology (especially of mass psychology) and education.

It is obvious that impartial investigation cannot be expected in the totalitarian States, and that there is therefore a great responsibility on Great Britain, the United States, and the other countries which still preserve a measure of intellectual freedom, to point the way to a better order.

Organized research in education is greatly needed. At present education depends mainly on books—that is, second-hand observation, inference, imagination, etc. There has been little, if any, scientific study as to the effects of such second-hand education as compared with first-hand contact with Nature, craftsmanship, and contact with the real problems of life.

As to the machinery of civilization, I venture to add the following, as subjects urgently needing scientific investigation in Great Britain—either by a new organization such as the suggested S.R.S., or by an extension of the British Association, or by the new Nuffield College at Oxford:

(1) *Imperfections of the monetary system.* This at present treats money primarily as a commodity rather than as a token for real wealth, that is, goods and services. It gives undue power to 'finance' as compared with that which is given to the producers of real wealth; it hampers the free production and consumption of wealth. It allows money to be bought and sold as a commodity, and thus causes instability in price-levels, and in the rates of exchange between the currencies of different nations. It also causes such gross anomalies as the destruction of real wealth—for example, wheat, cotton, coffee, fruit, fish, etc.—which cannot be utilized by those who would gladly consume them, because no additional 'tokens' (that is, money) are made available wherewith to purchase them.

The present economic system also forces each nation to strive for a favourable balance of trade as against other nations; this in itself is a perpetual stimulus towards national hostility.

(2) *Lack of statistics.* It has frequently been pointed out that efficient production and planning for future production are hampered by lack of statistics of production and consumption. It seems probable that adequate statistics, coupled with a rational monetary system—which equated the supply of money (and credits) to the production of real wealth—would greatly facilitate such production, and would obviate the present difficulties of selling the products of industry; this would incidentally save a large part of the great expense and labour incurred in advertising and salesmanship, and release a large personnel for further productive work. In the domain of public health also, much valuable information is probably lost by the lack of systematic medical statistics.

(3) *New Inventions.* At present there is no recognized system for investigating the merits of new inventions, and for supplying the capital wherewith to try them out. The consequent hardships—to which even the best inventors have been, and still are, subject—are notorious.

(4) *Changes of employment.* The rapid changes of technique and of demand for new industries appear to necessitate a corresponding system of training employees in new techniques, so that new industries can be developed without dislocation of present personnel. Experience during the Great War showed that such changes of employment can be effected much more easily than had been anticipated. The co-operation of the trades unions would, of course, need to be secured in the investigation of this problem —as also in that of the length of notice to be given to employees in industry in terminating their employment otherwise than for personal faults or inefficiency.

Chemistry

Prof. A. C. G. Egerton, F.R.S.

"Man learns from history that man never learns from history." Will the same be said, that man learns from science that science cannot help man ? Will a sociologist of the future find that the impact of science on the social organization had been a factor contributing to the better adaptation of those organizations against debilitating, disintegrating and disruptive influences, and that there was steady progress towards a higher state of being ? Or will it be said that the impact of science was to bring greater difficulties in its path than otherwise ?

On the material side, there is no doubt that the necessities of life can be obtained more easily as a result of the knowledge that man has gained through science. But is this facility gained at the expense of increased difficulties of a psychological and sociological character which are not so easily attacked by the scientific method ?

As a result of the application of science, the material conditions enabling a population to live within a given area can be assessed ; but we have only gone a little way towards carrying into effect the available material improvements. When we approach the complications confronting us in the application of the scientific method to biological and psychological problems and their influence on sociology, the way is not so clear. What would be the effect of the prolongation of the average length of life ? What would be the effect of increased leisure ? What are the psychological effects of the various habits of life of civilized man ? About such questions it is only possible at present to express an opinion, and no statement based on attack by the scientific method can yet be made.

Many matters in which human relationships come into play and about which action has to be taken are at present best dealt with by those responsible for government, who have the same experience towards such matters as the works technician has in applying his experience and rule of thumb methods to technical matters. Perhaps, as Ramsay MacDonald envisaged, the scientific method would eventually enter the realm of government and make the same advance as it has in the realm of technology. At present, however, the application of the scientific method to sociological problems has great difficulties.

A beginning can best be made, and has to some extent been made, by those responsible for government seeking the advice of men of science on all such matters in which their assistance can obviously be of advantage ; in connexion with nutrition, prevention of disease, agricultural policy, afforestation, denudation, pollution of air and water supplies, provision of power and of heat, conservation of resources, etc.

It is often said that the scientific worker should control the application of his discoveries so that they may be used for the general good, instead of allowing them to be employed haphazard or utilized by those tendencies which egg men on to ill. As matters stand at present, it is not possible for the scientific investigator or the technician to control in what direction his work will be utilized. The man of science has less power almost than anyone towards the direction of human affairs. He is not organized, he cannot strike or lock himself out without running counter to his ideals of an unbridled curiosity into the workings of Nature, and he is as a rule too liberal-minded and disinterested to wish to keep his knowledge secret after the manner of the ancient priesthoods. On the other hand, he cannot stand by and see his work desecrated by folly, and he should have more power to enable him to help prevent such desecration. How can this be achieved ?

Articles in Nature have suggested certain ways and means. By all means let questions of what help the man of science can give be discussed, studied and reported. But committees and reports are not enough. Responsible scientific men who have achieved respect in their own particular line of work must carry the responsibility of their position and should be ready to be the link between the specialist in their particular branch of science and those who are responsible for government.

Things happen in this way at present. The Royal Society has always provided such assistance as it has been asked to give. Unfortunately, what is done is not enough. In some countries responsible men of science are taken into greater confidence as advisers and leaders in the State. It is this that has to be encouraged, rather than the setting up of a number of committees the work of which it is no one's particular interest to further. It has been unfortunate that, at a time when the achievement through science has been so great, the advice of those who have brought it about has not been more sought in matters of policy. To this day even on the boards of companies which are directly exploiting the results of scientific developments, those who have been very largely responsible for those developments are not included. The technical man is still kept in his place. In fact it is only through their own force of character that men of science and technical men have shared in the control of affairs.

Perhaps the fundamental error of these days is that economic considerations are allowed to override all others, and at a time too when such values are not really essentially paramount, for through the command of natural resources the human requirements of life can nowadays be met (provided growth of population is to some extent controlled). Science, art and religion contain the basis of other values which must not be subservient to economic values. The pursuit of science has a value on its own account. The execution of a fine piece of experimental work or mathematical analysis has a beauty of its own, just as poetry and art have their particular appeal. It is this aspect of science which influenced such great men as Scheele and Faraday.

There must be men in each country to give effect to this sense of values. Those responsible for government should be able to consult with a permanent body, such as the Royal Society, which would be the focus of the various advisory councils needed, and the link with similar bodies in other countries. The British Association provides an adequate means for discussion of the various problems, but it is possible that executive action could best be taken through a smaller representative body such as the Royal Society, as close co-operation exists between the two organizations.

If an international council is appointed to work in collaboration with economists and politicians, I think that the appointments to such bodies should be made by collaboration between the Royal Society and the Government.

The substance of my remarks is that scientific men should be invited to take a closer and more responsible position in the affairs of State, and should be in closer touch with those responsible for government, as they were in the days of Charles II.

Prof. F. G. Donnan, C.B.E., F.R.S.

As a foreign member of the Amsterdam Academy of Sciences, I am very glad to have had the opportunity of associating myself with the action taken by that body, an action which led to the recent setting up by the International Council of Scientific Unions of a "Committee on Science and its Social Relations". There can be no doubt that this Committee is destined to carry out most valuable work, and its formation on such a secure international basis may well mark the beginning of a new era in the history of mankind.

The proposal to found in Great Britain a Society for the Study of the Social Relations of Science is one which I wish to support most strongly. The existence of such a society in this country—and of similar societies in other countries—would be the surest guarantee for the success of the great work initiated by the formation of the international committee.

The impact of science on society—to employ a now famous expression—is of two kinds. In its less obvious and yet perhaps finally most important form, it alters the general 'climate' of thought and opinion. In the nineteenth century, when steam-driven machinery in factories, steam-boats and railway trains, and the application of electrical science in the telegraph, telephone and electric light were changing the social and economic relations of people, the work of Wallace, Darwin and Huxley caused a fundamental change of general outlook. So also in the present century, with its vast organization of factory production and great power stations, its electric trams, motor-cars, aeroplanes, cinemas, radio, gramophones, etc., the great discoveries in physics, chemistry and astronomy have produced a profound effect on the general climate of opinion; whilst it is probable that the biological and psychological sciences are destined in no very distant future to effect another and perhaps still more drastic development.

It is with no intention of underrating the enormous effects of applied science on the social and economic conditions of humanity that I mention these matters. I want simply to suggest that we must pay equal attention to the influence exerted on the actions of men by the general outlook which they derive from the current scientific philosophy presented to them. It is of very great importance that this 'ideology' should be the best available.

In spite of everything that has been written on the subject, it is perhaps not yet sufficiently realized that the inhabitants of this planet are witnessing at the present time a very peculiar epoch in its history —the epoch of the enormously rapid advance of science and its applications. Although speculative prophecy is usually of small value, I am inclined to hold the opinion that this epoch will be a relatively brief one, confined (bar 'accidents' of a terrestrial or extra-terrestrial character) to the next ten thousand, or possibly the next two thousand, years. It is hard to say when the zenith of this peculiar period will be reached. Certainly nothing like it has ever been experienced before by the inhabitants of this earth. Will its effects be beneficial or catastrophic? That is the serious question to which civilized humanity is now slowly awakening. Modern science is the revelation to mankind of possibilities and potentialities undreamed of even by such giants as Galileo, Newton and Harvey—undreamed of, therefore, only a few hundred years ago. What will a Wellsian historian, writing, say, in the year 20,000, have to say of this epoch?

In the somewhat complacent mixture of romanticism and utilitarianism which characterized the nineteenth century, many men, intoxicated by the advances of that age, dreamed of a continuous upward progress of humanity. Wiser, or perhaps more disillusioned, than they, we of this century are by no means sure of such a continuous progress. Many see a possible, or even probable, danger of collapse. Such a crash of civilization could never be due to the true advance of scientific knowledge, though it might be accelerated by the inhuman and anti-social use of this knowledge, and by a false ideology based on a perverted interpretation.

I think that one of the main objects of the new society will be the careful study of the reversible social-scientific reaction, science $\rightleftarrows$ human welfare; how by the advance of science to increase human welfare, and how by the advance of human welfare to increase science. This is one of the great dynamic equilibria of a beneficent and benevolent civilization.

At the same time we must avoid the errors of an easy sentimentalism founded on august abstract nouns and grandiloquent phrases. Human society and its welfare are extremely difficult and complicated matters, the hard, concrete realities of which demand detailed and highly critical study. Although we may reject the application to human society of the holistic conceptions of the beehive and the termitory, or the idea of the flowering of a great aristocracy based on a partial de-humanization of the rest, it will be for the biological and psychological science of the future to say what are the possibilities and what may be the best available solution. Unlike traditional philosophy and traditional theology, science does not attempt to storm the citadel of truth ; it rests on patient experimental research, and offers no simple panacea and no facile Utopia. Great and immense, therefore, are the prospects and potentialities of the new society, for they will be based on the essential fluidity and adaptability of scientific thought, the steady progress of discovery, and the slow building of whatever conception of the *summum bonum* mankind is capable of attaining. There may be room here for personal optimism or pessimism, but none for tears or an inaction born of despair.

Prof. John Read, F.R.S.

The furtherance of the ideal under discussion will depend largely upon the character of science teaching in the future. Such teaching in the past has consisted too often of a systematized inculcation of facts and theories, unillumined by any adequate reference to the bearing of these facts and theories upon everyday life, or to their influence upon the development of modern civilization. A neglect of the historical and humanistic aspect of science has been equally pronounced : incidentally, the scientific worker's neglect of history has found a counterpart in the historian's neglect of science.

A frequent consequence of what may be called the teaching of science in blinkers has been a soulless and uninspiring presentation of a vast field of human thought and endeavour which is fraught with possibilities as an instrument of education, as distinct from instruction. Dr. George Sarton has well said that "the more science enters into our lives, the more it must be 'humanised', and there is no better way to humanise it than to study its history. Such studies, reconciling the purely scientific, the historic, and the philosophic points of view, would be the source of the soundest and highest idealism." The man of science is a pioneer and an architect of human progress, and as such he should cultivate a wide vision. Only by so doing will he be able to help efficiently in building up a human society capable of appreciating the spirit and method of science, and of putting the discoveries of science to sane and effective uses.

Prof. J. C. Philip, O.B.E., F.R.S.

The significance of scientific method and scientific discovery for social and economic conditions, national and international, is increasingly recognized, and the proposal to provide a specific forum for the exposition and discussion of the relevant problems merits cordial support. In the columns of Nature, from time to time during recent years, the importance of these problems has been stressed, and it is entirely appropriate that the Editor should initiate suggestions for a further definite step in this matter.

Scientific men are often regarded as standing aloof from common human interests, and indeed their own attitude has frequently given support to this view. Some have been inclined to rate the value of science as inversely proportional to its utility and to the extent of its contact with the practical affairs of life. In the world situation of to-day, however, when the frequently serious economic consequences of technical development and the extensive application of scientific knowledge to destructive ends are only too evident, such a detached attitude becomes impossible for a reflecting man.

Advancing knowledge has outstripped the development of social ethics, and one feels that, however marvellous the discoveries of the last fifty years may be, their applications have in many cases provided only "improved means to unimproved ends", as Mr. Aldous Huxley has put it recently. It is time that vision and brains were devoted, not so much to the extension of the boundaries of knowledge, as to a serious and systematic examination of the problems which the discoveries of science have created.

A society for the study of the social relations of science, such as is now proposed, would provide opportunity for the dispassionate investigation of these pressing questions. Operating in conditions of objectivity and free discussion, the society should attract the sympathy and support not only of scientists but also of others to whom the welfare of the community is a major concern.

Dr. C. H. Desch, F.R.S.

The effects produced on society by the growth of science fall into three main categories : the changes in material conditions caused by inventions ; the influence of scientific thought on the intellectual outlook ; and the increased appreciation of the mutual dependence of peoples. It is the first of these which attracts most attention, and seems to offer the most fruitful field for such an organization as is suggested, but the other two are no less important. Although the present is called the Scientific Age, mainly on account of its material achievements, it is doubtful whether current views on social questions are appreciably affected by scientific ideas. The history of scientific discovery and thought, the scientific interpretation of historical events, and the study of such concrete problems as the conservation of natural resources and their relation to international trade, fall into the third category.

In discussions on this subject, 'science' has too often meant only the physical sciences. No doubt public interest in nutrition and in eugenics has done much to bring biology into the field, whilst popular interest in psychology even proves embarrassing from its failure to distinguish science from charlatanism, but science remains incomplete unless it includes sociology, in the Comtean sense of a synthesis of the social sciences. In the public view, its place has usually been taken by economics, which deals only with a single aspect of social life. Unless science be understood to embrace social as well as physical and biological phenomena, it would seem impossible to bring it to bear effectively on social conduct.

As science becomes more specialized, so that workers in different branches find it increasingly difficult to understand one another's language, the need for a synthetic outlook becomes more urgent. This view has been frequently expressed in NATURE.

It is regrettable that so few workers in experimental science have taken a keen interest in social science, if we except the recent enthusiasm in some quarters for the Marxian system, which exalts the economic above all other social factors. The Sociological Society (founded 1904, since 1930 the Institute of Sociology) has attracted few scientific workers, in spite of the early efforts of Francis Galton and Patrick Geddes, but it would seem an appropriate centre for discussions of the social relations of science, whilst the annual gatherings of the British Association afford an excellent opportunity for bringing results before the public. It needs to be shown that a new society, unless its programme be very carefully thought out and some guiding principle of synthesis adopted, would do the work better than existing organizations. There will be general agreement as to the need for such action as that suggested, but it is not clear that the solution proposed is the best.

Summary

THE comments in the foregoing letters may be conveniently summarized in three groups: *why* is it necessary to go deeper into the social relations of science, *what* are the activities envisaged, and *how* can they best be brought about.

The rapid and persistent growth of natural knowledge leads to effects which have to be correlated (Bragg, Fleure). There is a need for intensification and direction in the study of the social relations of science (Boswell) and guidance in the organization of society (Hall). All is not well in the way science is applied to social life (Levy). The liberty of science is threatened (Hopkins). Social developments are ill-balanced (Bartlett, Philip) and may destroy civilization (Bernal, Donnan, Kerr, Lindemann).

The social problems created by science can be solved by scientific method (Flugel) but educative action is needed both for scientific workers (Blackett) and for other citizens (Kerr). As the sciences become more specialized, the need for their synthesis increases (Desch, Salisbury, Spearman) and also that for a closer relationship between scientific and social workers (Laski, Marquand, C. S. Myers). It is the duty of scientific workers, as citizens, to study the social implications of science (Needham, Stopford) and to see that Government and legislature receive the best advice from those scientifically qualified (Egerton, Ryle).

The proposed organization would provide a meeting place between men of science and others interested in statescraft (Crew) and would prevent them from going about the business in the wrong way (Tizard). It should study the social background of science (Le Gros Clark), the historical relations between science and society (Blackett) and, in general, the reversible reaction science ⇄ society (Donnan). In particular, it would investigate the repercussions of science on social affairs and also likely future developments (Boswell, Russell).

As specific problems, it might find out the number of scientific workers, how they are financed and how their work is co-ordinated (Bernal, Huxley, Needham) and might draw up a code of ethics for them (Hill). The mechanism of production, the unsatisfactory method of dealing with new inventions, the imperfections of the financial system, the lack of statistics, problems of employment and ecological studies also deserve attention (Sargant Florence, Paget, Salisbury).

The organization envisaged should eventually humanize scientific teaching (Read), bring together results scattered in many journals (Boswell), act as co-ordinating body to other societies (C. S. Myers) and encourage them to study specific problems—for example, the anthropological and folklore societies might inquire into the springs of human action (Fleure). It should obtain and distribute funds for research (Huxley, Hall, Wells) and might eventually act as information bureau and consultative body for administration and industry (Flugel, Huxley).

The need for preventing unnecessary duplication is stressed, particularly with reference to the activities of the British Association, the Royal Society and the Institute of Sociology (Ferguson, Egerton, Desch). Sociologists would welcome co-operation (Farquharson) and the proposed organization might grow into a section of the B.A. (Crew).

Other than scientific workers should be welcomed as members (Hopkins, Levy, Philip, Stopford). Sociology should be well represented (Ginsberg). Representatives of the chief societies interested in social questions should be included (C. S. Myers) but membership should be individual (Haldane). Manual workers should be allowed to join (Haldane) but economic quacks should be excluded (Marquand).

Apart from one correspondent (J. L. Myres) the comments and criticisms are mostly constructive. The chief difficulties foreseen are in connexion with retaining a cool, scientific attitude towards emotional and political subjects (Ferguson, Chalmers Mitchell, Stopford) and of obtaining a fair, unbiased board of referees for the publications (Blackett, Haldane, Levy). Here, perhaps, the First Interim Report on Schemes and Proposals for Economic and Social Reforms, published by the British Science Guild and the Engineers' Study Group (see NATURE, May 25, 1935) shows that at least one group of investigators found that the problem was not insoluble.

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tions of this, his favourite, field of research, and did his best to build up really adequate series upon which future systematists could work. It will require the labour of two or three generations of systematists to exhaust the possibilities of the material now available. It is to be hoped that the Tring Museum will be carried on as a living institution and that enough neighbouring land can be acquired to admit of future extension.

Protection of Aborigines

Recent correspondence in the Press has shown that there is a considerable body of public opinion which is still far from satisfied with the treatment accorded the races of backward civilization under British jurisdiction, notwithstanding the undoubted improvement in conditions and a more sympathetic attitude towards them to be observed in recent years. With a view to the possibility of further improvement, it has been decided by persons and organizations interested in the problem to hold a public meeting for the discussion of the question of their preservation. The meeting will be held by permission of the Council of the Royal Empire Society in the Assembly Hall of that body on April 28 at 3.45 p.m. The chair will be taken by Lord Moyne, who will speak on "Natives in the Solomon Islands". Other speakers will be Dr. W. van Waterschoot van der Gracht, president of the Pygmy Sub-Committee of the Nederlandsche Commissie voor Internationaale Natuurbescherming, on "The Preservation of Backward Primitive Races"; Dr. John R. Baker on "The Natives of the New Hebrides"; and Dr. Julian Huxley, who will deal generally with the preservation of primitive cultures. Tickets of admission, which is free, may be obtained from the Secretary, Aborigines Protection Society, Denison House, 296 Vauxhall Road, S.W.1.

Indian Cultural Studies

Notwithstanding the assurance that the Indian collections of the Victoria and Albert Museum, South Kensington, were not to be dispersed and that space would continue to be provided for them in the galleries of that Museum, which followed Mr. de la Valette's lecture before the Indian Section of the Royal Society of Arts (see Nature, December 25, p. 1108, and January 29, p. 177), the critics of the methods of the ethnographical sections of our national collections are still of the opinion that less than justice is done to requirements for the study of the cultural history of India, compared with what might be attempted with the resources at command. A joint committee accordingly has been formed, consisting of representatives of the five bodies more intimately concerned in the study of India and her peoples. These are the Royal Society of Arts (Indian Section), the India Society, the Royal Asiatic Society, the East India Association and the School of Oriental Studies. Although the joint committee has as yet, it is understood, arrived at no decision as to its precise aims and methods of procedure, in principle the general purpose is to secure provision which in scope and display, dignity and standing, will be worthy of so great a dependency as India, with its tradition of advanced civilization stretching back thousands of years, and as the place of origin of at least one of the religious systems of the world's history. The traditions of the Victoria and Albert Museum, though it included 'industry' in its original purview, are not such as to foster a treatment of Indian culture in which technology and the humbler arts of life have no less claim, if not indeed a stronger claim, to treatment than fine art. But while the Indian collections continue to be merely a department of a larger unit, they must be subordinated to the purpose of the whole. The joint committee has been criticized, notably by the writer of a letter in *The Times* of March 23, as academic; but surely if its purpose is rightly understood, it is precisely the academic spirit which it aims to avoid. What could be more closely in touch with modern India than a comprehensive museum of Indian culture, which should cover both past and present ?

University of Birmingham

At the last meeting of the Council of the University of Birmingham, the following resolution was passed: "The Council has considered the recommendation of the Finance and General Purposes Committee with regard to the pressing needs of the Department of Physics, involving a capital outlay of about £60,000. It unanimously recognizes the urgency of the requirements, but, owing to the present state of University finance, regrets that it is not possible at present to put this work in hand. It is, however, most desirable in the interests both of teaching and research that there should be no delay, and the Council would be most grateful for any financial help from outside to enable the University to meet these requirements." This is a sequel to a report on the needs of the Physics Department made to the Council by Prof. M. L. Oliphant, who points out that the equipment and general facilities of the Department are totally inadequate for present needs. The time has come to review the temporary expedient adopted twenty years ago of having a considerable portion of the Department in old army huts.

The scheme for extension of the Physics Department proposed by Prof. Oliphant includes an additional block which would consist of a large central research hall suitable for high-voltage work, flanked by a number of research rooms, a machine room, workshop, dark rooms and a basement room for high-energy X-ray work. The general idea is that the buildings themselves should be simple and less costly than those of the remainder of the University, and the design should be elastic to be capable of readjustment with the changing needs of physical research. The present building could then be used entirely for teaching work and accommodation of staff. Unfortunately, it appears that architectural considerations require that the frontage to the great court should be of the massive and costly type exhibited in the rest of the University building as a whole, though the rear part radiating out behind the curved frontage might be of the relatively cheap design favoured by Prof. Oliphant. The financial stringency indicated in the resolution of the Council is due to the heavy expenditure required for the completion and equipment of the new Medical School. The needs of the University of Birmingham, particularly in such a subject as physics, should have a first call on the generosity of Midland industrialists.

Protection of Wild Fowl

THE Wild Fowl Enquiry Sub-committee of the British Section of the International Committee for Bird Protection was received on April 6 by Sir Samuel Hoare, the Home Secretary, to discuss the question of the further protection of wild fowl. The deputation, which was introduced by Mr. Perch R. Lowe, chairman of the sub-committee, included its secretary, Miss P. Barclay-Smith, and representatives of bodies interested in the preservation of wild life and of museums. The immediate object which this sub-committee has in view is to promote legislation aimed at the prevention of the importation of wild duck and wild geese into Great Britain during the close season. There is also the further question of preventing the exposure for sale of wild duck during the same period and also of extending the close season to such limits as would be in the interests of the wild duck, sportsmen, and everyone concerned. At the present moment, large consignments of wild duck are shipped from Holland to British markets during our close time, having been caught in the many decoys which that country possesses. In view of the threatened diminution of the status of wild duck brought about by the many adverse factors affecting their welfare at the present time, the commercialization in Europe of any bird habitually shot for either sport or food, or both, cannot rationally be allowed to continue during both the open and close season. It will be remembered that the present sub-committee was successful last year in getting legislation set up to prevent the importation of quail into Great Britain during the close time.

Royal Botanic Garden, Calcutta

A NUMBER of men of science from Great Britain and elsewhere who were attending the jubilee meeting of the Indian Science Congress in January last were able to be present at the celebrations of the hundred and fiftieth anniversary of the Royal Botanic Garden, Sibpur, Calcutta, a note on the history of which appeared in NATURE of January 1. Sir James Jeans, president of the Congress, congratulated the Garden on its anniversary. Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, in his address, stated that it was the first time a director of the Royal Botanic Gardens, Kew, had been to India in his official capacity. Sir Arthur pointed out the similarity in position, scientific interest and æsthetic beauty between the two Gardens. He emphasized the importance of the Sibpur Garden, and expressed the hope that the Government of Bengal will recognize its importance and that the necessary funds will be forthcoming both for the maintenance of the scientific staff and for the upkeep of the living collections. Sir Arthur suggested that Sibpur should, like Kew, serve as a training ground for student gardeners, in order that the many good gardens and parks in India may be maintained at a high standard of excellence. To this end, he suggested that the practice of sending men from Kew to Sibpur as instructors or curators should be continued.

DR. K. BISWAS, the present superintendent of the Royal Botanic Garden, Sibpur, referred to the keen interest taken in its welfare by the late Sir Jagadis Chandra Bose, and also by the late Prof. Hans Molisch, both of whom frequently visited the Garden. Dr. Biswas briefly reviewed the history of the Garden, most of the superintendents of which have been botanists of eminence. Economic botany naturally takes first place in the activities of its scientific staff, and Dr. Biswas gave examples of what has been and is being done in this direction, for example, cultivation and utilization of teak, jute, cotton, flax, tobacco, rubber, coffee, cocoa, etc. The Garden also offers good scope for the study of the tropical flora; 1,500 species are under cultivation. In fact, Indian botany is offered excellent opportunity for advancement with the help of the Royal Botanic Garden, its excellent Herbarium and its Library at Sibpur, Calcutta.

British Empire Cancer Campaign

AT the recent quarterly meeting of the Grand Council of the British Empire Cancer Campaign, a further grant of £1,000 for one year was placed at the disposal of the North of England Council of the Campaign to enable the short wave investigations to be continued under the direction of Dr. F. Dickens and Dr. S. F. Evans. This work, which is a continuation of that which appeared in the last Annual Report of the Campaign and in a recent issue of the *American Journal of Cancer*, concerns the investigations of the effect of varying forms of heat upon malignant tissues. It was also decided to allot a further sum of £1,338 for one year for the extension of the national propaganda work being carried out by the Central Propaganda Committee. Sir Charles Gordon-Watson, vice-chairman of the Clinical Cancer Research Committee, reported that the organization for the statistical cancer inquiries in the teaching and special hospitals of London and the hospitals of the London County Council and the Middlesex County Council has now been completed. He stated that all these Institutions have appointed registrars to take charge of the records at their respective hospitals and that the headquarters' arrangements are being perfected to deal with the data concerning more than 17,000 new cases of cancer yearly in the metropolitan area of London. The Grand Council confirmed the recommendation for the appointment in the near future of a full-time medical secretary and registrar at headquarters for this purpose.

Civil List Pensions

THE following pensions, among others, were granted during the year ended March 31, 1938, and are payable under the provisions of the Civil List Act, 1937, whereby the total amount has been increased from £1,200 to £2,500: Miss Alice Mary Buckton, in recognition of her services to literature and of the services rendered by her father, the late Mr. George B. Buckton, F.R.S., to entomology (£50 additional to the previous pension of £60); Mrs. Agnes Maud Carey, in recognition of the inventions of her husband, the late Mr. Robert Falkland Carey, in connexion with the discharge of aeroplanes from ships (£25 additional to the previous pension of £75); Miss Evelyn Marie Jeanette Dupré, in recognition of the public and scientific services rendered by her father, the late Dr. A. Dupré, F.R.S. (£75); Dr. Frank Elgee, in recognition of his services to archæology and geology (£130); Miss Alice Everett, in recognition of her own and her father's services to physics and other branches of science (£100); Miss Rachel Mary Fleming, in recognition of her services to anthropology and geography (£20 additional to the previous pension of £80); Prof. James John Guest, in recognition of his services to science (£100); Sir James Marchant, in recognition of his public and social services (£30 additional to the previous pension of £75); Mr. James Reid Moir, in recognition of his services to prehistoric archæology (£110); John A. J. Starkey, Marjorie M. J. Starkey, Jane R. Starkey (during the minority of any one of them), in recognition of the services rendered by their father, the late Mr. James Leslie Starkey, to archæology (£210 in trust).

Announcements

THE Linnean Gold Medal for 1938 of the Linnean Society of London has been awarded to Sir D'Arcy Thompson, professor of natural history in the University of St. Andrews.

SIR DAVID PRAIN has been appointed president for life of the Imperial College of Tropical Agriculture. Sir David, who celebrated his eightieth birthday on July 11 last (see NATURE, July 17, 1937, p. 98), was director of the Royal Botanic Gardens, Kew, from 1905 until 1922. He was a member of the Tropical Agricultural College Committee appointed by Lord Milner in 1919 and had been vice-chairman of the Imperial College of Tropical Agriculture from its foundation in 1921 until last year, when he retired. His appointment as life-president of the College is a particularly fitting honour which, it will be the general wish of all scientific workers, he may enjoy for some years.

SIR MERRIK BURRELL has been awarded the Gold Medal of the Royal Agricultural Society for distinguished services to agriculture. Sir Merrik was president of the Royal Agricultural Society and chairman of the Council of Agriculture for England in 1936, and for many years was chairman of the Society's committee which founded and administered the London Quarantine Station before it passed into the control of the Ministry of Agriculture.

WE regret to announce the death of Mr. J. E Marsh, F.R.S., demonstrator in the University Museum, Oxford, from 1886 until 1930, on April 13, aged seventy-seven years.

ON April 17, a new British record for gliding was made by Mr. C. Nicholson, who flew in his Rhonsperber sailplane from Huish (Wilts) to East Bigbury, near Plymouth, a distance of 122 miles. The previous record was held by Mr. P. A. Wills, who flew 104 miles from Dunstable to Pakefield on July 5, 1936 (see p. 714). On April 18, Mr. J. S. Fox broke Mr. Nicholson's record by flying in his Rhonadler sailplane from Huish to Fowey, Cornwall—a distance of 144 miles.

THE British Association announces that Charles Darwin's home, Down House, Downe, Kent, and the gardens and grounds, are open from 10 a.m. until 6 p.m. daily until September 30, including Sundays. Admission is free.

THE annual Congress of the Ophthalmological Society of the United Kingdom will be held at the Royal Society of Medicine, 1 Wimpole Street, W.1, on April 28–30, under the presidency of Dr. Gordon Holmes. Further information can be obtained from the Secretary, 7 Queen Street, W.1.

THE sixteenth International Congress of Physiology will be held at Zurich on August 14–18 under the presidency of Prof. W. R. Hess and will consist of six sections devoted respectively to general and comparative physiology; biophysics; biochemistry; applied physiology (sport, aviation); psychophysiology; pharmacology. Further information can be obtained from Prof. Rottler, Sonnenweg 6, Basle, Switzerland.

AN earthquake of moderate intensity was recorded at Kew Observatory on April 13. The first movement reached Kew at 2 hr. 49 min. 23 sec. G.M.T. and the records indicated that the epicentre was 1080 miles away, probably in southern Italy.

A UNIT for clinical research in surgery has been established at Edinburgh by the Medical Research Council, acting jointly with the Royal Infirmary, the University, and the Royal Hospital for Sick Children. The unit will be located in the Infirmary, with facilities also in the University Department of Surgery and at the Hospital. The director is Mr. W. C. Wilson, who has for this purpose been appointed to the whole-time staff of the Council. The arrangement has at present been made for a period of five years, as from April 1, 1938. The establishment of 'units' or departments of this kind in selected hospitals forms part of a policy adopted by the Medical Research Council for the promotion of research work in clinical science, as opposed to the laboratory branches of medicine.

ERRATUM. In the letter entitled "Occurrence of the Freshwater Medusa, *Craspedacusta sowerbii*, in Eastern Canada" by the late Prof. H. B. Fantham and Dr. Annie Porter in NATURE of March 19, on p. 515, col. 2, line 26, for 1938 read 1937, and on p. 516, line 37, for 32·03 read 32·30.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 753.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Recent Solar Eruptions, Auroras, and Magnetic Storms

IN connexion with the aurora of January 25–26, 1938, discussed in detail in NATURE of February 5, p. 232, it may be of interest to report that a brilliant and prolonged solar eruption and an unusually severe radio fade-out were observed at the Commonwealth Solar Observatory, Canberra, on January 24.

Owing to cloudy weather, the first spectrohelioscope observation of the day was not made until 1512 Eastern Australian Standard Time (0512 G.M.T.; all times which follow are G.M.T.). An exceptionally large eruption was then seen to be in progress around the large spot group at 22° N., 80° W.; from then until 0700, when the intensities were still high, observations were made through breaks in the clouds. No abrupt changes in intensity corresponding to the maxima observed in the aurora were noted, although curved prominences, similar to Pettit's Sunspot Type[1] (Class 3*b*), developed between 0519 and 0540.

One of the severest short-wave radio fade-outs ever recorded with the Observatory automatic $P'f$ equipment began at 0250. The ionospheric echoes during the morning were fairly normal, but disappeared suddenly at 0250, and no further echoes were recorded until 0645 when weak reflections from the F_2 region were observed. A further fade-out of signals occurred at 0700, followed by a rapid increase to normality by 0745. From previous experience of the correspondence between bright hydrogen eruptions and radio fade-outs it appears almost certain that the large eruption first seen with the spectrohelioscope at 0512 actually began a few minutes before 0250 G.M.T.

During a period of more than eighteen months of observations with the spectrohelioscope, we have found that, whereas a severe eruption is frequently followed by a number of small eruptions around the same spot group, on no occasion has it been followed within a few hours by another large eruption. Hence it appears likely that the remarkable aurora of January 25 was connected with the unusually prolonged period of intense solar activity commencing about 0250 described above, rather than with a later eruption occurring after sunset here.

The interval between the beginning of the earlier eruption and the reported time of commencement of the auroral display was 39 hours (or 35 hours if the very much smaller and later eruption at 0700, indicated by the radio observations, be taken as the time of the eruption responsible). The magnetic storm which accompanied the auroral display was reported[2] as commencing at 1151 G.M.T. on January 25. The interval between the beginning of the eruption and the outbreak of the magnetic storm was thus 33 hours, although the storm did not become intense until 1730, corresponding to an interval of 38½ hours. These times are considerably greater than the average (about 26 hours) given by Hale[3] for the interval between solar eruptions and corresponding magnetic storms and auroras. It would thus appear that the velocity of projection of particles at small angles to the sun's surface is considerably less than that along the normal.

The magnetic storm recorded at Abinger[4] at 22½ hr. on January 16 can be satisfactorily related to solar activity occurring earlier on that date. No spectrohelioscope observations were possible at Canberra on that day; but a severe fade-out, commencing at 0040 G.M.T. and lasting several hours, indicated without doubt the occurrence of a major eruption, probably connected with the same spot group then 30° E. of the central meridian, commencing at that time. The time interval in this case is 22 hours. This group, then 34° W. of the central meridian, was also very active on January 20–21. From the first spectrohelioscope observation at 2314 on January 20, until 0125 on January 21 there was considerable activity. At 0202 an eruption of importance 2 on the I.A.U. scale was in progress, the intensity gradually decreasing until conditions approached the normal at 0240 G.M.T.

The radio observations showed abnormally poor reflection conditions from 1950 January 20, culminating in a fade-out at 0150 January 21. A further fade-out of short duration occurred at about 0715 G.M.T.

An aurora was observed just after dusk at Canberra, at 1030 on January 22, although it probably began some considerable time before it was first noticed. An intense magnetic storm began at approximately 0500[4] on the same day. Although the connexion here is not quite so definite, it seems probable that the corresponding time lags, taking the radio fade-out times as indicating the commencement of the eruptive activity, were either 32½ or 27 hours for the aurora (though this time may be too great by a few hours) and 27 or 21½ hours for the magnetic storm.

A. J. HIGGS.
R. G. GIOVANELLI.

Commonwealth Solar Observatory,
Canberra.
March 18.

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[1] *Astrophys J.*, **84**, 332 (1936).

[2] *C.R.*, **206**, 357 (1938)

[3] *Astrophys. J.*, **73**, 402 (1931).

[4] NATURE, **141**, 192 (1938).

Eddington's Fundamental Equation

IT is well-known that Eddington has obtained the equation[1]

$$10\,m^2 - 136\,m.m' + m'^2 = 0 \quad . \quad . \quad . \qquad (1)$$

where m' is the mass of a 'scalar particle', that is, a particle the expectation values of the spin and charge of which are zero, and m the mass of a charged particle with spin ℏ/2. The two values of m are shown to be associated respectively with the two signs of the charge, and writing them as m_p and m_e, we have

$$m_p : m' : m_e : : 1847{\cdot}6 : 135{\cdot}9 : 1.$$

Now the only property of the scalar particle that Eddington has used is that it may be described by a scalar strain vector, for which all the coefficients except s_{16} (the probability density) are zero. He saw that such a strain vector could be used to describe our knowledge of a particle when no observation of its charge or spin had been made, and so wrote that the scalar particle is "a particle which (so far as our information goes) has equal probability of being a proton or electron and equal probability of either direction of spin . . . a mathematical fiction, having no counterpart in experimental physics"[2]. However, it is not necessary to regard the scalar particle in this way, for it may be treated as a particle with as much independent existence as is usually ascribed to the neutrino. Then, according to Eddington's theory, it must have zero charge and zero spin (so that it may be represented by a scalar strain vector) and a mass $m' = 135{\cdot}9\ m_e$ in order to satisfy (1). If this particle were to combine with an electron or positron with the emission of a neutrino, it would yield a heavy negative or positive electron obeying Bose statistics and with mass between 136 and 137 times that of an ordinary electron.

This result is so closely in agreement with the U-particle theory of Yukawa[3], Bhabha[4], and others, which is in turn supported by facts, so far as present experimental accuracy goes, that it seems very unlikely that equation (1) can be fundamentally wrong, even although the way in which it is obtained is difficult to understand. That the equation should give, in addition to the mass ratio of the proton and electron, the right order for the mass ratio of the electron and a neutral spinless particle (and this before the heavy electron theory was put forward) suggests that Eddington's theory merits more attention than is usually given to it.

H. C. CORBEN.

Trinity College,
Cambridge.

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[1] "Relativity Theory of Protons and Electrons" (Camb. Univ Press, 1936.) Equation (12.47).

[2] "Relativity Theory of Protons and Electrons", p 89

[3] Yukawa, *Proc. Phys.-Math. Soc. Jap* , **17**, 48 (1935).

[4] Bhabha, NATURE, **141**, 117 (1938).

X-Ray Study of Thymonucleic Acid

A FEW years ago an occasion presented itself of examining by X-rays a small specimen of sodium thymonucleate kindly provided by Prof. W. J. Schmidt[1] of Giessen, and an imperfect fibre photograph was obtained with a strong period along the fibre axis of about 3½ A.; but the observation was not followed up at the time. We have now continued the investigation with material prepared in the Department of Chemistry of the Caroline Institute, Stockholm, by the method of Hammarsten and Bang[2]. The viscosity and double refraction of flow of this material in aqueous solution were the subject of a recent communication in NATURE by Signer, Caspersson and Hammarsten[3].

Films of sodium thymonucleate stretched some 250 per cent have been found to give a striking, though still rather obscure, X-ray fibre photograph in which by far the most prominent reflection corresponds to a spacing along the fibre axis of 3·3$_4$ A., *which is almost identical with that of a fully extended polypeptide chain system,* such as β-keratin[4] or β-myosin. The true period along the fibre axis is much greater than this—perhaps seventeen times as great, to judge by the present photographs—and there are also side spacings up to about 26 A., the best defined being one of approximately 16·2 A.

In view of the hydrodynamic and optical properties of the solutions[3] and of the optical properties of the solid fibres[1], the natural conclusion from the X-ray data is that the spacing of 3·3$_4$ A. along the fibre axis corresponds to that of a close succession of flat or flattish nucleotides standing out perpendicularly to the long axis of the molecule to form a relatively rigid structure, strongly optically negative, and showing double refraction of flow. At first sight the distance 3·3$_4$ A. between successive nucleotides might seem improbably small, but it is confirmed by the high density, which is 1·62–1·63 gm./c.c. for the dry substance. (Compare the density of ascorbic acid, 1·74, the flat molecules of which are piled together at an even smaller distance (3·16 A.)[5]). The average weight of a sodium nucleotide is roughly 330, whence if A be the average area :

$$3{\cdot}34 \times A \times 1{\cdot}62 = 1{\cdot}65 \times 330 \text{ (approx.)};$$

which means that the average area per nucleotide should be about 100 A.^{2}, as it clearly must be from known interatomic and intermolecular distances (a plausible estimate for the purine nucleotides gives something like 15 × 7½ A.^{2}). Again, the X-ray data lead to an estimate of the molecular weight (between 500,000 and 1,000,000) similar to that already arrived at by other methods[3]; for we may assume an effective average width of the molecule in solution of about 20 A., and therefore from the hydrodynamic data, which indicate a length to width ratio of roughly 300 : 1, infer a length of the order of 6,000 A. Such a length would contain some 2,000 nucleotides of thickness 3·3$_4$ A., and so would agree well with the weight just quoted.

The significance of these findings for chromosome structure and behaviour will be obvious. It seems difficult to believe that it is no more than a coincidence that thymonucleic acid consists of a long succession of nucleotides spaced at a distance so nearly equal to that of the long succession of amino-acid residues in a fully extended polypeptide. Rather is it a stimulating thought that probably the interplay of proteins and nucleic acids in the chromosomes is largely based on this very fact, and that some critical stage in mitosis, involving elongation of the protein chains, is realized in close co-operation with the dominating period of the interacting nucleotides.

We should like to express our indebtedness to Prof. Hammarsten and Dr. Caspersson of the Caroline

Institute for preparing for us the experimental material and for biochemical data.

X-ray examination of other nucleic acids and polynucleotides is in progress.

W. T. ASTBURY.
FLORENCE O. BELL.

Textile Physics Laboratory,
University of Leeds.
March 25.

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[1] Cf. Schmidt, W. J., "Die Doppelbrechung von Karyoplasma, Zytoplasma und Metaplasma" (Berlin, 1937).

[2] Hammarsten, E., *Biochem. Z*, **144**, 383 (1924)

[3] Signer, R., Caspersson, T, and Hammarsten, E., NATURE, **141**, 122 (1938)

[4] Cf. Astbury, W. T., NATURE, **140**, 968 (1937).

[5] Cox, E G, NATURE, **130**, 205 (1932). Cox, E. G, and Goodwin, T. H, *J. Chem. Soc*, 769 (1936).

Structure of Metals

IN the note by Dr. A. Muller[1] with the above title, the scatter of spots in high-dispersion X-ray photographs was interpreted as indicating variations in lattice constant of individual crystals of the order of 1/1000 to 1/2000.

Prof. W. L. Bragg and H. Lipson[2] afterwards advanced the tentative explanation of the effects observed by Müller without making the deduction that the lattice constant varies. The scatter of spots in stationary photographs deduced from the effect shown by Prof. Bragg and Lipson is equivalent to a $\Delta d/d$ value of 1/2000 approximately, for l equal to 10^{-4} cm.

There are two further effects which can give rise to scatter of spots from grains of identical lattice constant. (1) A purely geometrical effect due to the finite convergency of the X-ray beam. (2) The fact that the $K\alpha$ lines have a finite width. The first effect, the purely geometrical effect, can give rise to an angular scatter of spots which for a given constant diameter of pinhole or diaphragm becomes less as the specimen to film distance increases, provided a focusing technique is utilized; for example, pinhole, diffraction line and specimen surface lie on the circumference of the same circle.

If a reference sphere is drawn, it is easily seen that a reflection is possible provided the normal to the set of planes giving the reflection lies within a band which is determined by the maximum angle of convergence of the incident X-ray beam subtended at the specimen surface. Furthermore, the reflection spots themselves can be within a band of similar angular width. The angular width of this band, $\Delta\omega$, or what is the same thing, the possible scatter of the reflection spots from crystals of identical lattice constant, is given by

$$\Delta\omega = \frac{\text{diameter of pinhole}}{\text{specimen-diaphragm distance.}}$$

Such a scatter might erroneously be taken as arising from a variation in lattice constant which for normal cameras of 5–10 cm. film-specimen distance can amount to 1 part in 1000 to 1 part in 2000.

Dr. Müller has kindly informed me that his high dispersion photographs were taken at 30 cm. with a 0·3 mm. pinhole. The purely geometrical scatter accounts only for a variation $\Delta d/d = 1/20,000$ approximately and does not explain Muller's result.

The second effect, the more important effect, is that due to the finite width of the $K\alpha$ lines usually used; it does not depend on the geometry of the camera system, though it must be considered in conjunction with the geometric effect in determining the conditions in which α_1 and α_2 reflections may intermingle.

Values for the half value width $\Delta\lambda$ of the K lines of copper, iron and cobalt taken from Compton and Allison[3] are as follows:

Full width at half max. of $K\alpha$ lines

Element	Line	Wave-length in X.U.	$\Delta\lambda$ in X.U.	$\Delta\lambda/\lambda$
Iron	$K\alpha_2$	1936	1·18	1/2000 approx.
	$K\alpha_1$	1932	1·02	,,
Cobalt	$K\alpha_2$	1789	0·95	,,
	$K\alpha_1$	1785	0·82	,,
Copper	$K\alpha_2$	1541	0·77	,,
	$K\alpha_1$	1537	0·58	,,

This definite half-value width would account for variations in angular scatter of spots from crystals of identical lattice spacing equivalent to $\Delta d/d = 1/2000$ as an upper limit, whilst since the half-value width is purely an arbitrary method of estimating line width, spots could occur possibly even down to $\Delta d/d = 1/1000$.

It is of special importance to take these effects into account when using rotating or oscillating film back reflection methods of determining lattice constants, as in internal stress measurements; that is, one must average over a large number of spots, otherwise serious errors in lattice constant and in internal stresses deduced will result.

R. A. STEPHEN.

X-Ray Service Laboratories,
Philips Lamps, Ltd.,
London.
Mar. 21.

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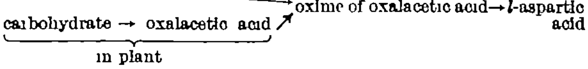
[1] NATURE, **140**, 1012 (Dec. 11, 1937).

[2] NATURE, **141**, 367 (Feb. 26, 1938).

[3] "X-Rays in Theory and Experiment", by Compton and Allison.

Biological Synthesis of Amino Acids from Atmospheric Nitrogen

SYMBIOTIC nitrogen fixation in leguminous root nodules proceeds, according to our conception, in the following manner:


N₂→ hydroxylamine
carbohydrate → oxalacetic acid
in plant
oxime of oxalacetic acid → l-aspartic acid

This conception is based, in the first place, on the investigation of excreted nitrogen compounds from the root nodules. In extreme cases up to 80 per cent of the total fixed nitrogen is excreted into the medium from the root nodules during the growth of the pea. This nitrogen is, as regards a small part, oxime-nitrogen (usually 1–2 per cent of the total nitrogen) but mainly amino nitrogen, belonging to l-aspartic acid and to its decomposition product β-alanine (not to lysine, as we first assumed). As the legume bacteria decarboxylate l-aspartic acid forming β-alanine, l-aspartic acid is the first amino acid excreted[1]. Its excretion from young nodules in large amounts proves that it is formed in nitrogen fixation as a primary amino acid, from which other amino acids are then formed.

In investigating the further transformation of l-aspartic acid in the host plant, it has been noted that if l-aspartic acid and, for example, pyruvic acid, are added to the mass of crushed pea plants, the amino group is transferred from aspartic acid to pyruvic acid, whereby α-alanine is formed, thus:

l-aspartic acid + α-keto acid → oxalacetic acid + α-amino acid.

In three hours the reaction is already far developed. The alanine was determined by extracting it from the reaction mixture with butyl alcohol and thereupon oxidizing it with ninhydrin to acetaldehyde. The transfer of amino group to α-keto acids in the plant is similar to that shown by Braunstein and Kritzman[2] in animal tissues.

The formation of aspartic acid as the only primary amino acid in nitrogen fixation is surprising. The dicarbonic acids of 4-carbon group thus attain a central position in the synthesis of amino acids. Oxalacetic acid which, according to our theory, is the acceptor to hydroxylamine, is found in considerable quantities both in pea plants and in red clover, from which we have up to the present determined it. Since the hydroxylamine reacts with the oxalacetic acid already in very dilute solutions almost immediately, it is clear that free hydroxylamine cannot be detected in the root nodules. The isolation of the oxime indicates, however, the course of the reaction. The oxime isolated as an excretion product, precipitates according to Foreman and thus apparently is the oxime of oxalacetic acid.

The reason why the hydroxylamine in the nodules reacts only with oxalacetic acid and not with other aldehydes or ketones is that the reaction with oxalacetic acid occurs at a much higher rate than with other keto acids investigated by us. In neutral solutions, each containing 0·2 millimols of oxalacetic acid, ketoglutaric acid, or pyruvic acid as sodium salts, the rate of reaction of hydroxylamine with oxalacetic acid was about seven times greater than with ketoglutaric acid and about fourteen times greater than with pyruvic acid. No reaction can be observed with glucose and fructose in such dilute solutions during 2 minutes' experiment time.

ARTTURI I. VIRTANEN.
T. LAINE.
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Helsinki.
March 15.

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[1] *Suomen Kemistilehti*, 10, 32 (1937). *Enzymologia*, 3, 266 (1937).
[2] NATURE, 140, 503 (1937).

The Most Probable Place of Location of the Genes in the Chromonemata

GENETIC investigations during the last three decades have supplied evidence that the genes are located linearly in the chromosomes. Cytological studies of the meiotic prophases showed that the chromonemata are differentiated in length, consisting of chromomeres. Cytological studies on the salivary gland chromosomes in many insects and especially in *Drosophila* disclosed a discoid structure of the chromosomes. "From the differential staining behaviour of these chromatin disks one can conclude that they are or contain chemical compounds of diverse nature"[1].

The differentiation of the chromonemata in the somatic cells in plants has offered somewhat greater difficulties. Recently, I succeeded in preparing preparations from *Triticum Timopheevi* root tips in which the chromomere structure of the chromatids during the late prophases and early metaphases was very distinctly disclosed. In a number of chromatids the chromomeres were much more closely arranged at the distal ends of the chromosomes, thus forming the heterochromatic regions[2]. In *Drosophila* the heterochromatic regions are poor or devoid of genes[3,4]; therefore they are called inert regions.

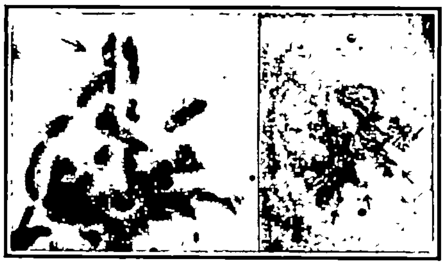
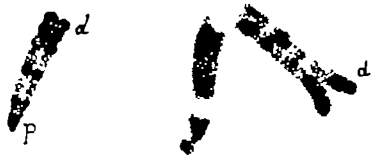


Fig. 1.

PHOTOMICROGRAPHS FROM THE ROOT TIP CELLS OF *Triticum Timopheevi*. CHROMOMERES IN THE CHROMATIDS ARE MARKED.

If we may use the differential staining for diagnosis of heterochromatic (inert) regions, as we seem to have good reasons for doing, we can conclude that heterochromatic regions are rich in chromomeres, but poor in interchromomeric substances. If the genes were located in the chromomeres, the heterochromatic regions should be active, but since they are inert, the genes should be located then between the chromomeres.



(a) (b)

Fig. 2.

(*a*) THE LONGER ARM OF ONE CHROMOSOME; *d*-DISTAL AND *p*-PROXIMAL ENDS. (*b*) A WHOLE CHROMOSOME. DARKER REGIONS CAN OFTEN BE SEEN AT THE DISTAL ENDS; THEY ARE USUALLY DUE TO CLOSER ARRANGEMENT OF THE CHROMOMERES, THOUGH SOMETIMES THESE CHROMOMERES ARE SOMEWHAT LARGER.

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Academy of Sciences of U.S.S.R.,
Moscow.
March 1.

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[1] Kostoff, D., *J. Heredity*, 21, No. 7 (1930)
[2] Kostoff, D. [NATURE, 141, 690 (1938)]
[3] Muller, H. J., and Gershenson, S. M., *Proc. Nat. Acad. Sci.*, 21, No. 2 (1934)
[4] Prokofieva, *Bull. Acad. Sci., U.S.S.R.*, 394 (1937).

Function of the 'Fossula spongiosa' or Spongy Furrow in Reduviidæ (Rhynchota)

So far as is known, the majority of Reduviidæ are predators of other insects, and consequently their anterior legs in particular, with the median legs, are of utmost importance in assisting them to capture their prey, especially when it is an active insect. But, in spite of their predaceous habits, it is perhaps remarkable that few Reduviidæ, with the exception of the sub-family Emesinæ and the Old World genera, *Irantha*, *Polydidus* and *Scipinia*, possess anterior legs of the raptorial type.

Very considerable diversity of structure, however, is exhibited by the anterior tibiæ of various genera, which may be thickened apically, dilated for the greater part of their length, provided with single or multiple spines, or may be of a simple type. In many species the anterior tibiæ and sometimes the median tibiæ also are provided, on the inner surface, with a sulcate or flat area of very dense short setæ. This area may be short or may cover at least half the tibiæ of the anterior legs, but is always short on the median tibiæ.

This area is referred to as the 'fossula spongiosa' or 'spongy furrow', a term which, however, is not entirely accurate for, as stated in the previous paragraph, it is not always sulcate, but is more or less flat and, in fact, may have a narrow raised area throughout longitudinally.

The origin of the term 'spongy furrow' is obviously due to the fact that the examination of most Reduviidæ has been restricted to dried specimens, and it is when they are in this condition that the structure on the tibiæ appears sulcate. In some species the 'spongy' area on the anterior tibiæ is produced, and extends to about the middle of the tarsus.

In the blood-sucking Reduviid *Rhodnius prolixus* Stål, the 'spongy furrow', which is small and present on the anterior and median tibiæ, has been considered to be a climbing organ by Gillett and Wigglesworth[1], who based their conclusions on the fact that the adult *Rhodnius* were able to climb the glass walls of the jars in which they were confined. Larval *Rhodnius*, they stated, were unable to do so. According to these investigators, in the living *Rhodnius* the organ is "an elastic sac distended with fluid". In dried specimens, however, it is shrunken and depressed.

Now, the localities which this species of *Rhodnius* inhabit are roughly constructed mud and thatch huts, an environment in which they are able to move about freely without the aid of a specially adapted climbing organ. The absence of the 'pad' from the tibiæ of larval *Rhodnius*, which would require it equally as would the adults, if it were a climbing organ, since they inhabit the same localities, indicates that the structure is not for that purpose. Those Reduviids to which a climbing organ might be advantageous, such as the Malaysian genera *Ectinoderus* and *Amulius*, frequenters of trees up which they climb, possess tibiæ devoid of a 'spongy furrow'; and furthermore, it is noteworthy that they cover the anterior pair thickly with resin to aid them to capture their prey, which consists largely of small bees of the genus *Melipona*. A 'spongy furrow', if it were present, would in this case be rendered ineffective as a climbing organ by the resinous covering.

Some other Old World genera, namely, *Sycanus* and *Cosmolestes*, as far as observation goes, prey principally on the relatively sluggish larvæ of Lepidoptera, to find which they are obliged to climb about on plants. From these genera the spongy furrow is absent.

In my opinion, it would seem therefore that the function of the 'spongy furrow' is not for the purpose of assisting the insect to climb but to enhance the gripping power of the tibiæ when the prey is captured. Further investigations may show that the degree of development of the furrow is related to the degree of toxicity of the saliva injected into the prey when captured, higher gripping qualities being combined with a less toxic or less rapidly acting fluid.

It should also be pointed out that a feeble development of the 'spongy furrow' is common when the anterior femora and tibiæ are provided with spines. In the case of *Rhodnius*, the 'spongy furrow' should probably be considered a vestigial organ, as it would be of no assistance to the bug when attacking man.

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Straits Settlements and
Federated Malay States.

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[1] "The Climbing Organ of an Insect *Rhodnius prolixus* (Hemiptera, Reduviidæ)", *Proc. Roy. Soc.*, B, 111 (1932).

Modern Studies of the Foraminifera

MAY I suggest that an opinion may be arrived at regarding modern studies of the Foraminifera other than that given in NATURE by Mr. E. Heron-Allen ?[1]

Mr. Heron-Allen deplores the amount of literature published on the Foraminifera of late years, and of the number of families, genera and species described therein as new. I cannot see any escape from this result when an increased number of persons studies any group, in this case on account of its fairly recently recognized economic importance, the Foraminifera now being largely used as horizon markers in oilfield geology. Of the fact that it is often not possible to identify one's specimens with described material, there may be instanced the considerable number of forms described as new in some fifty valuable monographs and papers on the group by Mr. Heron-Allen himself, usually in collaboration with Mr. Arthur Earland.

I cannot appreciate that this is anything extraordinary, or that it differs from the modern tendency in other branches of zoology. For example, the number of described insects is colossal, and the estimated number yet undescribed is vaster still. Why, then, should one be aghast that detailed work on the Foraminifera (which often swarm in myriads), of areas and geological formations in which they may have been hitherto completely unknown, should yield many new forms ? The point that new names are often given unnecessarily is as old as the subject; it may be worse now, partly on account of the difficulty of keeping pace with the new literature, particularly when papers are written in places where adequate access to it is impossible.

Mr. Heron-Allen referred (136, 132; 1935) to "the great *scientific* Foraminiferists" of old, implying that the work of modern students of the group is not scientific. As a general statement neither claim is acceptable. It is clearly impossible to make an analysis of the literature to decide what is "scientific" and what is not, and the selection of particular modern work to illustrate the point might be invidious. But in my opinion, and without denying the poor quality of some, there is much work of the post-War period that is fully up to the standard of any of that of Mr. Heron-Allen's 'giants'.

On the other side of the picture, two of Mr. Heron-Allen's examples of the "great *scientific* Foraminiferists" are Terquem and Haeusler. Terquem's fourteen monographs on the Jurassic Foraminifera form one of the most appalling examples of species-making in the whole of the literature. In these, according to my notes, he proposed no fewer than 682 new trivial names, very many of which appear to be redundant. Haeusler, on the contrary, in his sixteen monographs and papers, also on the Jurassic Foraminifera (omitting his first paper, which his later work did not confirm), proposed only some 34 new names all told, preferring to identify many of his specimens with forms described from Tertiary and Recent material.

Were the works of these two authors to be held up as models, the future of the systematic study of the group would be black indeed.

It is concluded that modern work on the Foraminifera is very like that of those who are now dead: it is either good, bad or indifferent. The difficulty is that there is more of it to cope with.

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Longships,
Capel-le-Ferne,
Folkestone.
March 28.

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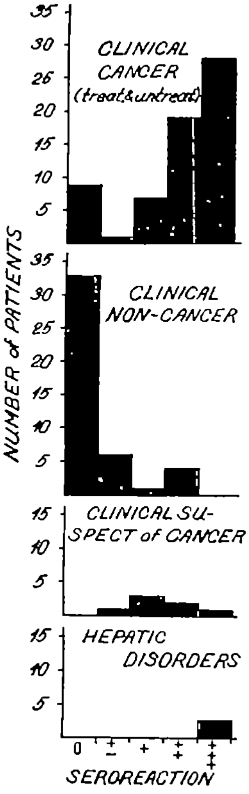
[1] NATURE, 134, 43 (1934); 136, 132 and 797 (1935); 141, 558 (1938).

The Prague Sero Reactions for Cancer

Waldschmidt-Leitz[1], Brdička[1,2] and collaborators have recently published preliminary notes on sero reactions for cancer; they measured the activation deactivation of certain enzymatic processes or examined by the polarograph the reactions of certain catalytic processes after addition of serum or peptidized serum from men or animals with or without cancer, and ascribed the difference in action of cancer sera and non-cancer sera to differences in concentration of active S—S groups.



After a visit (by H.) to the institutes in Prague, where the workers in question kindly demonstrated the technique and material, we have carried out the sero reactions according to Brdička's polarographic methods[2,3] on sera from 118 patients: 44 without clinical symptoms of cancer, 7 with symptoms suspect of cancer (2 rough hypertrophia prostatæ with 'lumbago'), 1 anæmia simplex with achylia gastrica (61 years old), 1 cardiospasm, 1 agglutinatio vaginæ with fluor (72 years old), 1 cancer uteri incipiens (?), and 1 chronic icterus, suspect of cancer pancreatis (80 years old); 64 with clinically manifest cancer, and 3 with parenchymatous hepatic disorders (1 intoxication with sanocrysin, 1 intoxication with iodine and 1 with statis hepatis e morbu cordis incompensata).

For the reactions we have used two preparations:

(a) To 5 ml. of 0·05 *N* hydrochloric acid containing 5 mgm. pepsin, 0·2 ml. serum was added. The mixture was incubated at 40° C. for 20 minutes and then 0·2 ml. was withdrawn and added to 10 ml. of 0·0016 *N* cobaltous chloride in 0·2 *M* ammonium chloride – ammonia buffer (equal parts). The polarographic curve of this mixture was registered[2].

(b) To 1 ml. of 0·1 *N* potassium hydroxide 0·4 ml. serum was added; the mixture was kept at room temperature for 20 minutes, 1 ml. of a 20 per cent solution of sulphosalicylic acid was added and the mixture filtered; 0·6 ml. of the filtrate was added to 5 ml. of the following solution (to 150 ml. *N* ammonia + 50 ml. *N* ammonium chloride + 700 ml. water was added 100 ml. 0·03 *N* hexamine cobaltic chloride). The polarographic curve of the mixture was registered[3].

Every day a sample from a clinically non-cancer patient was used as a standard. The galvanometer sensitivity was 1 : 200; the strength of reaction was taken as the difference of curve height in millimetres between standard and unknown serum according to the following scheme:

Reaction 0 : lowest = 0 mm. or both = 1 mm.
± : „ = 1 „ „ = 2 „
+ + : „ = 2 „ „ < 6 „
+ + :6> „ = 3 „ and highest ⩾ 6 mm.
+ + + : „ ⩾ 6 „ „ „ ⩾ 10 „

The results are given in the accompanying block diagram, which shows that the majority of the non-cancer sera fall in the negative group, while the majority of the cancer sera + the 'hepatic' sera fall in the strongly positive groups. *The difference is unquestionable.*

Our present technique and material do not allow statistical treatment or conclusions regarding the future diagnostic value of the reactions. Further investigations are being undertaken for this purpose.

We wish to thank Profs. Waldschmidt-Leitz, Heyrovský, Brdička, Knaus and Novak in Prague for kind personal communications.

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O. M. HENRIQUES.
J. SCHOUSBOE.

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Finsen Institute and Radium Station,
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Feb. 19.

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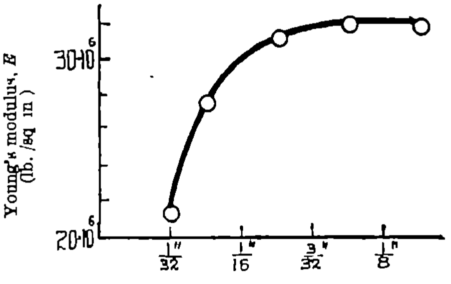
[1] Waldschmidt-Leitz, Conrath, Gloeditsch, *Naturwiss.*, 25, 60 (1937); Brdička, NATURE, 139, 330 (1937) (see literature there).

[2] Brdička, NATURE, 139, 1020 (1938).

[3] Brdička, personal communication.

Value of Young's Modulus for Nickel Wire as Influenced by the Diameter

MAKING use of the electro-magnetic method for measuring the frequency of longitudinal vibrations



Diameter.

as described in a previous note[1], tests for Young's modulus have been made on pure annealed nickel wires of various diameters in the "as received" condition. The results are shown in the accompanying graph, and it will be seen that for wires of diameter less than about 3/32 in. the value of the modulus rapidly decreases with the diameter.

Tests made on copper-plated nickel wires after heating in hydrogen to a condition of maximum magnetic permeability give a similar curve for Young's modulus, but the values are in general somewhat lower.

T. F. Wall.

Department of Electrical Engineering,
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March 19.

[1] Nature, 131, 351 (1934), also, *J. Inst. Elect. Eng*, 75 (Dec 1934)

Reflecting Power of Ultra-pure Aluminium

Electrolytic polishing of metallic surfaces, which has been studied by one of us[1], does not modify the metal structure. On the contrary, it is known that classical methods of polishing greatly alter the superficial crystalline structure.

Recent work with copper has shown that surfaces polished by the electrolytic process give values of the optical constants which are reproducible, whereas this is far from being the case when surfaces of copper are prepared by mechanical polishing or by evaporation in vacuum[2].

We give here the first results of an optical study of aluminium surfaces prepared from metal 99·998 per cent pure. An aluminium block is laminated to 7 mm. Little strips are then cut (of about 2·3 cm.^{2}) which are polished with emery paper (0–04), covered with paraffin. The metal is recrystallized by heat treatment and the polish is finished on felt disks covered with a suspension of fine alumina (6 and 12 hours). Many of these surfaces were subjected to electrolytic polishing[3] for a time sufficient to allow dissolution of the superficial pellicule formed during the final stage of the polishing. The other surfaces were finally polished on cloth disks covered with alumina (12 hours).

The reflecting powers of these two types of surfaces have been measured by the photo-electric method of Orsel[4] modified by one of us[5]. The filtered light of a tungsten strip lamp is used ($\lambda = 4500$ A.). The seven surfaces polished electrolytically have the same reflecting power within the experimental error (about 1 per cent), and the reflecting power is remarkably constant at every point of each surface. It is observed that the size of the metallic crystallites conditioned by the previous heat treatment has no influence; moreover, the surfaces even after many days exposure to atmospheric conditions, but protected against dust, do not show any alteration. Table 1 gives the results. The reflecting power is given by comparison with a polished surface of galena taken as a standard.

Table 1.

Number of sample		3*	5**	7**	8**	15**	17**	18†
Reflecting power	24 hours after polishing	2·23	2·23	2·24	2·24	2·25	2·25	2·24
	72 ,, ,, ,,	—	2·25					
	96 ,, ,, ,,	2·24	2·24					
	120 ,, ,, ,,	—	2·26	—	—	—	—	2·25

* Annealed for 20 hours at about 620° C
** ,, ,, 68 ,, ,, 620° C.
† ,, ,, 30 seconds at 350° C.

Table 2 gives the values of the reflecting powers of surfaces mechanically polished. These values are obtained immediately after polishing and they can be compared with the reflecting power of surfaces polished electrolytically.

Table 2.

Number of sample	1**	2*	4**	6**	9**
Reflecting power at different regions of each surface	0·61 0·57	0·68 0·66 0·65	0·60 0·62	0·73 0·68 0·69	0·67 0·68

* Annealed for 20 hours at about 620° C.
** ,, ,, 30 seconds at 350° C.

This table shows that the reflecting power varies notably from one surface to the other, and that even for a given surface it varies from point to point.

We conclude that ultra-pure aluminium surfaces polished electrolytically have a reflecting power well defined and reproducible. This suggests the use of such surfaces as optical standards. Moreover, such surfaces have a reflecting power greater than that of surfaces otherwise prepared. These observations show that this technique will be useful for the micrographic study of the crystalline structure of aluminium.

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Paris.

L. Capdecomme.

Laboratoire de Minéralogie,
Faculté des Sciences,
Toulouse.

[1] Jacquet, P., Nature, 135, 1076 (1935), *C.R. Acad Sci Paris*, 201, 1473; *Bull. Soc. chimique France*, (v), 3, 705 (1936).

[2] Lowery, H., Wilkinson, H., and Smare, D. L., *Phil. Mag* (vii), 22, 769 (1936), Capdecomme, L., and Jacquet, P, *C R. Acad Sci. Paris*, 204, 1415 (1937).

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A Whale Story

Many readers of Nature may have heard an incredible story, broadcast by the B.B.C., Regional, on January 11, 1938, in a series of talks called "Strange to Relate", about an alleged James Bartley of the *Star of the East* having been swallowed by a sperm whale and recovered alive from its stomach some hours after. The intelligence of readers of Nature is such that I expect and hope few if any gave credence to the story, but of the thousands who heard it I fear many must have thought, "It must be true, or the B.B.C. would not broadcast it".

I first came across this story in "Sixty-Three Years of Engineering" by the late Sir Francis Fox, and in reviewing that book for the *Journal of the Society of Engineers* (October–December 1925, pp. x–xiv) I made it amply clear from internal evidence that the story would not hold water. Afterwards, a published letter was found from the widow of the captain of the *Star of the East*, in which she stated that she was on board that vessel at the time of the alleged event, and that there was not a word of truth in it.

Through Dr. Julian Huxley, a member of the Talks Advisory Committee, I was able to bring the facts before the B.B.C. with the result that it was arranged to explain that the story was completely untrue. The correction was made on March 7, but few people who heard it would have recognized it as related to the dramatic story originally broadcast. Because there must be many thousands who heard the story but missed its correction, it seems worth while to record the facts in these columns.

A. S. E. Ackermann.

17 Victoria Street,
Westminster,
London, S.W.1.
March 29.

Albino Frogs

Some years ago, Dr. Nellie B. Eales wrote concerning records of albino frogs[1]. It will be of interest to zoologists to know that on March 28, 1938, a schoolboy found a mass of white spawn in a brook at Coley, Reading, Berkshire. The brook contained many other masses of normal spawn.

The appearance of the spawn was that of clear jelly with milk-white ova. The boy reported the matter to his master, who retained some spawn, and the rest was handed to the Reading Museum by the finder. Except for a small quantity passed to the University of Reading, we have the residue here.

To-day (April 5), many of the eggs have developed into white tadpoles with distinctly pigmented eyes, and slight pigmentation is developing rapidly in the dorso-lateral region. We shall endeavour to rear these specimens, but I shall be happy to pass specimens to any zoologist for scientific work.

It is assumed that one parent was probably a true albino, as in the case of the Woodcote specimens in 1933.

W. A. Smallcombe.

Museum and Art Gallery,
Reading.
April 5.

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[1] Nature, 132, 278 (1933).

Points from Foregoing Letters

Observations of solar activity made at Canberra, Australia, by A. J. Higgs and R. G. Giovanelli, with a spectrohelioscope and indirectly from a study of conditions in the ionosphere, have related recently observed auroras and magnetic storms to definite periods of activity. The interval, 38 hr., between the solar eruption and the auroral display of January 25–26 appears to be longer than usual (26 hr.).

H. C. Corben points out that, from Eddington's relation between the mass of the proton and that of the electron, the existence of a scalar particle of mass 135·9 can be deduced and this, combined with a positive or a negative electrical charge, will account for the recent observations which indicate that particles of about this mass exist in cosmic rays.

Dr. W. T. Astbury and Miss Florence Bell conclude from an X-ray examination of the sodium salt of thymonucleic acid that the molecule consists of a succession of some 2,000 nucleotides, standing out perpendicularly to the long axis, and spaced at a distance ($3{\cdot}3_4$ A.) almost exactly equal to the spacing of the succession of amino-acid residues in a fully extended polypeptide. The probable significance of these findings for chromosome structure and behaviour is pointed out.

R. A. Stephen points out that in addition to the purely optical effect as described by Prof. W. L. Bragg and H. Lipson, there are two further effects which may give rise to angular scatter of spots in high-dispersion X-ray photographs. (1) A purely geometric effect due to the finite size or lack of parallelism of the incident X-ray beam. (2) An effect due to the finite width of the lines of the $K\alpha$ doublet. The first effect is insufficient to explain the scatter observed by Müller but the second effect gives results of the right order.

Prof. A. I. Virtanen and T. Laine find that if *l*-aspartic acid and pyruvic acid are added to crushed pea plants, the amino group is transferred from aspartic to pyruvic acid with formation of α-alanine. The authors consider that aspartic acid is the only primary amino-acid synthesized during the fixation of nitrogen and discuss the manner of its formation.

Prof. D. Kostoff submits photomicrographs of chromosomes in the root tip cells of *Triticum Timopheevi* showing differential staining—the distal ends being darker—presumably owing to a greater number of chromomeres. Since the heterochromatic regions have been found to be genetically inert (in the fruit-fly), the author considers that the genes are probably located between the chromomeres.

The spongy furrow on the inner surface of the anterior tibiæ of certain species of Reduviid bugs, which are predators of other insects, serve the purpose of enhancing the gripping power of the tibiæ when the prey is captured, according to N. C. E. Miller. They do not apparently help in climbing, as suggested by previous writers.

Results obtained with the sero-reaction of cancer described by Waldschmidt-Leitz and Brdička are given by F. Bergh, Dr. O. M. Henriques and J. Schousboe. They have obtained positive reactions with the sera of most cancerous patients and with those suffering from certain diseases of the liver, whilst non-cancerous individuals give predominantly negative results. The difference, they state, is unquestionable, but the statistical evidence is insufficient, as yet, to prove the value of the reaction in diagnosis.

A graph submitted by Dr. T. F. Wall shows that for nickel wires of diameter less than about 3/32 in. the value of the Young's modulus (determined by the electromagnetic method for measuring longitudinal vibrations) decreases with the diameter.

Drs. P. Jacquet and L. Capdecomme have studied the reflecting power of ultra-pure aluminium surfaces polished either by the classical mechanical process or by the new electrolytic method. The latter does not change the superficial crystalline structure and gives values very nearly the same at all points of several samples, whereas surfaces polished mechanically show reflecting power variable from point to point and always smaller than that observed after electrolytic polishing.

Research Items

Survivals and Regressions in Javanese Culture

What might be termed a cultural 'backwash' is described by Dr. F. Stutterheim of Batavia in an account of a 'neo-megalith' in Old Batavia (*Bull. Raffles Mus.*, Singapore, 1937, Ser. B, 1, 3). It has been pointed out frequently that many of the so-called Hindu antiquities in Java are nothing but Hinduized versions of pre-Hinduistic holy sites. This is especially noted of monuments found high up in the hills and consisting of terraces and altars in the open. Thus Chandi Sukuh, on the slopes of Mount Lawu, immediately betrays its pre-Hinduistic origin by its lay-out in terraces, though its ornament, especially its reliefs and figures, show a Hinduized style. The main altar, a truncated pyramid, strongly suggests Polynesia and ancestor worship. In Java, such features are usually called "Polynesian" or "old-indigenous". In all instances, the evidence of Hindu art and culture in ornament and relief belongs in style to the latest period of Hinduism in Java. We may, therefore, assume that it represents the ultimate penetration of Hinduistic conceptions, valid for centuries in the plains, into the remote hill districts, where indigenous ideas had lingered on. It is known that the spread of Hinduism in Java was a very gradual process. At the same time, these monuments illustrate the persistence of the indigenous culture. A stronger proof of the persistence of these indigenous beliefs would be the occurrence of a Hindu or Mohammedan sanctuary transformed into a 'megalithic' or indigenous object of veneration. An example of such a transformation appears to be afforded by a recently observed mound covered with stones of different kinds in Kampong Traté of Old Batavia. It was topped by an upright stone of somewhat conical shape, which turned out to be smoothed river stone. Among the stones covering the mound were bricks, and three pairs of Mohammedan tombstones. These removed all doubt but that the original purpose of the mound had been that of Mohammedan burial, but that, probably at about 1700, it had been transformed into a holy place. At the foot of one stone were traces of flowers and incense. The smooth oblong cylindrical stones assembled here are strongly reminiscent of *gandik*'s stone rollers for crushing medicinal ingredients, which are considered all over the Archipelago to have strong magical powers.

Amphibian Mesectoderm

Rana japonica has been utilized by M. Ishikawa (*Mem. Coll. Sci. Kyoto*, 12, Oct. 1937) for investigating the origin and role of the mesectoderm during development and in particular with reference to cartilage formation. The mesectoderm makes its appearance in the early neurula stage. It takes no part in the formation of the neural tube as in Urodeles and migrates solely by the proliferation of its own cells, receiving no contribution from the dorsal part of the neural tube. Normally it migrates ventrally over the mesentoderm in the branchial region, and gives rise to the cartilages of the visceral arches. If it is transplanted into the brain cavity or into the somatic mesentoderm of the side of the body it also produces cartilage. Cartilage is also formed if it is transplanted into the mesenchyme of *Hynobius nebulosus*. Mesentoderm appears to be important but not essential to the production of cartilage by the mesectoderm. By the time of the closure of the neural folds, the mesectoderm is segregated into mandibular, hyoid and branchial units, and an extirpation of any one of them results in the lack of or incomplete development of the corresponding cartilage. The auditory capsule is derived from cranial mesentoderm and not from the mesectoderm.

Testing Insecticides and Fungicides

The constant production of new materials for the control of pests and diseases of fruit plantations calls for rapid laboratory methods for testing their efficiency. A procedure adopted at East Malling for testing fungicides has recently been described by H. B. S. Montgomery and M. H. Moore, and methods for insecticides are given by W. Steer (*J. Pom. and Hort. Sci.*, 15, No. 4; 1938). In the former method, 0·015 c.c. quantities of fungicide solution are spread uniformly over circular areas marked on glass slides and allowed to evaporate. 0·04 c.c. of an aqueous suspension of conidia of *Venturia inaequalis* is similarly applied and the slides stored in a saturated atmosphere at 21° C. Counts of germinations are then made at intervals. When desired, the spray deposit may be washed with water to simulate rainfall before applying the fungus. Methods of growing *V. inaequalis* in pure culture, and of assessing the results of treatment are described and the effects of tests with copper- and sulphur-containing materials discussed. Amongst organic substances tried, tetramethylthiuram disulphide was found to be highly fungicidal. The second paper describes the use of eggs of *Orgyia antiqua* L., *Operophtera brumata* L., *Aphis pomi* de G. and *Oligonychus ulmi* Koch, for testing ovicides. *O. antiqua* has also been used for contact and stomach poisons. Females of *O. brumata* are collected in orchards and induced to lay eggs on twigs in special cages. The twigs are then dipped in the insecticide, the toxicity of which is afterwards assessed from counts of hatched and unhatched eggs. Spray materials that show promise are applied to single branches of fruit trees to ascertain any damaging effect on the foliage before extensive field trials are begun.

Cytogenetics of Rice

The importance of rice as a world cereal has led to much recent work on the genetics of this plant. Two papers by Dr. S. Ramanujam (*J. Genetics*, 35, No. 2) deal mainly with triploids and their offspring. A sterile autotriploid mutant, which had thicker stems, broader leaves and larger spikelets, appeared in 1933. When grown with diploids, after being vegetatively multiplied, it gave a progeny of 60 plants, ten of which turned yellow and died as seedlings. These plants were derived from 150 good seeds which had been obtained from nearly 41,000 spikelets. A cytological study of these plants showed three nucleoli in somatic telophases, as against two in the diploid. Also three bivalents were attached to the large nucleolus in the pollen mother cells. The view that rice is a secondary tetraploid with basic number 5 chromosomes, including two pairs of satellited chromosomes, is confirmed. Some rice varieties, however, have but one pair of satellites. It is shown how this condition can arise. In the triploid progeny the chromosome numbers ranged from 24 to 30, with decreasing size of plant according to the number of extra chromosomes. *Oryza sativa* × *O. officinalis* finally gave a single seed which germinated and produced an intermediate sterile hybrid with $2n = 24$ as in both parents. Vegetatively multiplied and grown among *O. sativa* plants, ten seeds were obtained, six of which germinated and all proved to be triploid. The original hybrid showed failure of the chromosomes to pair in meiosis, but in certain cells they all divide in both mitoses, presumably producing diploid gametes which are alone functional. The $3n$ offspring showed extremely abnormal meiosis, with frequent coalescence and degeneration of pollen mother cells.

Stem Rot of the Oil Palm

The Department of Agriculture, Straits Settlements and F.M.S., has published as No. 21 in the Scientific Series, 1937, a paper upon the stem-rot of the oil palm by A. Thompson, senior plant pathologist. Observations made on a group of 720 oil palms growing on a quartzite soil with a sand-pan situated at various depths below the surface show that a form of stem-rot disease is caused by the fungus, *Fomes noxius*, and that the other fungi present in decaying leaf bases are relatively harmless. *F. noxius* is a facultative parasite which, on penetrating into the stem tissue via the leaf bases, normally extends laterally round the stem and horizontally in the outer stem tissue during the first years following infection; inward penetration then proceeds more rapidly but palms are rarely killed until two or three years after infection. The disease is only serious in areas of deep peat or in quartzite valley soils with sand beds approaching the surface. Control measures are discussed, and it is shown that burial of infected palms is not likely to be dangerous as *F. noxius* does not attack the roots.

Directional Recording of Atmospherics

One of the investigations of fundamental importance carried out by the Radio Research Board in Great Britain comprises the study of the nature and origin of the atmospherics encountered in radio reception. For several years past, radio direction-finding methods have been employed to locate the sources of atmospherics, and the results obtained have been compared with the position of storm areas obtained from meteorological data. A paper recently published (*J. Inst. Elec. Eng.*, March) by F. E. Lutkin under the title "Directional Recording of Radio Atmospherics" presents the latest results of this research work. These results have an enhanced value over those previously communicated in so far as they were obtained with an improved type of instrument, which is described in some detail. The directional receiver employed accepts atmospherics only over a sector of 20° unambiguously, and it is arranged to record the direction of arrival of these transient impulses continuously throughout the day. The minimum field strength required to produce a recordable deflection on the instrument is about 0·25 millivolt per metre. The paper deals with the records obtained in Great Britain during the years 1930–33. It is shown that most of the disturbances arrive from the west or south-west, but during summer afternoons sources to the east and south-east are productive; together with storms of a purely local character. It appears from this investigation that the majority of the atmospherics producing disturbance in long-wave radio reception in Great Britain are generated in distant regions of thunderstorm activity. They suffer variable attenuation in propagation, depending upon conditions in the ionosphere over the path along which they travel. In consequence the American sources supply the majority of atmospherics with a field strength exceeding 1 millivolt per metre in England. Summer afternoon and evening sources lie in the thunderstorms of Europe, but American sources always predominate during the night and early morning.

Principles of Violin Construction

In the issue of the *Journal of the Franklin Institute* of March, Mr. P. Jarnak of the Polytechnic, Copenhagen, gives the principal results of the investigations of the violin, viola and 'cello which, with the help of a grant from the Oersted Foundation and the co-operation of the Bell Telephone Co., he has carried out with a view of reviving an art lost soon after the death of Stradivarius in 1737. By electrical amplification and record of the sounds produced by some of the best old and modern instruments he has determined the relative amplitudes of the fundamentals and harmonics which give the most beautiful tones, and for these the body of the instrument must be capable of acting as resonator. The heavy wood back is, the author considers, divided into two coupled resonators by the sound post, the light wood front into four by the bass bar and bridge and these six resonators must be capable of reinforcing the requisite notes. He shows on calculating their possible frequencies from their dimensions that in instruments of good tone they do this—in bad ones they do not. By altering the dimensions of the resonating parts he has improved the tones of poor instruments and has confirmed his theoretical work in a way which should lead to the possibility of producing instruments equal to those of the old masters.

Shape of Eros and its Light-Changes

Dr. A. C. D. Crommelin has recently issued a paper on the question of the remarkable changes of light to which Eros is liable, these changes having been detected at its second apparition in 1900–1 (*J. Brit. Astro. Assoc.*, **48**, 5, March 1938). Two theories were put forward to account for this phenomenon: (1) differences of albedo on different parts of its surface; (2) departure of its figure from a spherical form. The Johannesburg equatorial at the Union Observatory showed the planet elongated at the near approach in 1931, and it is certain that Eros is dumb-bell or sausage shaped, rotating about an axis perpendicular to its long diameter. The period of light-change is $2^h\ 38^m$, and if the shape is symmetrical this may be only half the rotation period. Jaschek, at Vienna, and other observers, have noted light-changes of much shorter period, and this suggests local irregularities of figure—a condition quite consistent with the fact that cohesion, not gravitation, is the main factor in controlling the form of Eros.

Plant Protection in the Soviet Union

By R. C. Rainey

In the course of a recent visit to some of the chief Russian entomological research centres, I had the opportunity of seeing something of the headquarters of the Soviet plant protection service, the All-Union Institute for Plant Protection, and also of seeing the Plant Protection Station for the Leningrad Province. In view of the attention which Russian agriculture has attracted in recent years—Vavilov states that the 1937 harvest has proved the largest in history—the following notes may be of general interest.

The more basic agricultural research in Russia is directed by the Lenin All-Union Academy of Agricultural Sciences in Moscow, controlling the work of half a dozen or more research institutes. One of these is the Institute for Plant Protection; another is the Institute of Plant Industry, which has its headquarters in the former Ministry of Agriculture building in the Ulitza Gerzena, Leningrad (Fig. 1), and is directed by Dr. N. I. Vavilov, vice-president of the Academy, whose world-wide investigations into the origins of cultivated plants are now well known, and for whose assistance during the present visit I am particularly grateful.

Fig. 2.

Laboratories of the Institute for Plant Protection, Elagin Ostrov, Leningrad.

VIZRa, the Institute for Plant Protection, has its administrative headquarters in the Ulitza Krasnaya in Leningrad, while most of the laboratories are housed in a small palace (Fig. 2), said to have been formerly the residence of Stolypin, Nicholas II's minister, on the Elagin Ostrov, an island in the Neva on the northern side of the city. The gardens occupying the remainder of the island now constitute the Kirov Park of Culture and Rest; a dance for factory workers was in progress in the former ballroom of the palace during one of my visits to the Institute. Something like fifty research workers, together with their assistants, are employed by VIZRa, which is subdivided into a number of sections dealing with ecology, biological control, chemical control, mechanization of control measures, pests of special crops such as grain and cotton, and so on; in the limited time available it was only possible to see a small proportion of the work in progress, even apart from the extensive field studies.

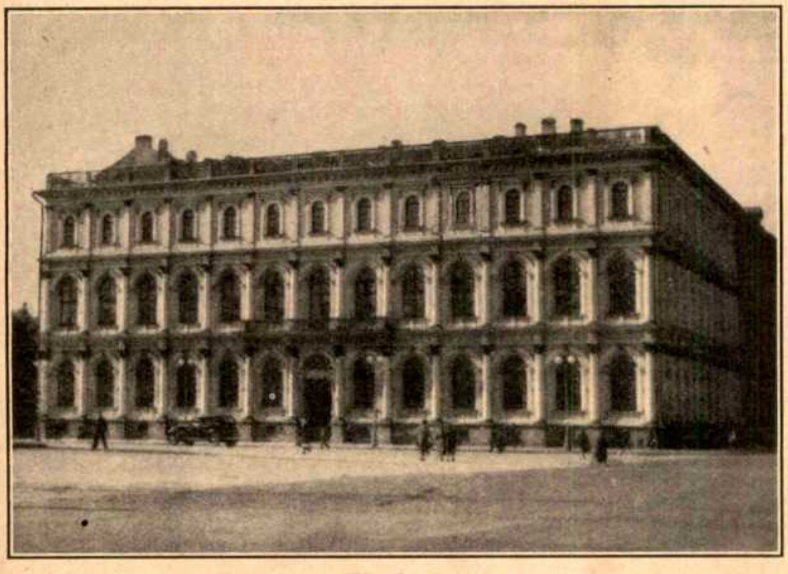

Fig. 1.

Institute of Plant Industry; Ulitza Gerzena, Leningrad.

Dr. J. I. Prinz and his collaborators are investigating problems of soil ecology, working chiefly with the chafer beetles *Melolontha melolontha* L. and *M. hippocastani* F., and with the wireworms *Agriotes obscurus* L., confined to the northern parts of the Union, and *Selatosomus latus* F., a more southern species. Considerable progress has been made in the difficult task of rearing these long-lived insects under controlled environmental conditions; *Melolontha*, for example, can now be reared without soil from the beginning of the second instar, and its life-cycle is completed in 10–12 months in the laboratory, as compared with four years or so in the field. The optimum conditions for oviposition and for the larval development of *Agriotes* have also been largely worked out.

Dr. I. A. Rubtzov's laboratory is primarily a methodological one, investigating methods of studying the various factors influencing insect numbers. Many of the methods used are those familiar in Great Britain, but they do not appear to be applied uncritically; for example, sulphuric acid and a number of metallic salts are no longer used in the control of humidity, as they are stated to have injurious effects on the experimental insects. Associated with Russian climatic conditions, temperatures down to −20° C. are used in cold-hardiness work. Some interesting work is in progress on the rearing of phytophagous insects such as plant-sucking bugs under conditions of controlled temperature and humidity; large double-walled thermostatically controlled greenhouses are available for the experimental plants. Rubtzov has also carried out important work in Siberia demonstrating phase variation in non-migratory grasshoppers essentially similar to, though less pronounced than, the phase differentiation in locusts.

The biological control section is directed by N. F. Meyer, who has carried out a considerable amount of survey and taxonomic work on the parasitic Hymenoptera, while V. P. Pospelov is in charge of investigations in insect microbiology.

In the chemical control section, which includes the laboratories of insect toxicology, oil emulsions, vegetable poisons, fumigants, and phytotoxicology, Dr. C. J. Bliss, the American statistician, has been working for the last two years on a contract with the Soviet Government; he has been carrying out a programme of theoretical and practical work on the application of statistical methods to entomological problems, with particular reference to the design of experiments for insecticide trials. A new type of spray testing apparatus, incorporating the ideas of Campbell and Tattersfield with modifications suggested by Bliss, and made by the Institute's technicians, has recently been supplied to several of the laboratories. A somewhat similar apparatus is used for laboratory trials of insecticidal dusts; leaves are dusted under controlled conditions in a special chamber, and standard disks of treated leaf are supplied to each insect. The concentration of dust on the leaves is determined by weighing similarly exposed cover-slips of known area on a microbalance; the amount of dust ingested is determined from the area of leaf eaten, found by mounting the partly eaten disks on squared paper. The method is of course applicable only to stomach poisons. The staff of the chemical control section, like other Soviet workers whose duties involve handling toxic materials, each receive a free extra milk allowance of half a litre daily.

The Plant Protection Station (STAZRA) for the Leningrad Province is directed by Prof. N. N. Bogdanov-Katkov, who also holds a teaching post in the Institute of Applied Zoology and Phytopathology, at which plant pathologists and entomologists are trained. A visit was also made to the field station at Peterhof, about twenty miles out of the city on the sea-coast near Peter the Great's palace. Research is carried on in addition to the advisory work, and recommendations concerning new control measures are circulated among the collective farms of the province. One such new control measure is the use of a naturally occurring hydrated ferrous phosphate to protect seed, particularly seed corn, from various stored products pests, particularly the flour mites *Tyroglyphus farinæ* DeG. and *Glycyphagus destructor* Schr., often associated with the predaceous mite *Cheyletus eruditus* Schr. The ferrous phosphate is found under the peat of the moors of Karelia and elsewhere at a depth of a foot or so; on air-drying, it falls to a fine blue powder which is used as a seed-dressing. It appears to act not as a poison but as a repellent, the mites dying after some weeks apparently from starvation.

The arsenicals generally used against orchard and vegetable pests are calcium arsenate and sodium arsenite and arsenate; the employment of lead arsenate is illegal, on account of the possibility of cumulative poisoning. The alkaloids aconitine and anabasine appear to be used to a considerable extent; another somewhat unfamiliar insecticide is chloric acid, used as a 1/10 per cent solution for the destruction of the eggs of the cabbage root-flies *Phorbia brassicæ* Bch. and *P. floralis* Fall., which cause considerable losses in the spring and summer respectively—cabbage pests generally are of considerable economic importance in this province. The staff of the Station appeared well informed on foreign practice; they were, for example, familiar with the proprietary organic mercury compounds used in Great Britain against smut (*Ustilago* spp.) on cereals.

The field station is chiefly concerned with the mass breeding of the Chalcid parasite *Trichogramma evanescens* Westw. for the control of a number of pests, particularly the codling moth, *Cydia pomonella* L., in apple orchards, and also the pea tortricids, *C. nigricana* Steph. and *C. dorsana* F. The parasites are reared on *Sitotroga cerealella* Oliv.; the stock culture of the latter is maintained in some three tons of grain.

The parasite was originally introduced from abroad, and the mass breeding work has been in progress for the last three years. A number of the collective farms in the province now breed their own *Trichogramma* for release; a peasant came in with a consignment of parasitized eggs from his collective farm for cold-storage at the Peterhof laboratory during the visit there. 2,500 acres of orchards have recently been treated, the parasites being released at the rate of about 120,000 per acre. Complete control is not claimed, but experimental results showing, for example, a reduction in the proportion of infested fruit from 33 per cent in the control areas to 17 per cent in the treated ones were quoted. The results suggest a localization of the activity of the released parasites which does not agree with the rapid dispersion found, for example, with *T. lutea* Gir. in the Transvaal, though environmental differences, mainly perhaps in temperature, may be involved here.

In conclusion, one or two general points concerning accommodation and equipment may not be out of place. Though most of the existing accommodation is of a temporary nature—the Institute of Plant Protection is to follow the majority of the central scientific institutions to Moscow within the next few years—one's general impression was not unfavourable. Equipment was surprisingly good; microscopes, micro-balances, incubators, electric motors and relays, constant temperature rooms, calculating machines, and glassware of all kinds may be mentioned as examples of Soviet-made apparatus apparently fully up to the standard of that in use elsewhere.

Noise and Housing

THE great interest which is being displayed at the present time in quiet housing is reflected in two reports which have reached us: the first, on the "Hygiene of Housing", from an international commission of the Health Organisation of the League of Nations; the other, on the "Construction of Flats for the Working Classes" (H.M. Stationery Office. 1*s*. net), from a Departmental Committee of the Ministry of Health. Both reports deal with various scientific and other aspects of the housing question, and are in general harmony as to the steps which should be taken in relation to the environmental problem of noise and its bearing on the amenities of housing.

The League of Nations Commission, under the chairmanship of Dr. G. W. C. Kaye, collated the experiences of a number of countries in lessening the nuisance of noise in many circumstances. The report directs attention to the significance of town planning by public or private authorities, with the view of locating dwellings in quiet areas, and securing the co-operation of industrialists in the lay-out of noisy plant. Not only external planning but also the interior planning of dwellings must be given close attention, so that, for example, bedrooms are allocated to the quietest rooms. Then again, dwellings may be insulated against external or internal noise or vibration by sound-proof walls, double windows, composite floors, suspended ceilings, resilient floor coverings, and sound-absorbent surfacings for walls and ceilings. Above all, noises should be reduced or isolated at the source; some countries have resorted to legal enactments and restrictions, but as regards others, research, education and the force of public opinion are more likely to be helpful. Among aggressively disturbing interior noises, particularly for flat dwellers, are powerful loud-speakers, hissing water taps and noisy sanitary fittings. Quieter motor-vehicles would be a boon for those who live and try to sleep in dwellings situated in busy thoroughfares. The report quotes standards of noise-level which are considered desirable and practicable in different classes of rooms in various locations, together with standards of noise opacity of walls and floors for air-borne and impact noises respectively.

The report of the Ministry of Health Committee, under the chairmanship of Sir George Humphreys, is on much the same general lines in its references to questions of acoustics. There is an appendix dealing with noise in working-class flats, which was prepared for the information of the Committee by the National Physical Laboratory and the Building Research Station. The Committee is impressed with the value of composite structures in arresting sound transmission, though it appreciates that the basic principles involved are not yet fully established. The Committee awaits the expeditious prosecution of research into the effects of specific forms of discontinuity in structural systems, and the provision of acoustic data for the different units of construction, not omitting, of course, the all-important matter of comparative cost.

Association between Nematodes and Insects

MR. PROSPER BOVIEN contributes an important paper (written in English) on the above subject, in the *Videns Kabelige Ueddelelseer fra Dansk naturhistorisk Forening*, 101, 1937, which has only recently come to hand. His investigations relate to the family Anguillulidæ, which may become associated with insects in various ways. From a survey of the literature, and his own investigations, the author concludes that these nematodes and insects may be associated in four different ways. (1) Symbiotic association, such species living in the frass or tunnels of wood-inhabiting beetles. Other species live in the nests of ants or termites. The prevalence of a special larval stage ("Dauerlarve" of Fuchs) has been ascertained in some instances. These larvæ may be carried externally, for example, under the elytra of beetles, loosely adhering or protected by a 'cocoon'. In some cases they may invade the gut, pharyngeal glands or the hæmocœl of the host. (2) Species found in dung and decaying vegetation which may pass through larval stages carried by insects loosely attached to the exoskeleton or firmly adhering as 'cysts'. Others have endoparasitic larvæ affecting insects. (3) There are also species which occur as actual parasites in the body-cavity of insects where reproduction takes place. (4) Species which combine parasitic and saprozoic types of behaviour.

Among the life-cycles studied by this author, special mention may be made of that of *Heterotylenchus aberrans* gen. et sp. nov. which is parasitic in the onion fly (*Hylemyia antiqua*) and of two new species of *Neoaplectana* which are abundantly present in larvæ of Bibionid flies. It is believed that the number of species with "Dauerlarven" is much larger than has been supposed. Their extraordinary power of resistance is commented upon and mention is made of finding living larvæ of *Aphelenchoides* in chrysanthemum leaves which had been kept for five years in a drawer in a laboratory. Among flies of the family Psychodidæ, up to 50 per cent were found to carry "Dauerlarven" of *Rhabditis dubia* sp.n. which are lodged externally like tightly fitting rings in the intersegmental furrows of the abdomen. When placed in dung, which harbours a rich population of Psychodidæ, these larvæ developed into adults in a few days. The paper is one of more than ordinary interest, commended to the notice of zoologists as well as to the specialist.

Science News a Century Ago

Arrival of the *Sirius* and *Great Western*

On the morning and afternoon respectively of April 23, 1838, the S.S. *Sirius* and the S.S. *Great Western* anchored in New York Harbour. The former had made the passage from Cork in nineteen days and the latter the passage from King Road, in the Severn, in fifteen days. Their arrival was the occasion for a remarkable outburst of enthusiasm. On April 23, 1838, the *New York Herald*, under the heading "The Beginning of the New Age in Steam Power", said, "The feelings of this community, on this occasion . . . can't be described", and the same paper the next day said, "The excitement yesterday was tremendous; from an early hour in the morning until dark, myriads of persons crowded the Battery to have a glimpse of the first steam vessel which had crossed the Atlantic from the British Isles, and arrived at this port. . . . This excitement was further increased by the arrival of the *Great Western*, from Bristol . . . making the passage in fifteen days, thus solving the problem of possibility, and showing what can be done by enterprize, expenditure, courage and skill, in encountering the stormy weather which these two vessels have so successively braved and surmounted."

To Lieut. Roberts, the captain of the *Sirius*, the British Consul wrote on April 23, "I have the honour and happiness to congratulate you on the arrival of your steamship across the Atlantic, at a season when strong gales so generally prevail, thereby having proved that British skill had accomplished a most important enterprise, which will produce a revolution in commercial and social intercourse, of which we are incapable of forming any just conceptions. Permit me, Sir, to add that I have, in common with my fellow subjects of Her Majesty in this City, a further cause of rejoicing, that the honour of accomplishing the enterprise has been achieved by a son of the British Navy, and that it was completed on St. George's Day."

Line of Levels across Northern Syria

At a meeting of the Royal Society on April 26, 1838, a paper was read entitled, "An Account of a Line of Levels, carried across Northern Syria, from the Mediterranean to the River Euphrates", by W. T. Thomson, with geological and botanical notes by W. Ainsworth. The line of levels was undertaken in connexion with Colonel Chesney's expedition of 1835 sent out to determine the possibility of placing steam boats on the Euphrates and Tigris and so connecting with India by steam. One of the results of the expedition was to show that the bed of the Euphrates was 628 ft. above the level of the Mediterranean. The whole of the district over which the line of levels was carried, said Thomson, naturally divides itself into four regions, each of which is characterized by its relative elevation, and the manners and habits of its population. The first region commencing from the Euphrates comprises the country of the upper chalk and conide limestones, which averages an elevation of 1300 ft. The soil is light, somewhat stony, and of no great depth, and is highly productive in crops of corn and cotton. The second region comprises the country of ostracite limestone and feldspath pyroxenic rocks, having a mean elevation of 450 ft.; the third is the lacustrine plain of Umk about 305 ft. above the Mediterranean and covered for the most part with the gramineous plants which feed the flocks of the pastoral and nomadic Turcomans; and the fourth region, formed by the valley of Antioch, is rocky and irregular with elevations from 220 to 440 ft. It comprises also the alluvial plains of the Orontes.

Smallpox among American Tribes

The issue of the *Gazette des Hôpitaux* of April 26, 1838, gives the following account of a severe epidemic of smallpox which was prevalent at that time among some American tribes: "The situation in Upper Missouri is appalling. Small-pox, or the 'black disease', as it is called, has chiefly attacked the tribe of the Assinaboins. After death caused by the disease the body becomes quite black and swollen to thrice its ordinary size. People are actively engaged in collecting the bodies and burning them in heaps. The Sioux tribe which has been vaccinated has hitherto escaped infection. Nearly all the tribe of the Mandans, numbering 1,600 souls, who lived above Saint Louis, have disappeared, only 31 being left. The pestilence has attacked the Minaterees or Big Bellies, another neighbouring tribe, with equal violence. The Arickareas as well as the Grees have been almost entirely destroyed. The Assinaboins with a population of 9,000 no longer exist. The great nation named Black Feet numbering 50,000 or 60,000 inhabitants has suffered severely. More than a thousand houses each containing eight inmates have been decimated. It is probable that all the tribes in the Columbia region as well as those extending to the south of Missouri will be affected."

The *Athenæum* and Postal Reform

The *Athenæum* devoted the leading articles in its issues of April 21 and April 28, 1938, to a review of the "Minutes of Evidence taken before the Select Committee on Postage", printed by order of the House of Commons. The Committee had been appointed largely through the proposed reforms set out by Rowland Hill. Much evidence had been given of the various means used by individuals and business houses to evade the very high rates of postage charged by the Post Office, and in commenting on this the *Athenæum* said, "We might almost say that *fortunately* for trade and commerce, the operation of the government monopoly is counteracted by the clandestine conveyance of letters. The means of evasion are so obvious and frequent, that the post has become only the extraordinary, instead of the usual channel for the transmission of business letters." The postage was then for all intents and purposes little more than a tax and a source of revenue and not a means of promoting trade.

In connexion with the proposal that prepaid envelopes should be provided, it had been suggested that this would lead to forgery. To counteract this, it was proposed that a peculiar paper with lines of thread or silk stretched through its substance should be used. The advantages of such paper were that it would be difficult to make and counterfeit, and by diversifying the colour, material and arrangement of the threads, forgers could be defeated. To illustrate the use of this device, the *Athenæum* instructed Mr. Dickinson, the inventor, to supply paper of this kind for its issue of April 28, which accordingly appeared with some of its sheets made of paper containing fine blue threads half an inch apart.

Societies and Academies

Dublin

Royal Dublin Society, February 22.

Phyllis Clinch, J. B. Loughnane and P. A. Murphy: A study of the infiltration of viruses into seed potato stocks in the field. The infiltration of viruses into seed potato stocks in the north-west of Ireland was studied. The only viruses found were *X*, *B* and *A*. It was found possible to grow stocks for six years without incurring any virus infection.

J. B. Loughnane and P. A. Murphy: Dissemination of potato viruses *X* and *F* by leaf contact. Virus *X* (*Solanum virus* 1) spread freely to potatoes under controlled experimental conditions both under glass and in the field by leaf contact, virus *F* (*Solanum virus* 8) was found to spread similarly under glass, and there is evidence that virus *B* (*Solanum virus* 4) can be conveyed in the same way. Some potato viruses are transmitted by leaf contact as well as by insects.

E. J. Sheehy and W. Kearney: The occurrence of the uræmic condition in chickens, and its relation to protein and other dietary factors. Evidence is presented to show that this disorder is connected with both the protein and the non-protein constituents of the dietary, and that it is controllable.

G. T. Pyne and L. Ó. Droma: The rôle of albumin in cheese-making. Experiments on the preparation of Cheddar cheese from pasteurized milk to which albumin had been added both before and after pasteurization show that the detrimental effect of pasteurization on cheese-making (in so far as it acts through its effect on albumin) is due to precipitation of albumin on the casein micelles rather than to any change in the soluble albumin content of the milk.

Edinburgh

Royal Society, March 7.

W. T. Gordon: *Tetrastichia bupatides*, a carboniferous Pteridosperm from East Lothian. On the theory that magmatic waters emitted from volcanoes in eruption might decompose the ashes and thus produce petrifying solutions, a successful search for petrified plants was made at Tantallon Castle, East Lothian, in ashes of Lower Carboniferous age. One of these plants, *Tetrastichia bupatides*, possessed a stem with central xylem cylinder, cruciform in section, and, save for the spiral protoxylem elements, composed entirely of reticulately thickened tracheids. The petiole at certain levels had a trace similar to that described in *Lyginorachis papilio*, and the sclerotic elements resemble those found in *Telangium affine*. The new plant has the simplest structure of any known Pteridosperm.

N. W. Radforth: An analysis and comparison of the structural features of *Dactylotheca plumosa* Artis and *Senftenbergia ophiodermatica* Göppert. Of these two Carboniferous fern-like compressions, the former has been regarded as a true fern with annulate sporangia, while the latter was believed to be a Pteridosperm from the nature of its apparently exannulate sporangia. However, this analysis has shown that the fructifications of *Dactylotheca plumosa* are definitely annulate and identical with those of *Senftenbergia*. Moreover, from a comparison of other structural features it is clear that these two fossils are merely different parts of the same plant, and therefore can no longer be regarded as belonging to separate genera. Since the name *Senftenbergia* has priority, this genus must now embrace the forms previously described as *Dactylotheca plumosa*. The spores, which hitherto had not been revealed, have been isolated from the sporangia in their various developmental stages. Both the sporangia, the structure of which has been worked out in detail, and the mature spores which are characteristically ornamented, resemble so closely the sporangia and spores of the living fern *Aneimia* that the view of a possible relationship between *Senftenbergia* and the living Schizaeaceous ferns to which *Aneimia* belongs, is now greatly strengthened.

A. C. Aitken: Studies in practical mathematics. (3) The application of quadratic extrapolation to the evaluation of derivatives and to inverse interpolation. The first part of the paper shows how to interpolate by quadratic proportional parts (quadratic extrapolation) for the value of a function and several of its derivatives at the same time. The second part of the paper shows how quadratic extrapolation may be made available for inverse interpolation. A set of crude approximations to the desired value of the variable, given by ordinary proportional parts, yields in general very accurate values when treated by quadratic extrapolation.

Paris

Academy of Sciences, February 21 (*C.R.*, 206, 545–632).

Alfred Lacroix: The granular rocks found with the ankaratrite of Takarindoha, at Madagascar.

Georges Bouligand: The distance of a variable point to a fixed ensemble.

Jules Dubourdieu: Absolutely monotonic functions and the mathematical theory of assurance accidents.

E. J. Gumbel: The prediction of floods.

Kentaro Yano: Remarks relating to the theory of spaces with conformal connexion.

Karl Menger: An abstract form of the generalized theorem of Borel-Lebesgue.

Christian Pauc: Semi-continuities of inclusion in the general spaces of Fréchet.

Dragoslav S. Mitrinovitch: Geometrical problems where various differential equations intervene.

V. A. Kostitzin: The general differential equations of the problem of natural selection.

Jean Delsarte: A new extension of the idea of almost periodicity.

Georges Valiron: The Borel directions of metamorph functions of infinite order.

Marcel Sédille: Extension of the methods of calculation of the wheels of axial turbo-machines.

Maurice Denis: The aerodynamics of a wing in vibration.

Jean Mandel: The equilibria by parallel sections of soils and of media plastic at the limit of flow.

Félix Cernuschi: The adsorption of gases by surfaces as a particular case of dissociation equilibrium.

Frans Van Bergen: The variation of the resistivity of an electrical conductor placed in a magnetic field.

Pierre Vernotte: A new solution of the problems of heat, allowing the commencement of the propagation to be studied in all cases.

F. Bedeau and L. Herman: A new amplifier with valves for weak currents.

Miroslaw Romanowski and Maxime Picard: A potentiometer bridge for the comparison of standards of electrical resistance.

Emile Pierret and Charles Biguenet: A resonance phenomenon observed in electronic oscillations of triode valves.

Noel Felici: The movement of supraconductors.

Georges Carpéni: The electrometry and ultraviolet spectrography of croconic acid. The comparative constitutions of rhodizonic and croconic acid.

Paul Laffitte and André Parisot: The projection of flame in gaseous mixtures.

Arnold Lassieur: A method of determining carbon dioxide based on the electrical conductivity of baryta solutions.

Raymond Paul and Guy Hilly: The preparation of an active iron and its application to the semi-hydrogenation of acetylene derivatives. The iron was prepared by attacking iron-aluminium alloys containing 20–30 per cent of iron with caustic soda solution. At 100° C., and under pressure, hydrogenation is selective, acetylene derivatives giving the corresponding ethylene compounds.

Henri Clément and Jean Savard: The methylation of xylene. From a quantitative study of the methylation of xylene by the Friedel and Crafts reaction it is concluded that the reactions leading to the different derivatives are successive and not simultaneous.

André Lenoble: The chronology of the volcanic eruptions of the massif of Ankaratra (centre of Madagascar).

Fridolin Firtion: The faunal characters of the Givetian limestones of the Schirmeck region.

Jean Lacoste: The style of the internal branches of the south Riffian virgation and the massif of Karia.

Jean Dufay and Junior Gauzit: The spectrum of the aurora of January 25, 1938. This aurora was essentially characterized by the considerable intensity of the two OI red lines with respect to that of the green line and by the presence of the bands of the first positive system of nitrogen.

Albert Vandel: The chromosomes of the Asellota.

Georges Schæffer: The origin of the extra heat in the specific dynamic action of proteins.

Jean Roche and Maurice Fontaine: The respiratory pigment of the sea lamprey (*Petromyzon marinus*) and on the zoological distribution of the protohæmatinic respiratory pigments (hæmoglobins and erythrocruorines).

R. Dujarric de la Rivière and P. Garnal: The toxicity of the spores of *Amanita phalloides*.

Rome

National Academy of the Lincei (*Atti*, 26, 55–128; 1937).

G. Fano: Observations on some finite geometries (1).

P. Buzano: Ruled surfaces of the *n*th order of *n*-dimensional space having ∞^n homographies in themselves.

A. Consiglio: The calculation of the integrals contained in Villat's formula relative to a circular corona.

R. L. Gomes: Dirac's matrices in the broad sense.

M. Schönberg: The function $\delta(x)$ of Dirac.

A. Terracini: A possible particularity of the principal lines of a surface (1).

G. N. Watson: Study of a particular function defined by an improper integral.

P. Cicala: Non-stationary motion of a wing of finite lengthening.

P. Gallitelli: Chemical analysis of the granite of Montorfano and of the granite and tourmaline of Alzo.

G. Goidànich: A little-known disease of the vine.

M. Benazzi: The prehypophysis of *Rana esculenta* does not bring about œstrus in the undeveloped female rat.

E. Sacerdote: Photo-electric photometer for the determination of hæmoglobin in very dilute solutions of blood.

V. Zagami: Experimental researches on the seminal fluid (2). The pH value of the seminal fluid of the cock.

Sydney

Royal Society of New South Wales (71, 1937).

C. E. Fawsitt and R. W. Stanhope: Viscosities of some complex salts in aqueous solution. Solutions of complex salts containing copper, silver, zinc, nickel and cobalt along with ethylenediamine and pyridine were examined for viscosity. Most of these solutions have a greater viscosity than that of the corresponding simple salts. However, the viscosities of zinc and nickel salts with ethylenediamine are scarcely different from the viscosities of the simple salts. The ethylenediamine copper salts have a lower viscosity than the corresponding simple copper salts. The electrical conductivities of the complex zinc and copper salt solutions (dilute) containing ethylenediamine are slightly greater than those of the simple salt solutions.

A. J. Birch: (1) Exudation of *Araucaria Bidwilli*. The exudation is shown to consist of a gum oleo-resin, the former containing pentosans, and the latter d-limonene and unidentified esters. (2) The α-phellandrene fraction of eucalyptus oils. An extension of the method already described by Birch for the detection and estimation of α-phellandrene is given, which enables the detection of dl α-phellandrene in the presence of active substance. The method is applied to the examination of the α-phellandrene fractions of the oils of ***Eucalyptus dives*, *E. Risdoni*, *E. Radiata*** and ***E. Amygdalina***, the first three of these oils containing large amounts of p-cymene, and the last dipentene. In no case is dl α-phellandrene present. A commercial sample of α-phellandrene contains p-cymene and origanene. It is suggested that the presence of p-cymene in α-phellandrene largely accounts for the variations observed in the optical rotation.

Germaine A. Joplin and Alma G. Culey: Geological structure and stratigraphy of the Molong-Manildra District. Silurian, Devonian, Tertiary and Recent formations have been recognized, and a detailed description is given of the Palæozoic strata. The Silurian has been divided into an upper (Manildra) and lower (Molong) series. Middle Devonian (Garra Beds) and Upper Devonian (Lambie Beds) are both recognized and all the Palæozoic rocks have been shown to be conformable. It has been pointed out that folding took place during the Kanimbla Epoch at the close of the Devonian, and that the Palæozoic series have been thrown into folds trending a little to the west of north.

[*To be continued.*]

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, April 25

Royal Geographical Society, at 5.30.—Isobel Hutchison: "Alaska and the Pribilof Islands"—(Geographical Film).

Royal Aeronautical Society, at 8.—(at the Institution of Electrical Engineers, Savoy Place, W.C.2).—H. E. Wimperis: Presidential Address.

Tuesday, April 26

Royal Statistical Society (at the Royal Society of Arts), at 5.15.—Discussion on "Is the Trade Cycle a Myth?" to be opened by Dr. E. C. Snow.

Institution of Civil Engineers, at 6.—Sir William Bragg, P.R.S.: "The Crystal and the Engineer" (James Forrest Lecture).

Wednesday, April 27

University of Cambridge (in the Arts School).—Prof. E. Cartan: "Geometric Theory of Spinors" (Rouse Ball Lecture).*

Thursday, April 28

Institution of Electrical Engineers, at 6.—Prof. Max Born: "The Statistical Laws of Nature" (Kelvin Lecture).

British Psychological Society, at 8.30—(at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Dr. William Brown: "Hypnosis, Suggestibility and Progressive Relaxation and Experimental Study".

Chemical Society, at 8.—Prof. J. E. Coates: Haber Memorial Lecture.

Friday, April 29

University College, London, at 5.30.—Prof. The Svedberg: "Molecular Migration under the Influence of Centrifugal, Osmotic and Electrical Forces" (succeeding lectures on May 2 and 3).*

Royal Institution, at 9.—Dr. R. N. Salaman, F.R.S.: "The Origin of the Potato".

Iron and Steel Institute, April 29–30. Annual Meeting to be held at the Institution of Civil Engineers, Great George Street, London, S.W.1.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Lecturer and Demonstrator in Civil Engineering in University College, Cardiff—The Registrar (May 9).

Assistant Lecturer in Chemistry in Bradford Technical College—The Director of Education, Town Hall, Bradford (May 14).

Assistant Lecturer in Mathematics in the University of Manchester—The Registrar (May 14).

Assistant Mechanical Officer for the Nigerian Government Railway—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote M/5504).

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Some Good Garden Plants. By F. J Chittenden. Pp. 143+24 plates. (London Royal Horticultural Society) [44

Meteorological Office. Air Ministry Professional Notes, No. 80: A Height-Computer for Use in Aerological Work. By E G. Bilham (M.O. 336t) Pp. 13+1 plate. (London: H.M. Stationery Office.) 3*d*. net. [44

National Institute of Agricultural Botany. Eighteenth Report and Accounts, 1936–37. Pp. 21. (Cambridge: National Institute of Agricultural Botany) [44

Tanganyika Territory. Soil Erosion. A Memorandum by E. Harrison Pp. 22. (London: Crown Agents for the Colonies) [44

National Union of Teachers. Information for Members of Annual Conference, Margate, 1938, including the Executive's Report, Financial Statements, Rules, List of Executive, and Information respecting Provident Society, Benevolent and Orphan Fund, etc. Pp. cl. (London: *Schoolmaster* Publishing Co., Ltd) [74

This Cruelty Called Sport. By Air-Commodore L. E. O Charlton. Pp 48 (London: League for Prohibition of Cruel Sports.) [74

Department of Scientific and Industrial Research. Forest Products Research Records, No. 23: Kiln-Seasoning Treatments of Teak and their Effects on its Wearing Qualities as Flooring Part 1, by R. A. G. Knight; Part 2, by F. H Armstrong Pp. ii+14+5 plates. (London: H M. Stationery Office) [74

Register of Attested Herds under the Tuberculosis (Attested Herds) Scheme (England and Wales) and Tuberculosis (Attested Herds) Scheme (Scotland). Pp 44 (London and Edinburgh Ministry of Agriculture and Fisheries) Free [74

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1937 (Twenty-third Report). Pp viii+101. (London: H.M Stationery Office.) 7*s*. 6*d*. net. [74

Fitness Wins: Twenty-four Ways of keeping Fit. Issued by the National Fitness Council. Pp. 64. (London. H M. Stationery Office.) 2*d*. net. [74

Other Countries

Astronomische Abhandlungen der Hamburger Sternwarte in Bergedorf Band 3, Nr. 2. Über die Beobachtungen der 13755 Anhaltsterne fur das AG-Zonenunternehmen auf der Hamburger Sternwarte in Bergedorf (3. Bergedorger Sternverzeichnis). Von F. Dolberg und J. Larink. Pp. ii+99–130+2 plates Band 4, Nr. 10. Farbenindizes in den offenen Sternhaufe NGC 1027 und IC 1805 und den Kapteynschen Eichfeldern 26, 35 und 40 Von Martin-Christopher Clasen. Pp 237–251. (Bergedorf: Verlag der Sternwarte.) [44

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 160: Coupled Wing-Fuselage Vibrations. By Katsutada Sezawa and Wataru Watanabe. Pp. 171–194. (Tôkyô. Aeronautical Research Institute) [44

Cornell University. Agricultural Experiment Station. Memoir 207. The Blossom-Blight Phase of Fire-Blight, and Methods of Control. By E M Hildebrand. Pp. 40+3 plates. Memoir 208 A Physiological Study of Dormancy in Seed of Magnolia Acuminata. By Michel Afanasiev. Pp. 37. Memoir 209: A Study of Potato Yellow Dwarf in New York. By L. M. Black. Pp. 23+4 plates. Bulletin 677: Experiments with Cover Crops on Long Island. By P. H. Wessels and John D. Hartman. Pp. 27. Bulletin 679: Economic Studies of Vegetable Farming in New York; 3: Truck-Crop Production and Prices. By E. G. Misner. Pp 72. Bulletin 680 Development of Highway Administration and Finance in New York. By W. M. Curtiss. Pp 63. Bulletin 681 Development of Assessment of Property and Collection of Taxes in Rural New York. By F. F. Hedlund. Pp 51. Bulletin 682: Vegetable-Crop Production in Orleans County, New York. By W. C Barnes Pp. 23 Bulletin 683: An Economic Study of Land Utilization in Monroe County, New York. By W. T. Wilson and J. N. Efferson. Pp. 47. (Ithaca, N.Y: Cornell University.) [44

Publications of the South African Institute for Medical Research Vol 7, No. 40: Studies on Insects of Medical Importance from Southern Africa and Adjacent Territories (Part 4). By Dr. Botha De Meillon. Pp. 301–411. Vol. 7, No 41: Typhoid Fever on the Witwatersrand; Bacteriological Aspects, Serological Diagnosis, Specific Prophylaxis and Specific Treatment. By Dr. W. Lewin. Pp. 413–550. (Johannesburg South African Institute for Medical Research) [44

A Report on the Technical Colleges of South Africa. By Dr. F. H Spencer. Pp. 65. (New York: Carnegie Corporation.) [44

Rubber Research Institute of Malaya. Planting Manual No. 7: Rubber Growing, Elementary Principles and Practice. Compiled and prepared for Publication by A Moore from Material supplied by Members of the Staff of the Institute and in consultation with the Department of Agriculture, S S and F.M S. Pp. 82. (Kuala Lumpur. Rubber Research Institute of Malaya.) 50 cents. [44

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Acting Director of Agriculture for 1936. Pp. 85 (Colombo. Ceylon Government Press.) 1 rupee. [44

League of Nations: Child Welfare Information Centre. Summary of the Legislative and Administrative Series of Documents of the Child Welfare Information Centre to December 31st 1937. (Series of League of Nations Publications, IV, 3.) Pp 52. (Geneva: League of Nations; London: George Allen and Unwin, Ltd) 1*s*. [44

Twenty-fifth Indian Science Congress, Calcutta, 1938. The Structure of the Himalayas and of the North Indian Foreland. By D. N. Wadia. (Presidential Address, Section of Geology.) Pp. 28+1 plate. (Calcutta Royal Asiatic Society of Bengal.) [44

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 17: A Brief Survey of some of the Important Breeds of Cattle in India. Pp. iii+45+52 plates. (Delhi: Manager of Publications.) 2 rupees; 3*s*. 6*d*. [44

Department of Agriculture, Straits Settlements and Federated Malay States. General Series, No. 29: The Cultivation of Lowland Tea at the Central Experiment Station, Serdang. By J L. Greig. Pp. iii+31+8 plates. (Kuala Lumpur: Government Press.) [74

Indian Central Cotton Committee: Technological Laboratory Technological Bulletin, Series A, No. 41. Spinning Tests on Punjab-American 4F Cotton with different Schemes of Drafts in the Speed Frames. By Dr. Nazir Ahmad. Pp. ii+12. (Bombay: Indian Central Cotton Committee.) 8 annas. [74

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Science and Society

AT last there are signs, in Great Britain at least, of a rapidly growing awareness of the importance of those complex problems confronting our community, due primarily to the astonishing rate of advance of scientific knowledge during the last generation, a rate which is accelerating even as we study it. Our social outlook and our social institutions toil feebly behind this advance and, lagging as they do, permit the placing of weapons of unparalleled potency for good or evil in the hands of those who may, alas, be unfit to use them. Faced with an annihilation of distance which makes it possible to put a girdle round the earth in a few days, to discuss, as an everyday matter, the possibility of establishing aeroplane factories in Canada for the supply of Britain; with methods of transport which, thanks to the labours of physicist, engineer and biologist, bring the fruits of the earth in perfect condition from the antipodes to our shores—give us, in Sir William Hardy's words, "Summer all the year round"; with the knowledge that "the growth and health of children in poor industrial areas and in the homes of many agricultural labourers are still seriously handicapped by protein and vitamin deficiencies", and that "the evidence for this has been fully substantiated by social and dietary surveys"; men of science must obviously accept a certain amount of responsibility for the solution of problems created by them.

These problems, raised by increase of knowledge, are met by social and economic—what for the use of a better word must be called 'plannings'—which might have been adequate to the needs of an era when a sparsely populated nation could be considered roughly as a self-supporting economic unit; when national patriotism, itself a plant of comparatively recent growth, was well enough fitted to the age in which it flourished; when a great man of letters could write of that bloody swathe which the dæmonic energy of Napoleon was cutting across Europe—"this war, of which philosophers take no heed"; but they are not adequate to-day, when the whole structure of civilized life is in peril. Here are problems of plenty and of deficiency, of war and of peace, which, in the terms of their presentment, are peculiarly the products of our own age—most of them problems which the world has never before been forced to meet. What contribution can the man of science make towards their solution?

It is a moot point whether he, as a social and political animal, has been greatly influenced by his own scientific outlook. Faraday shut the door of his laboratory when he went into his oratory, and the man of science too often in the past has kept his political and scientific methods completely separate, and has been as much a victim to prejudice as his brother trained in the humanities. It is this tendency to arrive at political and ethical conclusions in terms of emotional reactions rather than rational judgments which makes government an art—the cynic would say, a dodge—rather than a science; which gives point to the demand for a "World Encyclopædia", recently stressed by Mr. H. G. Wells. It is a hopeful sign that, as was shown in the columns of the last issue of NATURE, so great a mass of considered opinion is so fully awake to the fact that it is worse than useless to meet these problems of our own age, armed with machinery devised to deal with those of the eighteenth and nineteenth centuries.

The correspondence shows a remarkable consensus of opinion. Practically all are agreed that some organized body is necessary which shall study the problems, many of them highly controversial, evoked by the impact of science on society, in an objective and rational manner. Such a body must have the closest linkings with the physical and biological sciences, with economics, engineering, psychology, anthropology and sociology. It must provide a platform for free and frank debate ; it should conduct its investigations as much by means of research committees and discussions as by the formal reading of papers ; it should endeavour to make its findings plain to the man in the street.

There can be no question as to the need for such work to be undertaken. The present age is deafened by the cries of advertisers of nostrums of all kinds ; and those of us who believe that, before all and above all, reason, and conviction by an appeal to reason, are the indispensable bases for any ordered, successful and permanent social advance, cannot but be alarmed at the growing tendency to explosions of mass-hysteria. It is only when reason provides the outlook that the emotions may be trusted to control the direction. In a society such as is proposed it is of the first importance that its explorations should be conducted and its conclusions reached in a detached and cool spirit. Coolness does not mean cold-bloodedness nor does it connote any hesitation in pursuing the right path once that path is known.

The main problem being one of the interaction of science and social relations, it is clear that, as Prof. Ginsberg has put it, "the study of the effects of science on social relations requires not only a knowledge of science, but also of social relations". The problems are, in fact, sociological, and the society which undertakes the task of studying these repercussions must have a very wide field on which to draw. It may be that the ends in view will best be served by the formation of a new society charged with the special task of surveying and interpreting the social relations of science, but before actually constituting such a society, the British Association, itself a pioneer in the attack on some parts of the problem, might be invited to undertake the task.

As some correspondents have pointed out, the annual meeting of the Association provides an admirable platform from which to announce progress, but that much more than this is needed : and much more is possible. Already the Association is enlarging its activities to meet the changing needs of a changing era. It has initiated, in many of its sections, papers and discussions which touch upon these topics ; it has taken part in the jubilee meeting of the Indian Science Congress Association, recently held in Calcutta, thereby establishing an important principle of overseas delegations. At the present moment its general officers are in consultation with their colleagues of the American Association for the Advancement of Science on a scheme for international co-operation such as that Association has recently adumbrated. The Association possesses sections the work of which touches closely that of a society for the study of social relations, and it is second to none in its experience of the manner of work of research committees. Is it too much to suggest that the Association might very well consider the arranging of discussions of these problems to be held in London or elsewhere at regular intervals outside the annual meeting ? For the organization of such meetings, and the undertaking of appropriate investigations by research committees, an entirely new department of the Association might be constituted. It seems to us that this plan would be preferable to the addition of a new section, or sub-section, to deal with the social relations of science.

A new society of the kind contemplated implies much more than an annual report ; and if the British Association accepted responsibility for its functions, either by the formation of a new department or otherwise, the present annual report would have to be supplemented by a new periodical publication comparable to the proceedings or journals of other societies, and devoted mainly to the advancement of knowledge of the impact of science on society and of society on science.

It may be that the serious questions of finance and of policy involved will make it too difficult for the Association to undertake this work. But in its constitution and outlook it is at least a possible body to undertake such duties, and its long and brilliant traditions are sufficient guarantee that the work, if undertaken, will be carried out in the true spirit of science and of public service. We suggest, therefore, that when a meeting is held to discuss proposals for constituting a body to organize inquiries into the social relations of science and publish the results, the possibility that the Association might accept this responsibility should be considered. Even if the Association fails to do so, for financial or other reasons, it might in many ways assist the work of any new society which may be formed.

The Mandæans

The Mandæans of Iraq and Iran:
Their Cults, Customs, Magic, Legends and Folklore. By E. S. Drower ('E. S. Stevens'). Pp. xxvi + 436 + 29 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 25*s.* net.

HITHERTO our knowledge of the Mandæans—a small community of some 5,000 souls dispersed over a few places in Iraq and Iran—has been confined to the writings of Lidzbarski and Brandt, which rested on such scanty texts as had found their way to Europe, and the casual observations of Petermann, who spent three months in 1860 in the marshes of Lower Iraq, and of various other travellers whose curiosity they aroused. The results of these labours were not altogether satisfactory: Petermann's sojourn was too short to give him more than a modest acquaintance with a single community, while the works of Brandt and Lidzbarski suffer from a lack of any knowledge of the people themselves. Mrs. Drower, whose husband held a position as judicial adviser in Iraq, has the double advantage of having been able to familiarize herself with the remains of Mandæan literature and of having been resident in Bagdad since 1922, with ample opportunities of investigating the customs of these interesting people at first hand.

At the beginning of this period, Mrs. Drower was compelled to carry out her work through the medium of Arabic, but since 1931 she set herself to learn also Mandaic, the ancient Aramaic dialect in which the sacred books of the Mandæans are written and their rites carried out, but which is now rapidly dying out in ordinary use; and almost the only regret which the reviewer has is that she is not a trained philologist, as she herself confesses and as some of her transliterations and translations show, since the dialect is linguistically of some interest and Nöldeke's "Mandäische Grammatik" deals only with the language as known in a few published texts.

The Mandæan religion, which is generally regarded as a kind of Jewish gnosticism from the Aramaic *manda*ᶜ 'knowledge' (though Mrs. Drower doubts this explanation), whence its name is derived, is based on the ancient worship of the principles of life and fertility, and the symbol of the 'Great Life' is running water—a natural idea in a country which the two great swiftly flowing rivers, the Tigris and the Euphrates, traverse—and it follows from this that the central rite is baptism or rather total immersion in flowing water. The second great life-giving power is light, bestowing health and strength, virtue and justice. The third important element is the doctrine of the immortality of the soul and its close connexion with the souls of its ancestors. From this insistence on 'living', that is running, water is derived one of the two reasons why the Mandæans have such contempt for Christians, inasmuch as these use 'dead' water for their baptisms. The other is the celibacy of their monks and nuns, since the Mandæans regard the procreation of children as a religious duty; indeed, they go so far as to hold that even the most pious Mandæan, if he dies childless, after passing through a state of purgatory and a sojourn in the worlds of light, must return again to a physical state and become a father.

Mrs. Drower offers various conjectures about the origin of the Mandæans and, what is of great interest, tells much of their own traditions. Thus they claim descent from the ancient Egyptians and annually partake of a ritual meal in memory of those Egyptians who perished pursuing the "wicked Jews" across the waters of the Red Sea, while she shows that their doctrine has clear affinities with Mazdæism. A very primitive water-cult seems in fact to lie behind Mandæism, but very diverse elements have been absorbed into it, especially from Babylonian religion and that of the Parsis: for example, the ritual immersion of the priests is probably of Babylonian origin and writing and books are under the charge of the planet *Nbû*, who is none other than the Biblical Nebo (Isaiah xlvi, 1) or Babylonian *Nabû*, the patron deity of scribes, while the ritual meals (apart from certain specific differences) closely resemble those of Indian Parsis. Even the baptism of Adam has become the occasion of an annual feast!

Some Mandæan practices strike the modern reader as strange, if not actually revolting. Thus an expectant mother is removed for her confinement from the house, which she may pollute, to a cattle-shed or store-shed, where she spreads "something soft or without value, such as old clouts" in a corner on the ground and is there delivered; the mother is then immediately, if possible within half an hour, helped down to the river by the midwife and subjected to three complete immersions with the customary prayers; but, if the weather is cold, she may be soused in the place where she is lying. In view of these and the other baptisms and rites which mother and child undergo, it is scarcely surprising that the Mandæans are not a growing community. The dwindling is helped by the spread of education, which is driving the young people into the towns where, even if they wished it, there are not always adequate facilities for continual baptisms in running water; for the oftener a man is baptized (for example, after marriage, birth, illness, travelling, touching the dead, every conceivable sin, and so on) the better, since "baptism, alms, and good deeds make the perfect Mandæan", and these good deeds include scrupulous performance of death-rites and observance of the cult of the dead. What this may mean may be gathered from the fact that the author herself was present at a single ceremony which lasted eighteen hours! Further, the true Mandæan generally refuses to take any medicine even after going to a European doctor, although he has faith in ointments and does not object to injections; and during a recent cholera outbreak one community refused to drink boiled or chlorinated water on the ground that it was 'dead'.

At the same time the priesthood, which is for the most part hereditary, is being recruited with increasing difficulty, partly because of the high standard of pure Mandæan blood and of freedom from physical blemishes required in the priest, and partly because of the growing difficulty in modern cities of finding an unpolluted foreshore where he may carry out his innumerable baptisms in running water. Further, consecration to the priesthood is no light affair: it can take place only when some pious and aged person of ritually pure and priestly stock is at the point of death, and the consecrated priest can carry out no office until he has performed the ceremony of marriage for another priest; if no priest is willing to get married, the new priest remains isolated until one is found ready and willing to contract a marriage (which is not difficult in a polygamous community) to oblige his colleague. It is, too, a symptom of decay that there has not been 'a head of the people', that is a 'chief priest', who attains that rank automatically on having consecrated five priests, for the last eighty years.

Mrs. Drower has divided her book into two parts, the first containing an account of the life and religion, customs and ceremonies of the people, and the second giving a number of folk-tales which she has taken down from the lips of her informers. The book is an admirable example of the results of field-work undertaken by a competent observer and checked by an adequate control of the literature of the subject; and even though a reader may and indeed will disagree with some of the author's suggestions in the sphere of comparative religion, he can only be grateful that she has gathered such a wealth of information at a moment when the Mandæan religion seems likely to disappear before the inevitable advance of modern civilization. The book will henceforth be indispensable as a corrective to the works of scholars who have written on the same subject without ever having set foot outside Europe.

G. R. Driver.

Science at Large

Obsessions and Convictions of the Human Intellect

By F. W. Westaway. Pp. xvi + 528 + 4 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1938.) 10*s*. 6*d*. net.

The plan of Mr. Westaway's book is ambitious. It is difficult to give adequate treatment to so large a number of subjects within the compass of a single volume, even of 500 pages. It is not merely that the topics are so numerous; they are so diverse. Thus Mr. Westaway not only introduces us to what may be termed pre-science, like astrology and alchemy, but also to modern forms of pseudo-science, such as palmistry, phrenology and so on. He deals, too, with witchcraft (showing that one may be thankful for some changes that science has wrought in human mentality), with squaring the circle and the history of π, with perpetual motion devices, as well as with theories of a fourth dimension. There follows a chapter on space and time and the idea of infinity, and one on scientific method. We are then conducted through the biological sciences, and afterwards into the realms of metaphysics and theology.

The volume is certainly one to be placed in a school library, and should help to give young science students (and even their teachers) the synoptic view which is in danger of being destroyed by too much specialization. The preface shows that Mr. Westaway is interested in the mental outlook of sixth forms, and perhaps the intelligent senior schoolboy would be the kind of individual to profit most from this book, which incidentally is not superficial though it is popular. Each chapter has a good bibliography. Perhaps the chapters on the physical sciences are the best i the book, but the early chapters, being so full unusual material, are highly interesting. When the author approaches the biological sciences, he writes with a refreshing absence of dogmatism. "We certainly still are profoundly ignorant of the real nature of either life, consciousness, or personality."

In approaching metaphysics, Mr. Westaway treats the subject without condescension, as being worthy of serious study. It is certainly good for science students to realize what difficult problems arise out of their own most familiar experiences, as well as out of the methods which they employ in their researches. The theological chapters attempt to make available some of the results of recent historical inquiry, as well as of the critical study of the New Testament. Though the scope of the book is already so wide, one could wish that a discussion of art as well as of religion had been included. Some acquaintance with the philosophy of art is calculated to widen the outlook of the scientific specialist even more, perhaps, than the study of religion (and the practice of art is no less valuable than the practice of religion). In art there are few vested interests in dogma such as those which are apt to deflect the scientific worker's interest from religion. But Mr. Westaway has been so generous that to ask for more seems out of place.

J. C. H.

Geographical and Economic Survey of Great Britain

The British Isles:
a Geographic and Economic Survey. By Dr. L. Dudley Stamp and Stanley H. Beaver. With Contributions by Sir Josiah Stamp and Dr. D. K. Smee. Second edition, revised throughout. Pp. xii + 719. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 25*s*. net.

In his preface to "Britain and the British Seas" Mr. (now Sir Halford) Mackinder wrote: "Britain is . . . known in such detail that it has been possible to attempt a complete geographical synthesis." In the thirty-five years that have passed since that work was published nothing has appeared to take its place. At the same time much work has been done on these Islands and one has only to glance at the references at the end of the chapters in the present volume to see to what extent Dr. Stamp and Mr. Beaver have been able to draw on the achievements of their fellow geographers spread over a period which has seen both the consolidation of geographical research in Britain and the vindication of the principles propounded in "Britain and the British Seas".

Between the appearance of this latter work and that under review, three books of importance to geographers have been published. The first volume of "The Oxford Survey of the British Empire" (1914) is most closely comparable to the present work in that it consists of a series of studies of aspects of the British Isles by acknowledged experts. M. Demangeon's "Les Iles Britannique" (1927) is an excellent representative of the French 'school' of regional geography, while the volume of "Essays" edited by Prof. A. G. Ogilvie (1928) treats in detail but with varied emphasis regions in Great Britain the boundaries of which were somewhat arbitrarily determined. The present work deals with these Islands in greater detail than any of the others, and the fact that a second edition has been called for within four years of its original publication is a tribute to its usefulness. It has become a standard text-book the general accuracy of which is vouched for by the co-operation of no fewer than nineteen "experts in many of the various fields covered". For this reason, if for no other, it will probably long maintain its place as a valuable work of reference.

Yet herein lies its weakness. What is wanted is a new 'geographical synthesis'. Dr. Stamp admits to, and this book reveals, a passion for facts. Facts are necessary, but facts alone cannot make geography: without vision, geographers must perish. This lack of vision is shown both in the general arrangement of the book and in the unevenness of its various chapters, some of which are long and valuable essays embodying much research while others are mere paraphrases, sometimes scarcely adequate, of the work of others. When the next edition is called for, is it too much to ask that the authors will indicate by way of summary or synthesis what is the hope that is in them—they quote from "Cavalcade"—and wherein is to be found the "dignity and greatness and peace" of Britain? Is it to be found in the use of the land or of "National Capital"? Or rather, is it not to be found in the part which the resources, and their use, will enable the British people to play in world affairs?

To come to narrower limits, it would be of advantage to think out the modern counterpart of Sir Halford Mackinder's 'metropolitan' and 'industrial' England. In this book, one is confronted with thirteen 'industrial regions' in Britain; twenty-five 'agricultural regions', with many sub-divisions, based to some extent on the

'Highland' and 'Lowland' zones; a different set of nineteen 'physiographic and structural units' based on the same zones; and a suggestion in Fig. 234 that, from the point of view of population density there are three divisions which "correspond roughly with industrial, good agricultural, and poor agricultural tracts". With all these ingredients could there not be a consideration of geographical regions? Or is geography to concern itself only with the distribution of different facts? Now that the authors have drawn upon the specialists, one is confident that they could undertake this formidable task. If they do they could then call the next edition of this book "The Geography of the British Isles".

J. N. L. B.

Progress in Enzyme Chemistry

Ergebnisse der Enzymforschung
Herausgegeben von F. F. Nord und R. Weidenhagen. Band 7. Pp. xiv + 437. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 34 gold marks.

This year's volume follows the now well-known lines: it is substantially larger, perhaps indicating the intense interest in the subject. With one exception, the articles are in English or German; that on sulfatases by Cl. Fromageot is in French. As usual they cover selected sections of experimental activity which can conveniently be summarized at this moment.

Pride of place may be claimed for M. L. Anson's brief note on crystalline carboxypeptidase, a long name for a pancreatic enzyme which, however, is explicit as to the action it performs. The enzymes are now largely regarded as proteins, so that it is a question of finding out the right conditions for their isolation, when the further investigation of their structure can go hand in hand with that of the proteins. Interposing, the view may be expressed that this particular problem of protein structure is not being attacked with all the forces that its importance indicates. Anson stresses the extreme difference in the protein properties of the various enzyme proteins, which have so far contributed to prevent their isolation by standardized systematic procedures. It is clear now that ordinary cells contain a multiplicity of proteins and that the specific properties of these serve to control many of the chemical reactions which take place in living cells. The control exercised by varying the stereochemical configuration of such a relatively simple substance as glucose has been often stressed; obviously with the complex proteins the possibilities of variation are infinitely more numerous.

Next in significance may be placed the story by H. Raistrick of some aspects of the biochemistry of the lower fungi, which indicate certain relationships in structure between the large number of mould metabolic products. The interesting conclusion is expressed that one of the first stages in the life of most fungi is that of synthesis of a complex polysaccharide from the nutrient available in the same way that starch is a primary product of synthesis in the green plant. At a later stage this polysaccharide is broken down in a variety of ways, giving rise to the characteristic products of the individual race. Renewed interest is at once attached to such polysaccharides and to their structure—four new ones are described.

The question of the relation of specificity to chemical structure continues to promote investigation. It is the basis of a well-compiled report on immunochemistry and its relation to enzymes by J. Marrack, as well as the article on emulsin by B. Helferich, who has long been the protagonist for ascribing a wide range of activity to this enzyme rather than regarding it as a mixture. His arguments are not altogether convincing. A new point of importance here is the hint that the tryptophane unit in emulsin has a role in its activity.

The knowledge of the group of ferments which breaks down the nucleic acids has progressed to a satisfactory stage and it is valuable to have a crisp summary of these nucleases compiled by H. Bredereck.

Among the more difficult articles is one from the pen of Otto Warburg on the chemical constitution of the enzymes, a question to which an answer is anxiously awaited. The treatment is largely mathematical and concerns the relation between the metallic prosthetic group and the conjugated protein for certain oxidizing and reducing enzymes.

The technical article this year concerns the part played by enzymes in the tanning industry; it is written by F. Schneider and covers a wide field in forty pages. Of technical interest also is a summary of the biochemistry of acetic acid bacteria which indicates all the more recent observations.

The examples selected suffice to show the wide range of subjects covered and the utility of the "Ergebnisse" in these days when it has become impossible to keep up with the original literature.

E. F. A.

Leçons d'algèbre et de géométrie à l'usage des étudiants des Facultés des Sciences

Par Prof. René Garnier. (Cours de la Faculté des Sciences de Paris.) D'après la rédaction de Badrig Guèndjian. Tome 3 : Élimination, éléments de géométrie réglée, transformation de Lie, applications à la géométrie conforme. Pp. vi+280. (Paris : Gauthier-Villars, 1937.) 80 francs.

THIS is the third volume of a series of "Leçons d'algèbre et de géométrie" written by Prof. Garnier for the use of students in the Faculty of Science at Paris.

The subject-matter in the present volume should appeal to the analyst who desires to study some higher geometry by his own favourite methods. The course starts with a chapter on algebraic equations, and consists of two main sections devoted respectively to symmetric functions and elimination. This provides a foundation for the remaining part, which deals, in seven chapters, with higher geometrical conceptions treated algebraically. The notion of a locus is first carefully developed and extended to conoidal surfaces as well as to those of revolution. Then follow chapters on Plücker's line co-ordinates, the linear complex, the tetrahedral complex, Lie's transformation, in which is included a discussion of pentaspherical co-ordinates, and an application of the transformation to curvature. Parts of the text are amplified in four short notes and additions given at the end.

The text is clearly written with great care and precision, and is quite easy to follow in spite of the fact that the subject-matter is by no means of an elementary character. There are, as usual in many French mathematical text-books, no exercises, but the whole course is both interesting and stimulating.

F. G. W. B.

Das Sammeln, Konservieren und Aufstellen von Wirbeltieren:

Leitfaden für Sammler, Liebhaber und Fachleute nach neuzeitlichen Gesichtspunkten. Von Gerhard Schröder. Pp. viii+93+32 plates. (Berlin : Paul Parey, 1936.) 4.80 gold marks.

SO far as precept, in place of the experience of watching a taxidermist at work, can instil methods of preserving and mounting vertebrate animals, this little book by the taxidermist of the zoological museum in the University of Berlin is a useful guide for collectors and amateurs. It describes the methods of skinning birds and mammals, the mounting of birds' skins, and the making of models and plaster casts of the larger mammals in the modern method for use as the foundation of the final mount.

The progressive stages of these processes are well illustrated by photographic reproductions. Plaster and paraffin moulds are recommended for fishes and reptiles, but no mention is made of the celluloid coatings which have proved so life-like in the construction of reptilian models in some American museums. Hints are given regarding the construction of large habitat groups.

Descartes' Discourse on Method

By Prof. Leon Roth. Pp. viii+142. (Oxford : Clarendon Press ; London : Oxford University Press, 1937.) 6*s*. net.

THE year 1936 marked the tricentenary of Descartes' "Discourse on Method", so Prof. Roth's study is both timely and welcome. A turning point in European thought, the "Discourse" has a story of its own, which is carefully recounted : we are shown that if it is formally true to look upon it as the introduction to Descartes' philosophy, this short work is materially a retrospect, a summing-up of a life's achievement, rather than the laying down of a programme ; hence its primary importance for the understanding of Cartesian philosophy.

The method proposed by Descartes is typical of philosophical rationalism : the rule of 'division' and of the unilateral 'order' is its keynote. But the method itself proved to be inadequate to Descartes' purpose, which was to substitute a physics based on metaphysics for a metaphysics based on physics, and to treat physics as a part of mathematics. The linking of the "Method" with physics proved to be disastrous. Their dissociation, effected by Descartes' critics, saved his philosophy from a total eclipse. Thus, Cartesianism has survived, not as a system of physics or metaphysics, but as a general method of analysis.

In estimating the nature and fate of Cartesianism, Prof. Roth is thus led to discuss the whole problem of the value of the mathematical outlook and the general competence of the mathematical mind. His excellent study may be considered as a lucid introduction to the history and problems of modern thought.

T. G.

Introduction to Mathematical Probability

By Prof. J. V. Uspensky. Pp. ix+411. (New York and London : McGraw-Hill Book Co., Inc., 1937.) 30*s*.

PROF. USPENSKY'S treatise on mathematical probability is a very comprehensive one and includes every theoretical aspect of the subject, with several chapters on modern developments. Only those investigations in theory which touch the philosophical borderline and researches such as those of Reichenbach concerning possible connexions with the polyvalent logical systems, are not reviewed. Chapters i–xii of the work do not presuppose any advanced mathematical knowledge, while Chapters xiii–xvi present all the chief results of modern investigations. There are three appendixes to the book, in one of which an outline of the famous Tsebysheff-Markoff method of moments applied to the proof of the fundamental theorem previously established by another method in Chapter xiv is given.

Problems are appended to every chapter, and for an advanced student there could not be a more admirable text-book from the purely mathematical and theoretical point of view. For just as no philosophical discussions are included, neither does the book go into any of the applications of probability to other sciences.

The Pragmatic and the Dogmatic Spirit in Physics

By Prof. J. Stark, President of the Physikalisch-Technischen Reichanstalt, Berlin-Charlottenburg

THE aim of physical science is the investigation and formulation of the laws which govern the properties and processes observed with objects of inanimate Nature. These inherent laws are independent of human existence, action, and thought, and are the same all over the world. For this reason, the object of physical science is international. But the manner in which physical research is carried out and described depends on the spirit and character of the men of science engaged upon it, and this spirit and character differ individually, as do men, nations and races.

When in what follows I speak of two principal types of mentality in physics, my observations are founded on experience. I have inquired into the mental characteristics that have led the great physicists of the past to their discoveries, and in the course of the forty years of my scientific life I have observed very many more or less successful contemporary physicists and authors of theories and of books, in an endeavour to discern the mainspring of their work. On the basis of this wide experience I have come to recognize that there are two main types of mental attitude among workers in the field of physics.

The pragmatic spirit, from which have sprung the creations of successful discoverers both past and present, is directed towards reality; its aim is to ascertain the laws governing already known phenomena and to discover new phenomena and bodies as yet unknown. Even before they tackle a particular problem, physicists of this school of thought have acquired a certain feeling of the reality of the phenomena to be investigated, by giving careful attention to all previously ascertained facts connected with their problem. On the basis of this feeling they form a conception as to what the body or process to be investigated may be like in reality. For them, however, such a conception is solely the means to the end of devising experimental arrangements for the empirical formulation of their question to reality itself. If the observations made with the apparatus chosen do not confirm the initial conception, as very frequently happens, they reject it without hesitation and seek stimulation from experience for a new conception for the purpose of new experiments. Their final goal is always to establish reality, whether they gain new knowledge or are led to obscure and still unexplored features of the phenomena investigated. The mathematically formulated theory is to physicists of the pragmatic spirit not an end in itself, but solely a method for the purpose either of presenting the knowledge gained from experience in a quantitative manner and as briefly and simply as possible, or of deriving mathematically for special cases results which follow from general laws obtained from experiment.

The physicist of the dogmatic school operates in quite a different manner in the field of physics. He starts out from ideas that have arisen primarily in his own brain, or from arbitrary definitions of relationships between symbols to which a general and so also a physical significance can be ascribed. By logical and mathematical operations he combines them and so derives results in the form of mathematical formulæ. He then seeks to give these a physical meaning by applying them to the results of experience. In so far as they are found to be in accord with experience, he underlines this agreement with the greatest of emphasis, and makes it appear as though the results of experience have been established and have gained scientific importance only by virtue of his theory. If there are any experimental results available that are not embraced by this theory or which stand in contradiction to it, he doubts their validity or considers them so unimportant that he does not deign to mention them. Dogmatic physicists further present things as though their theories and formulæ exhaustively covered the whole range of phenomena treated by them; they can see no further problems in this field, and thought and inquiry are ice-bound in their formulæ.

The aim of the pragmatic spirit is reality, and his way to this goal is appropriate and careful observation; the goal of the dogmatic spirit is the dogmatic formula, and his way is one of logical mathematical construction. For the pragmatic spirit physical research is a process of evolution from what has been established to new experimental knowledge; for him there is no such thing as classical physics or modern physics, but only physics. For the dogmatic spirit physics is a field for his logical formalistic activity towards revolution against existing principles and towards the accomplishment of general acceptance of his theories or, indeed, of his new 'world-picture' (*Weltbild*). The pragmatic spirit advances continuously to new discoveries and new knowledge; the dogmatic spirit leads to the crippling of experimental research, and to a literature which is as effusive as it is unfruitful and tedious, intrinsically akin to the theological dogmatism of the Middle Ages, which was opposed to the introduction of pragmatic natural science.

The researches of Lenard and of Rutherford present us with obvious recent examples of the manner in which the pragmatic spirit works in physics. By his experimental investigations on cathode rays, Lenard paved the way for the greatest discovery of the last fifty years, that of the electron, and furthermore, in the photo-electric effect, he revealed by careful measurements the connexion between the electron and light. From his intuitive sense of reality and by convincing experiments and measurements, Rutherford derived our knowledge of the radioactive transformation of chemical atoms and of their nuclear structure, knowledge which could never have been derived by dogmatic methods. The relativistic theories of Einstein, which are based on an arbitrary definition of space and time co-ordinates or their differentials, constitute an equally obvious example of a product of the dogmatic spirit. Another example of this kind is the wave-mechanical theory of Schrödinger. By an amazing feat of physico-mathematical acrobatics he obtains as a final result first a differential equation. He then asks what sort of physical significance the function that occurs in his equation may have, and for this he makes a suggestion, according to which the electron is arbitrarily smeared in a large spatial region round about the atom. In characteristic fashion, however, other dogmatic physicists (Born, Jordan, Heisenberg, Sommerfeld) give to the Schrödinger function another dogmatic significance, contrary to fundamental laws of experience. They make the electron dance round the atom in an irregular manner, and allow it to act externally as though it were simultaneously present at every point round about the atom with a charge corresponding to the statistical duration of its sojourn at each point.

There is still another important difference between the pragmatist and the dogmatist in physics, which has to do more with the characters of these two types. The physicist of the pragmatic spirit does not conduct propaganda for the results of his research in order to gain authority and influence; he finds his satisfaction in obtaining new knowledge and trusts that it will receive recognition from the expert as a representation of reality, and that it will serve as a step towards new advances. How different are the protagonists of the dogmatic spirit! They do not first wait for at least five years to see whether their revolutionary fashioned theories may perhaps prove to be inadequate or erroneous when examined in the light of experience. On the contrary, almost before they have been published, a flood of propaganda for them is started by articles in journals and newspapers, by text-books and by lecture tours, if possible right round the world. So far as I am aware, Rutherford never undertook lecture tours to make known the results of his researches. Of Lenard I know that he detested speaking about his researches before a wide public, and that he only twice took part in the German Congress of Natural Science (*Naturforscherversammlung*). On the other hand, older physicists will probably still remember with what pertinacity propaganda was carried on all over the world and before the widest public for Einstein's theories of relativity. Matters have not been quite so bad with the newer dogmatic theories which have been advertised under such terms as quantum theories, quantum mechanics, and so on; nevertheless, for the purpose of propaganda on their behalf, innumerable lectures have been held throughout the world, and very many text-books have been written about them.

In so far as the task of physics is the investigation of bodies and of laws concerning the reality of Nature, only the pragmatic attitude of men of science is qualified to solve them, and hence also alone entitled to do so. When the dogmatic spirit does not confine itself to theology and sociology, but also chooses physics as an arena for its intellectual gymnastics, one might tolerate this, but only under the condition that physical research of the pragmatic school of thought does not suffer in consequence. But for about three decades this condition has not been satisfied, at any rate not in Germany, where during this time the representatives of the dogmatic spirit have gained a dominating influence. By their collective action and their connexion with earlier Ministries they were able to acquire numerous chairs in physics, and above all in theoretical physics. In consequence of this, and because of the lively propaganda for modern dogmatic theories, academic youth was predominantly educated in the scientific ideal of the dogmatic spirit. Not men like Lenard and Rutherford, but Einstein and his dogmatic imitators were held up to them as models for scientific thought and work. I have taken the field against the dogmatic spirit in Germany because I have been able to observe repeatedly its crippling and damaging effect on the development of physical research in this country. In this conflict I have also directed my efforts against the damaging influence of Jews in German science, because I regard them as the chief exponents and propagandists of the dogmatic spirit.

This reference brings me to the national aspects of the mental outlook of men of science in research. It can be adduced from the history of physics that the founders of research in physics, and the great discoverers from Galileo and Newton to the physical pioneers of our own time, were almost exclusively Aryans, predominantly of the Nordic race. From this we may conclude that the predisposition towards pragmatic thinking occurs most frequently in men of the Nordic race. If we examine the originators, representatives and propagandists of modern dogmatic theories, we find amongst them a preponderance of men of Jewish descent. If we remember, in addition, that Jews played a decisive part in the foundation of theological dogmatism, and that the authors and propagandists of Marxian and communistic dogmas are for the most part Jews, we must establish and recognize the fact that the natural inclination to dogmatic thought appears with especial frequency in people of Jewish origin.

In establishing these facts, of course, I do not maintain that there are no Aryan men of science who are actively engaged in the dogmatic spirit in the realm of science; nor do I maintain that Jews cannot produce valuable experimental work carried out in the pragmatic spirit. I wish solely to make a statement on the frequency of occurrence of the natural tendency to pragmatic or to dogmatic ways of thinking. It must also be taken into consideration that, by training and practice, Aryans can become accustomed to the dogmatic and Jews to the pragmatic habits of thought. I acknowledge scientific achievement in new discoveries irrespective of the nationality of the discoverer, and I combat the harmful influence of the dogmatic spirit in physics whenever I encounter it in my scientific work, and regardless of whether the culprit is a Jew or not. Moreover, I have been engaged in this fight not only since 1933, for as long ago as the year 1922 I denounced in the strongest terms the formalism and dogmatism in German physics in one of my publications entitled: "The Present Crisis in German Physics".

Problems in the Oceanography of the North Atlantic

By C. O'D. Iselin, Woods Hole Oceanographic Institution, Woods Hole, Mass.

PROGRESS in our understanding of ocean circulation has generally been even slower than in some of the other branches of oceanography, in spite of the fact that in nearly every marine problem, both biological and physical, the current system plays a basic part.

At first the study of ocean currents was held back by the lack of accurate and convenient instruments. In more recent times, the expense of securing the observations has delayed the accumulation of adequate subsurface data on the distribution of temperature and salinity. If this were known in sufficient detail, it would probably not be a difficult task to settle several of the main problems which now confront physical oceanographers.

In particular, physical oceanographers have been unable to supply the climatologists and fisheries experts with the much-needed data on the variability of oceanic currents. Do ocean currents transport about the same amount of heat year after year, and are they, therefore, unimportant from the point of view of long-range weather forecasting? It is now known that changes in oceanic circulation have, on occasions, affected the fisheries of Great Britain; but it is not yet known if fluctuations in the strength of the Gulf Stream off the American coast bear any relation to fluctuations in the circulation of the water masses off the European coast.[1] Not only are such questions of considerable economic importance in some parts of the world, but also if the answers were known, it would be much easier to secure the necessary financial support to develop fully the science of oceanography.

For these reasons it is very encouraging that arrangements have been made during the past year for a co-operative programme of broad scope. The programme is to be undertaken jointly by the Bermuda Oceanographical Committee of the Royal Society and by the Woods Hole Oceanographic Institution. The Royal Society has obtained a generous grant from the British Government for the promotion of the scheme, and the Bermuda Biological Station is being developed as a base for the oceanographic work. The plan, which will shortly be in actual operation, involves the co-operation of the American oceanographers with the now increased staff of the Bermuda Biological Station; and the British grant, which covers a five-year period, also provides the Station with a much-needed research vessel.

The programme which has been suggested and on which work has already begun (June 1937) is essentially a continuation of modern oceanographic development, but it is hoped that it will be possible to stress those aspects of the investigation which now seem most likely to lead to the solution of the practical problems outlined above.

Three somewhat conflicting theories have been put forward to explain the mechanism whereby the changes in strength of the Gulf Stream could influence the fisheries of north-western Europe. The earliest and most popularly accepted belief concerning the influence of the Gulf Stream has the merit of logic and simplicity, but it is by no means certain that it is correct. This theory assumes that the Gulf Stream resembles a river of warm, saline water flowing north-eastward from the Florida Straits towards northern Europe, and that the current is variable. Thus, during years when it is stronger than normal, more warm water reaches the European coast to modify the climate and to alter the survival rate of young fish or to change the feeding grounds of the adults. In the light of recent oceanographic investigations, however, it is now known that the Gulf Stream bears little resemblance to a river of warm water. In fact, even off the American coast, only a very small part of the current is warmer than the surrounding seas, and after the current turns eastward and has passed the Grand Banks, the slight temperature maximum at the surface quickly disappears. For this reason, it now seems likely that only if the current changes very greatly in strength from year to year (and no sufficiently marked fluctuations have yet been observed) could it so directly cause a noticeable variation in the European coastal waters. Nevertheless, as will be explained later, the primary observations of the new project will attempt to follow the changes in strength of the Gulf Stream as it flows between Bermuda and the American coast during the next five years.

A second theory, which minimizes the importance of the Gulf Stream's influence on European waters, has been advanced more recently by Le Danois[2], a French oceanographer. He has pointed out that, on the whole, the North Atlantic Ocean can be subdivided into two great contrasting masses of water and that these do not readily mix. South of a line extending roughly from the Færoe Islands to the southern tail of the Grand Banks there is found a superficial, wedge-shaped layer of relatively warm and saline water which increases in thickness to 1,000 metres or more in lower latitudes. To the north at all depths, and elsewhere below the warm layer, is found a much greater mass of cold water of low salinity. Le Danois believes that the northern boundary at the surface between these two contrasting masses changes its location, depending either on variations in the volume of the warm layer or on a north-south shift of its mean position. An expansion or northward movement of the warm layer is termed a transgression and the opposite movement, a regression. Since the northern boundary of the warm layer is inclined towards the north-east, Le Danois believes that the main strength of a transgression is also expended in this direction and, therefore, that periodic variations are produced in the temperature and salinity of European coastal waters. He has collected evidence to support his theory that the transgressions come in cycles of increasing intensity having periods of 1, 4·6, 9·3, 18·6 and 111 years. Thus he has suggested that the periodicity is controlled by astronomical forces.

With some of the details of Le Danois' theory many oceanographers cannot agree, and especially they have ample evidence that the continuation of the Gulf Stream, better called the North Atlantic Current, cannot be disregarded. However, the northern branch of this current on the whole marks the northern limit of relatively warm water at the surface, and the main pattern of horizontal circulation in the North Atlantic is undoubtedly a huge clockwise eddy. Therefore, if the warm water at the centre of the eddy should increase in volume, or should its axis shift northward, the effect would be comparable to Le Danois' transgression theory. In other words, there is a possibility that changes in the amount or position of the warm-water core around which the North Atlantic eddy revolves and which it can be thought of as confining, may occasionally displace the current system of the north-eastern North Atlantic and thus cause marked and widespread variations near the European shore.

On the other hand, there is also the other possibility that the warm surface layer has a relatively constant volume and position, and this leads us through modern oceanographic principles to a newer theory that at the present time seems to have few drawbacks.

If we assume, as most investigators do, that the greater part of the energy which maintains the North Atlantic eddy comes from the trade winds, and if these should vary in strength from year to year, then the Gulf Stream, which is the most spectacular part of the eddy, would also vary in transport. If the current should increase, the Bjerknes[3] principle demands that the thickness of the central mass of warm water (the Sargasso Sea) should also increase. Therefore, unless the amount of warm water also increases, the diameter of the eddy must contract. In the same way, if the anticyclonic currents weaken, the dynamic height near Bermuda must decrease, which is another way of saying that the warm layer must become thinner. If this occurs, either the eddy must increase in diameter, or warm water must be discharged beyond the outer boundary of the surrounding circulation.

This line of reasoning leads to the idea that during periods of increasing strength of the Gulf Stream, the seas off the coast of Europe will become colder, instead of warmer, and that the reverse will happen during periods of decreasing oceanic circulation. This, of course, is exactly the opposite to the popularly accepted view. Since Bermuda is at approximately the centre of the main eddy of the North Atlantic, the new research vessel will easily be able to follow any changes in the thickness of the warm superficial layer. It can be confidently expected that as soon as this has been done over a period of a few years, it can then be shown which of these possibilities is correct.

Besides these supposed mechanisms involving variations in the intensity of the main horizontal currents, and expansions and contractions of the warm superficial layer of mid-latitudes, another basic theory has often been advanced. In this, the winds across the latitudes between the Grand Banks and northern Europe are considered the primary variable. If the surface water moves in the same direction as the wind, surface temperatures at a given point will rise during periods when southerly winds prevail and will fall with prolonged northerly winds.

Investigators, however, who are convinced by the theoretical studies of Ekman[4], which demand a net transport of the surface layer in a direction 90° to the right of the wind (for the northern hemisphere), will claim that it is easterly winds which cause increasing surface temperatures off the European coast. However this may be, it is clear that, provided the wind is sufficiently variable from year to year, wind currents in the surface layer can strongly influence surface temperatures. In fact, good arguments can be advanced to show that the variations in the strength and direction of the winds are a much more likely cause of changes in the European coastal waters than possible fluctuations of the oceanic circulation.

For the reasons outlined above, the programme of observations now being carried out in the neighbourhood of Bermuda and in the Gulf Stream involves two main investigations. First, the variability of the Gulf Stream will be examined with as much thoroughness as the available facilities permit, and secondly a detailed study of wind-produced movements in the surface layer will be made. In the Gulf Stream investigation the research vessel *Atlantis* of the Woods Hole Oceanographic Institution will play the leading part, while the smaller ship soon to be sent out to Bermuda, the *Culver*, will be chiefly engaged in examining the frictional effect of the wind on the sea surface. In addition, as already mentioned, she will make periodic observations to follow the changes in the thickness of the warm layer covering the central part of the Sargasso Sea. It is hoped that this dual programme will help to answer the question whether local winds or remote currents or a combination of the two are responsible for the variations in the physical characteristics of European coastal waters.

It may be of interest to discuss here some of the details of this five-year programme of observations. We will consider first the work the *Atlantis* began last June in the Gulf Stream. This current is so powerful and wide that an investigator with a single ship at his disposal is forced to use mainly indirect methods, for the technique of current-meter observations in deep water still remains unsatisfactory and time consuming. However, it cannot be stressed too strongly that the indirect methods should be supplemented as often as is practicable by direct observations of the strength of the current. The most reliable indirect method of measuring the volume of such a current as the Gulf Stream is to observe the vertical distribution of temperature and salinity at a number of stations spaced about twenty miles apart on a line crossing the current at right angles. From these observations the distribution of density can be calculated, and by applying the formula of Bjerknes the velocity and volume can be computed. While this method involves certain assumptions, on the soundness of which not all oceanographers are agreed, there is little doubt that should the current in this way be found to vary in strength over long periods by 20 per cent or more, the observations would impress even the most sceptical.

At the outset, therefore, the *Atlantis* has undertaken to occupy a section extending from Montauk Point on Long Island towards Bermuda at approximately monthly intervals. If this were to be continued for five years, practically the entire time of the vessel would be consumed and the mathematical computations would also be most laborious. However, in theory it is only necessary to observe the density of the water at two points on each side of the current, and this greatly simplifies the calculation of the volume of flow. As soon as the validity of this new shorter method can be established, the *Atlantis* routine observational programme will be greatly shortened.

The circulation theorem of Bjerknes is based on the principle that when a current in the northern hemisphere increases in strength, the sea surface must fall on its left hand side and rise on the right hand side. The relative changes in height of the sea surface on the two sides of the current can either be calculated from the subsurface distribution of temperature and salinity or can probably be observed by means of tide gauges. This method has not yet been given a thorough trial, but a comparison of the tidal records from

Bermuda and from the American coast has been made, and for years when subsurface oceanographic observations are available good agreement has been found. Thus it may well be that before long the *Atlantis* routine observations on the Montauk Point-Bermuda section can be very much curtailed or even entirely abandoned and the fluctuations in the strength of the current followed entirely through the tide-gauge records. The theory tells us that the surface of the Sargasso Sea is about 100 cm. higher than that of the waters north-west of the current. This difference in level will vary directly with the strength of the current. Thus an increase of 20 per cent should cause a rise of about 10 cm. at Bermuda and a corresponding fall on the opposite side, a change readily observed from the records of a properly located recording tide gauge.

This method should prove especially useful in the Straits of Florida, through which about a third of the ultimate volume of the Gulf Stream passes. Consequently the *Atlantis* has recently set out to install a tide gauge in the Bahamas, just across from Miami where the U.S. Coast and Geodetic Survey maintains a similar instrument. It is hoped that when these records are compared with the results obtained farther north, it will be possible to say whether or not the Gulf Stream as a whole increases and decreases in strength from year to year.

In the case of wind currents and the calculation of the exact coefficient of friction between the atmosphere and the sea surface, the observational difficulties are considerably greater. Several methods are in theory available. For example, the stress exerted on the water by the wind can be observed through the disturbance produced in the turbulent layer of either the sea or the atmosphere. It is a problem in which both meteorologists and oceanographers are equally concerned and to which the methods of both sciences can be applied. Unfortunately, in the past it has been found to be extremely difficult to secure sufficiently precise observations. The difficulty is partly instrumental, but it also results from the disturbance produced both in the water and in the air by a large research ship. In addition, wind currents can of course best be observed in regions where there are no permanent deep currents. It is hoped that the small vessel which is being sent out to Bermuda by the Royal Society will prove handier for this work than other ships that have already been tried out. Likewise, it is hoped that a region can be found not too far from Bermuda where the permanent currents are negligible.

It was first assumed that the stress exerted by the wind on the surface of the sea was probably proportional to the strength of the wind. But recently Rossby has presented evidence which indicates that there is a critical wind velocity below which the wind can get little grip on the water. He believes that this critical velocity is probably reached when the wind has a strength of about 15 miles per hour. If this can be demonstrated by satisfactory observations, then the surface movements produced by the winds can be calculated from the ordinary daily ocean weather maps and all winds less than the critical velocity can be neglected.

Moreover, there has recently been collected an increasing amount of evidence that the strength of the wind currents depends also on the stability of the surface layer. When the stability is great, apparently only a shallow layer is affected by the wind and the principle of Ekman's spiral perhaps breaks down. Thus if these matters can be more fully investigated, the wind currents for the practical purposes of this new programme can perhaps be neglected during seasons when the stability of the surface layer in mid-latitudes is very great due to the absorption of solar energy. Although the full magnitude of the problem can now be but dimly seen from the available observations, it is hoped that the calculation of surface movements from weather charts may not be insurmountable.

The possibility that there exists a critical velocity below which the coefficient of friction is extremely small leads us back to the variations in the strength of the Gulf Stream. As already mentioned, in all probability it is the energy absorbed from the winds across the latitudes of the trades which supplies the initial driving force for the current. If the trade winds vary slightly in strength over long periods and if the critical velocity falls within this range, then it is evident how the ocean can absorb much greater amounts of energy in certain years than in others. On the other hand, if the coefficient of friction is proportional to the wind velocity throughout the range met with in the trades, it seems unlikely that they can be the cause of important variations in the currents farther north.

In conclusion, we must frankly admit that the general outline of the Bermuda project given here will probably seem over-ambitious. However, if we had been able to go into more detail, it could have been shown that many of the special phases of the main problem are much less complicated and that the five years work that is planned will by no means fail if the main objectives prove to be hopelessly complex. When the twenty-odd investigations already started or planned are examined, it is evident that the chief strength of the whole programme lies in its attempt to encourage promising lines of investigation in physical oceanography. If several of these succeed, the entire effort will be justified. However, until physical oceanographers are able to show whether or not the surface layer of the ocean varies in temperature from year to year by a significant amount, they will get no peace from those who consider that science should have a practical objective. For this reason we hope we are justified in having attempted to explain how the work of the six or more cooperating investigators may eventually be fitted together. Let us hope that by such simple methods as observing the strength of the Gulf Stream in summer or by calculating the shift of the surface layer resulting from a prolonged spell of strong winds over the critical area west of Ireland, physical oceanographers will eventually be able to predict a mild winter or a good fishing season for northern Europe.

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[1] MacBride, "The Bermuda Oceanographical Station", NATURE, 139, 948 (1937).

[2] Off. Sci. Tech. Pêches Maritimes, *Revue des Travaux*, 8, 369 (1934)

[3] Defant, "Dynamische Ozeanographie". (Berlin: Springer, 1929) McEwen, "Physics of the Earth-V". (Washington: Nat. Research Council, 1932.)

[4] *Journal du Conseil*, 3, 295 (1928).

Obituary Notices

Mr. Edward Meyrick, F.R.S.

LEPIDOPTERISTS throughout the world will learn with deep regret of the death on March 31, in his eighty-fourth year, of Edward Meyrick, in his time the greatest authority and the most prolific writer on the Microlepidoptera.

At least so early as 1875, Meyrick published notes and new records, but in December, 1877, a post at King's School, Paramatta, N.S.W., provided him with greater opportunities for indulging his interest in collecting and studying Lepidoptera, of which during his ten years sojourn in the Antipodes he amassed an extensive collection. In the *Entomologist's Monthly Magazine* of August, 1878, he wrote :

> "I landed in December, the heat of summer, and have, therefore, only had half a year's collecting ; and as I had been prostrated during the last two months by an attack of low fever, I had only three months of actual collecting ; but I venture to assert that in the matter of *Micro-Lepidoptera* Australia stands pre-eminent among the nations [*sic*] of the earth."

Returning to Great Britain in January, 1887, Meyrick accepted the post, in the following September, of classics master at Marlborough College. This in no way hindered his entomological activities, and he was able to continue a series of contributions, commenced in 1879, to the literature of lepidopterology, unequalled in number and importance in the whole history of the subject.

In 1895 appeared his "Handbook of the British Lepidoptera", a remarkable achievement indicating his amazing energy and outstanding ability. Of this work J. W. Tutt (*Ent. Rec.*, 1895) wrote :

> "Mr. Meyrick's is probably the book of the year. It is the strangest jumble of advanced views and retrograde movement that has ever been published.
>
> "We have nothing but praise for the man who can step straight out of the old ruts, and produce a book which entirely upsets the treasured shibboleths of a school of entomologists, who were suckled on Newman and Stainton in their entomological babyhood, starved on Newman and Stainton in their manhood, and are still striving manfully to obtain nutriment from them in their old age. To such, if they see it, the book will be a revelation. But when one gets out of old ruts, one must know that the new road is sound and here our author is very doubtfully a trustworthy guide. The lines on which a new scheme of classification wants formulating must be compounded of the work done by specialists in various lines of work—Comstock, Dyar, Packard, Kellogg, Scudder, Chapman and Hampson are to hand. Instead of availing himself of all the material possible, our author chooses a path of his own, and neglects all the special work. Needless to say he often fails hopelessly. The unwieldy genera revert largely to the time when all butterflies were *Papilio*, all moths with pectinated antennæ, *Bombyx*, all 'Plumes', *Alucita*, and so on. In fact, the genera often comprise impossible combinations, and show the author to be utterly ignorant of the early stages of most of our British species. The book in detail is an utter failure ; yet in its broad aspects, we repeat again, that we have the greatest respect for the industry and pluck of the man who produced it."

This violent and badly expressed criticism was not altogether unjustified, and it is surprising that Meyrick, in the second edition published in 1928, again failed to avail himself of a number of facts that had been demonstrated by other authors, although he made some additions. The work was, however, no worse than that of many other authors right up to the present day, not excluding Tutt himself, and one example may be given to demonstrate the terrible muddle which even now exists in the genera of moths.

Boisduval (1828) erected a genus *Heliophobus* for *Noctua reticulata* Vill. (1789) and some other species, *N. reticulata* later being cited as type by Duponchel (1829). No notice has ever been taken of this, and *Heliophobus reticulata* has been placed successively in the genera *Hadena, Neuria, Mamestra* and finally by Meyrick in Hübner's genus *Melanchra*, with the type of which it is certainly not congeneric. Likewise *Noctua albicolon* Hubn. has travelled through the following genera : *Mamestra, Barathra, Luperina, Polia, Trichoclea*, finally ending up in *Melanchra* in

Meyrick's "Handbook" (1928), although it is a true *Heliophobus*. I do not hesitate to assert that this is by no means an isolated case among the British moths.

In the first edition of the "Handbook" (1895) appeared the *dicta* which have been called "Meyrick's Law": (1) No new organ can be produced except as a modification of some previously existing structure. (2) A lost organ cannot be regained. (3) A rudimentary organ is rarely redeveloped. It strikes me as strange that Meyrick should have reprinted these statements without modification after thirty-two years. One would have preferred the following modifications: (2) A lost organ is not regained. (3) A vestigal organ is rarely redeveloped.

In 1912 Meyrick commenced a separate publication of his own which he called *Exotic Microlepidoptera* and described as "a spasmodic entomological magazine on one subject by a single contributor". In his original preface Meyrick wrote:

> "The purpose of this volume is to ensure the speedy publication of material which is required for immediate use in other works proceeding at the same time, especially in my contributions to the *Genera Insectorum* and *Lepidopterorum Catalogus*; the delays incidental to publication through other channels would otherwise involve so much arrangement in advance as to seriously hamper the work."

Up to September, 1936, four volumes had been completed, running to some 2,500 pages in all, and during the next twelve months 160 pages of vol. 5 had appeared.

Latterly, Meyrick collaborated with Prince Aristide Caradja, the distinguished Roumanian lepidopterist, in a number of important papers on the Palæarctic Microlepidoptera (including Pyralidæ), with some valuable contributions to our knowledge of the Chinese fauna.

For many years Meyrick had identified Microlepidoptera and Pyralidæ for the Imperial Institute of Entomology. He was a very quick worker, a delightful correspondent and he rarely kept a colleague waiting long for identifications, always describing at once any new species.

I was pleased to note the impression made upon Meyrick, who was a man of very conservative views, by Wegener's theory of continental drift, even before the more recently collected evidence in support of it had been brought forward.

Meyrick was elected a fellow of the Royal Society in 1904. He had been a fellow of the Royal Entomological Society of London since 1880.

It is gratifying to learn that Mr. Meyrick's extensive collection, the value and importance of which it is impossible to estimate, is bequeathed to the British Museum (Natural History).

W. H. T. Tams.

An anthropological correspondent writes:

For many years Mr. Meyrick was responsible for the records of anthropometric measurement of the Marlborough boys, on which he prepared the reports appearing in the publications of the Marlborough College Field Club. When the Inter-Departmental Committee on Physical Deterioration, which reported in 1904, was sitting, the lack of exact evidence relating to the trend of physical development in the child and adolescent population of Great Britain was a grave drawback; but the Marlborough records, being almost the only material available for comparative purposes extending over any considerable period of time, afforded information of the greatest value for the inquiries of the Committee. It was mainly on this material that the Committee based its finding that the public school population, at least, showed no evidence of the alleged physical deterioration in the population at large, into which the Committee was appointed to inquire. The absence of exact data respecting the physical development of the school population of England and Wales was one of the decisive factors in bringing about the passing of the Act of 1907 for the medical inspection of school children; though much to the disappointment of many who were among its strongest supporters, it was not considered practicable to introduce into the elementary school a scheme of anthropometric measurement of a more extended character.

Dr. G. B. Grinnell

The death is reported of Dr. George Bird Grinnell, distinguished as geologist, naturalist and ethnologist, which took place in New York on April 11 at the age of eighty-nine years.

Dr. Grinnell was born on September 20, 1849, and educated at Yale University, where he graduated in 1870, proceeding to the degree of Ph.D. in 1880, and being awarded the D.Litt. in 1921. In 1870 he began his study of the Plains Indians, one of the activities for which he became most widely known. He was long recognized as the foremost authority on the history and customs of the Blackfeet, Pawnee and other Plains Indians, so that his appointment as Special Commissioner for the sale of lands to the Blackfeet and Fort Belknap Indians in 1895 was natural, and indeed inevitable. From 1874, when he joined the staff of the Peabody Museum as assistant osteologist, until his retirement in 1911, he was attached to this Museum or to the staff of Yale University. He was extremely active in collecting fossils and other specimens for the Museum, and took part in several expeditions, among them that to the Black Hills in 1874, the Yellowstone Park Reconnaissance expedition in 1875, expeditions to the Plains and the Rocky Mountains on behalf of his Museum, and the Harriman expedition to Alaska in 1899. Grinnell was the first in America to take action against the wholesale destruction of wild fowl and game, and his love for wild life in all its forms led to the foundation of the Audubon Society. For some years he was chairman of the Council on National Parks, Forests and Wild Life, and in 1925 succeeded President Hoover as president of the National Parks Association. In the same year he was awarded the Roosevelt Distinguished Service Medal for his lifetime's devotion to outdoor life.

News and Views

The "Jewish" Spirit in Science

IN July of last year, several correspondents sent us copies of an article entitled " 'Weisse Juden' in der Wissenschaft", from the German periodical *Das Schwarze Korps* of July 15. The main theme of the article was that it was not sufficient to exclude all Jews from sharing in the political, cultural and economic life of the nation, but to exterminate the Jewish spirit, which is stated to be most clearly recognizable in the field of physics, and its most significant representative to be Prof. Einstein. "There is one sphere in particular," the article says, "where we meet the spirit of the 'White Jews' in its most intensive form and where what is common between the outlook of the 'White Jews' and Jewish teaching and tradition, can be directly proved, namely, in *Science*. To purge science from this Jewish spirit is our most urgent task. For science represents the key position from which intellectual Judaism can always regain a significant influence on all spheres of national life. Thus it is characteristic that in a time which brings fresh tasks to German medicine and which awaits decisive achievements in the fields of heredity, race-hygiene and public health, our medical journals should, in the space of six months, publish from a total of 2,138 articles, 1,085 from foreign authors, including 116 from Russians of the U.S.S.R. These articles of foreign origin scarcely concern themselves with those problems which seem so urgent to us. Under cover of the term 'exchange of experience' there lurks that doctrine of the internationality of science which the Jewish spirit has always propagated, because it provides the basis for unlimited self-glorification."

Prof. Stark's Views

SEVERAL men of science of international reputation were named in the article as followers of Judaism in German intellectual life, and it was remarked that "They must be got rid of as much as the Jews themselves". *Das Schwarze Korps* invited Prof. J. Stark to express his opinion upon this suggested purge on account of "the importance of the problem for the future of German scientific work". After reading Prof. Stark's reply, we asked him if it represented his considered views upon the relative values of experimental and theoretical studies; and if so, whether he would care to make them known to other men of science through the columns of NATURE. He willingly consented to contribute the article, of which a translation appears elsewhere in this issue. At the moment we make no comments upon the views expressed by Prof. Stark; and we gladly give him the opportunity of making them known to the scientific world. We should, however, be surprised if the limitations which these new principles impose on the pursuit of scientific truth are generally accepted as the highest or the best means of promoting the advancement of natural knowledge.

James Watt International Medal

To commemorate the bicentenary of the birth of James Watt on January 19, 1736, the Institution of Mechanical Engineers of Great Britain decided to award every two years a Gold Medal to an engineer of any nationality who is deemed worthy of the highest award the Institution can bestow and that a mechanical engineer can receive. In the making of the award the Institution has secured the co-operation of engineering institutions and societies in all parts of the world. To be worthy to receive a medal struck in commemoration of one who was at one and the same time a scientific investigator, an inventor and a producer, the recipient himself should be an engineer who has achieved international recognition both by his work as a mechanical engineer and by the ability with which he has applied science to the progress of mechanical engineering. The Institution recognizes, however, that only rarely will it be possible to find men in whom these qualities are so equally balanced as in James Watt. It will, therefore, consider men who have attained world-wide eminence in mechanical engineering in any direction—science or research, invention or production. After considering the recommendations of mechanical engineering societies in leading industrial countries throughout the world, the Council of the Institution of Mechanical Engineers has unanimously decided to make the second award of the James Watt International Medal to Mr. Henry Ford of Detroit, U.S.A., nominated by the American Society of Mechanical Engineers. The first award was made in 1936 to Sir John Aspinall, who unhappily died before the actual presentation was made.

Henry Spencer Palmer (1838–1893)

ON April 30 occurs the centenary of the birth of Major-General Henry Spencer Palmer, a distinguished British military engineer who did important work in various parts of the world. The son of a colonel, he was born at Bangalore, Madras, and after passing through the Royal Military Academy, Woolwich, entered the Royal Engineers in 1856. From 1858 until 1863 he was engaged on the survey of British Columbia. On his return he joined the Ordnance Survey and in 1867 took part in the parliamentary boundaries commission appointed under Disraeli's Act of that year. His next work was the survey of the Sinai Peninsula, and in 1873, through Airy, he was appointed chief astronomer of the expedition sent to New Zealand to observe the transit of Venus of 1874. While at the Antipodes he assisted the French to determine the longitude of the Campbell Islands. He returned to England in 1875, and three years later was sent to Hong Kong as chief engineer of the Admiralty works. While there he designed a physical observatory for astronomical, magnetical, meteorological and tidal observations, and he made exact determinations of the position of the Hong Kong Observatory at Mount Elgin, Kowloon. In 1882, on his way home, he prepared a scheme for waterworks for Yokohama. This had been done at the request of the Japanese Government, and in 1885 he returned to the East to superintend the work. He also designed works for Osaka and Hakodate. He retired from the British Army in 1887 with the rank of major-general and died at Tokyo on March 10, 1893, at the comparatively early age of fifty-four years.

Research on Influenza

The Medical Research Council has published a long report of the investigations made by Dr. C. H. Andrewes and his colleagues into the influenza epidemic of 1936–37 (Medical Research Council, Special Report Series, No. 228. London: H.M. Stationery Office, 1938. 2*s*. 6*d*. net). They have amply confirmed their previous discovery that there is an acute disease which may be properly called 'influenza', due to a virus which is specially infective for ferrets, and that many outbreaks of a somewhat similar kind are not associated with the virus; these they call "febrile catarrhs". Much attention was given to the possibility of diagnosing the real influenza by clinical means, and with a certain amount of success, though it is clear that accurate differentiation without demonstration of the virus is still rather uncertain. They have also confirmed the disconcerting American finding that all strains of the virus are not antigenically the same. Their plans for large-scale trials of preventive inoculation were anticipated by the epidemic, which came earlier than was expected and made a muddle of the experiments; so far as they went, however, they did not show that inoculation was of any preventive value. Nor did the few cases which were treated with an anti-serum derive much benefit. In these respects, therefore, the results are disappointing, though a good deal has been done towards obtaining greater success in the outbreak which may be expected next winter.

The Earthquake in Anatolia

On April 19, a destructive earthquake occurred in central Anatolia. Its epicentre lay near Kirshehir, about 90 miles south-east of Angora, and in this district ten villages were completely destroyed and at least 200 persons were killed. In Yozgad, about 60 miles north-east of Kirshehir, much damage was also caused, but the loss of life was small. The disturbed area extended from the Black Sea nearly to the Mediterranean. The first vibrations reached London at 12.11 p.m., and the earthquake must therefore have occurred shortly before 2.30 p.m., local time, when most of the inhabitants were at work in the fields. Since the beginning of the eighteenth century, not less than thirty-one great destructive earthquakes (of intensity 3, Milne scale) have occurred in Turkey in Asia, with one exception either in the west of the country about Smyrna and Broussa or in the east about Erzeroum and Diarbekr. The central portion of the country has been comparatively undisturbed. From Miss Bellamy's "Catalogue of Earthquake Epicentres" we find that during the years 1913–30 there were six earthquakes in three centres near Kirshehir and Yozgad, though none was strong enough to be recorded more than 80° from the origin. In 1902, however, there was a destructive earthquake at Kastamonu, about 150 miles north of Kirshehir, of about the same intensity (degree 3) as the recent earthquake.

The Magnetic Storm of April 16

In the note on the great magnetic disturbance of April 16 as recorded at Abinger Observatory, printed in Nature of April 23, p. 721, it was only possible to give tentative estimates of the range in declination and horizontal intensity, for reasons then stated. Critical examination of the traces has since been made which confirms the estimate for declination but considerably reduces the figure given for horizontal intensity. The definitive ranges in the three elements are now stated, with the times of maximum and minimum, as below:

	Range	Maximum at	Minimum at
Declination (west)	5° 7′	6h. 15m. U.T.	7h. 50m.
Horizontal intensity	1880γ	7 54	7 21
Vertical intensity	494γ	7 52	7 36

York Museum of "Bygones"

The Castle Museum, York, of which the nucleus is the collection of Yorkshire "Bygones" formed by Dr. J. L. Kirk, of Pickering, was formally declared open by Lord Middleton, lord lieutenant of the East Riding, on April 23. The Museum is housed in the eighteenth century buildings, formerly the female prison, of York Castle, which, with the exception of the medieval Clifford's Tower, vested in H.M. Commissioners of Works under the Ancient Monuments Acts, is now in the possession and under the control of the Corporation of the City of York. The Corporation will be responsible for the maintenance of the Museum, and the sum of £8,000, in addition to two grants of £500 each from the Carnegie Trustees and the Rowntree Trustees, has been expended on the installation. The exhibits, including a Tudor half-timbered house and fifteen shop-fronts in two and three storied houses flanking a cobbled street, illustrate the life, domestic, commercial and industrial, of Yorkshire over a period of two centuries ending with mid-Victorian times. Among the more striking and characteristic features are old hearths and their furniture and old agricultural implements and horse-brasses. By a judicious arrangement with the former owner, the Corporation has retained the right to enlarge the collection with the view of making the exhibits illustrate as fully as possible the old-time life of the folk of Yorkshire. An annexe, for example, is to be added shortly, which will house specimens of old and obsolete vehicles. As was pointed out at the opening ceremony by Dr. Mortimer Wheeler, president of the Museums Association, the Castle Museum is a valuable addition to the all too scanty collections, which illustrate the past social life of England.

Science and the Home

THE great variety of material that the glass industry is now able to place at the disposal of the architect and the builder is well demonstrated by the 'Glass Hall' erected in the *Daily Mail* Ideal Home Exhibition at Olympia, which closes on April 30. The exhibits showed that in the hands of artist-craftsmen glass can be made a most effective medium of decoration. As regards the Glass House itself, the light-diffusing outer walls were made of fluted glass bricks permitting no observation from the outside. A partial vacuum inside renders them useful for the insulation as regards heat and sound. Each of the rooms of this house exhibits phases, useful and decorative, of the possibilities in glass, and the Crystal Kitchen has glass walls on two sides with the great merits of giving plenty of light and of being very easily kept clean. The Glass Train brought into Addison Road Station for the Exhibition, is, in a way, even more striking, as throughout it the walls, floors and ceilings are of glass. It is an exhibition in itself and includes examples of the 'Insulight' glass bricks mentioned above and of the Armour-plate glass, specially heat-treated so as to possess great fire-resisting properties with high mechanical strength. It can be bent through 30° without breaking and will withstand a range of temperature from − 70° C. to + 300° C. The numerous fittings and other features represent nearly six hundred different varieties of glass. In another branch of industry the domestic possibilities of 'Staybrite' in pans, sinks, door furniture, toilet fittings and table-ware are demonstrated. The strength and wearing properties of this and similar materials must inevitably prove their superiority in the home. Then for the purpose of keeping food fresh and cool, one of the oldest principles for the production of long-sustained low temperature is employed in the 'Kepkold' series of coolers. By keeping the surrounding absorbent tiles supplied with water the cooling effects of evaporation are obtained without recourse to the more expensive refrigerators the utility of which depends on a supply of electricity or gas.

Optical Projection of Surgical Operations

AN optical apparatus of some interest to surgeons, devised by Profs. H. Costantini and L. Verain, of the University of Algiers, has recently been produced by the firm of Barbier Bénard and Turenne, 82 Rue Curial, Paris. It is termed a 'Scialyscope' and is a development of the shadowless light now installed in many operating theatres. It consists essentially of a conical reflector nearly 2½ metres in diameter, and of roughly parabolic form, by means of which the rays from a very powerful light-source are concentrated on the field of operation. Beneath the lamp itself is placed an optical system containing a large right-angled prism by which an image of the field of operation is formed on a translucent screen in an adjoining room. The magnification on the screen is 3½ diameters, and the illumination is so powerful that a spectator at a distance of seven metres can obtain a brilliant view of every detail in the field of operation. There has always been very great difficulty in demonstrating operative details to a group of students; their mere presence in an operating theatre is undesirable, and it is obviously impossible for most of them to obtain any but a fleeting glimpse of what is happening. With this apparatus forty or fifty students in an adjoining room can easily follow every detail, and it will be noted that their view is obtained from a point immediately above the field of operation. By means of a microphone and a loud speaker, the surgeon can describe to them at the same time all that is being done. The method would appear to have considerable possibilities and it certainly overcomes the difficulties involved in demonstrating operative details to a number of individuals.

Report of the University of Birmingham

IN his seventeenth and last report to the Council, presented at the annual meeting of the Court of Governors of the University, the Vice-Chancellor (Sir Charles Grant Robertson) gives a summary of the progress of the University during his tenure of office. In 1920 "the high hopes, the vaulting ambitions and the dreams of a golden dawn that inspired a Great Britain freed by the Armistice from the terrors and horrors of the War slowly faded away or were frozen out, and in their place came spiritual and moral anarchy and the cynicism derisive of the past, and baffled by the present, that fears nothing but the future". Since then the University has gone rapidly forward. The income and expenditure in 1921 were £143,631 and £144,535 respectively, while for 1937 they were £232,690 and £230,805, not taking into account the sums for fellowships, scholarships and other trust funds which pass through the accounts of the University. Assets have increased to £2,199,306, and the University is free from debt, the contributions to the endowment since 1920 being not less than £930,000. The grants from local authorities have increased from £11,887 to £33,570. Expenditure in stipends has increased from £34,131 to nearly £100,000. There are now 34 full-time professors and 10 part-time, while the non-professorial staff now numbers 297. The Library grant has been quintupled and the number of readers and of books taken out has increased eightfold. "The function of a university library is not merely to satisfy existing needs, but to create new appetites as yet unknown and always unpredictable; you never can tell what may result from the contact of a young mind with an adequately equipped library. In a university more minds than we are aware of are always at flash-point. It is the spark that is so often wanting."

SIR CHARLES notes with satisfaction the success which has attended the large measure of self-government which has been given to the undergraduates—"the student body has justified the confidence that the unification of responsibility with power demands". He wishes, however, that a really serious share in these activities were not left to an able but overburdened minority, and to a still smaller but very vocal opposition who find in the Vice-Chancellor and 'the authorities' the source of all their troubles. "But that is almost inherent in all 'day universities' in huge cities where two hours or more have to be spent daily in coming and going. It may require another generation to pass before the truth that a university education is a life together and not merely a learning together is grasped by every fresher at entry." The number of students which showed a steady increase until 1933–34 has since shown a progressive though small decline. This decline is viewed with some anxiety and is regarded as probably due to the fall in the birth-rate, the forecast being made that by 1955 the number of students may have fallen to not more than 1,200 or 1,300, or perhaps less. It is noted that about 45–50 per cent of the students hold scholarships or grants from public funds which enable them to take a university course, and that about 48 per cent started their education in an elementary school.

Obstacles to Teaching

In her presidential address on April 16 to the National Union of Teachers, Mrs. E. V. Parker, a teacher in a London County Council school, dwelt on those unfavourable conditions which hamper the work of teachers eager to contribute to the salvaging of civilization. The generous ideals of the Hadow Report, foreshadowing the elimination of social class distinctions in a unified system of public education and "freedom for every child to attain its full stature", have not been realized; nor can they be without provision by the community of proper material environment in school and home and drastic reduction of the size of classes. The freedom of the teacher is threatened with partisan interference which seeks "to sap and undermine by labelling many of our positive educational activities as propaganda". In the junior school the incubus of the external examination from which elementary schools were rescued in 1895 has reimposed itself as an instrument for selection for free secondary school places, which should be the birthright of every British child. In the new senior schools a large measure of freedom is enjoyed, but they need levelling up to the standard of the older secondary schools in point of leaving age, staffing and amenities. Meanwhile, it is essential that the last months before the child leaves school should be devoted to an earnest effort to gather up the loose threads of knowledge, to give meaning to all the work already done, making plain its applicability to the problems of life and providing the stimulus that will result in a continuance of interest and effort for self-education.

Japanese Nationalism and Intellectual Freedom

Japan won her high place among world powers in little more than a generation by a will to accept and assimilate ideas from outside her own culture, which was a cause of wonder and admiration among all civilized peoples. It is, therefore, all the more remarkable that this liberal attitude should now have been abandoned in favour of a spirit which interprets the springs of nationalism in the narrowest sense. A commission, it is reported by the Tokyo correspondent of *The Times* in the issue of April 21, is engaged in investigating the books in use in the universities of Japan with the view of determining whether they are fully in accord with the national spirit. Among books which it has been decided to ban are Mill "On Liberty", Bertrand Russell's "Roads to Freedom", George Gissing's "Private Papers of Henry Ryecroft", "Tess of the D'Urbervilles" by Thomas Hardy and "Ulysses" by James Joyce. The choice might seem peculiar, and, in fact, to English-speaking peoples almost capricious, even when it is added that the principles of selection exclude all books which encourage liberalism, offend morals, describe excessive cruelty, or whose authors have attacked Japan. With the exception of the ground last-named, which may or may not be regarded as excusable, such a policy seems not only over solicitous for the intellectual weakling, but even admirably calculated to produce the stunted judgment which in the long run will make for national weakness rather than strength.

The London Television Service

The paper on the London Television Service read to the Institution of Electrical Engineers on April 21 by T. C. Macnamara and D. C. Birkinshaw describes the television station recently built by the British Broadcasting Corporation in a part of the Alexandra Palace, London, N. The reports of the reception of the transmissions have in general been encouraging. The range of the station, originally estimated to be about 25 miles, has proved to be considerably farther in most cases; good reception can be obtained up to about 35 miles. Reports of visual receptions have been received from Brighton, Southend, Cambridge and Bedford, the distances of which from the station are 40–60 miles. In these cases reception took place under exceptionally favourable conditions. It has been found that in the ultra-short waves used for television, the interference due to electro-medical apparatus used for high-frequency diathermy is sometimes serious. For example, a North London hospital situated about half a mile from the Alexandra Palace has a spark diathermy machine which when used completely 'jams' the reception of the five-metre radio link transmitter at the Palace. The whole of the walls and ceiling of the room were covered with aluminium foil 5 mm. in thickness, applied with a paper backing after the fashion of ordinary wall paper. At one end of the room, which was open, a partition covered with ½ in. mesh chicken wire was erected and good electrical connexion made between the aluminium foil on the ceiling and walls and the chicken-wire. A similar screen was placed over the window and another was laid on the floor underneath the usual rubber floor material. The treatment effected complete suppression of the interference. If the screened door in the partition was opened by only a few inches, the interference was almost as bad as with the unscreened room. This proves the necessity of taking thorough measures.

A Bird New to Great Britain

An interesting addition to the British bird list is described by H. F. Witherby in the March issue of *British Birds*, namely, the first identified specimen of the western little bustard (*Otis tetrax tetrax*). This specimen was one of two "strange birds" shot during a partridge drive at the Wadworth estate of Yorkshire, just south of Doncaster, so far back as December 9, 1922. The shooting tenant presented the specimen to Capt. E. W. S. Foljambe, who had it preserved at Osberton, Nottingham, whence he recently sent it to London for expert study. The whereabouts of the second bird shot on that date have not been traced. The western race of the little bustard inhabits Spain, Portugal, France and north-west Africa, and differs from the eastern race in the possession of more sandy-buff colour on the upper parts and wing-coverts, in having the black markings less pronounced, and the vermiculations finer. The eastern little bustard (*Otis tetrax orientalis*) had previously been recorded in Great Britain, and the specimen was at first thought to belong to that race. One was shot at Addlethorpe, Lincolnshire, in November 1933, another in Kincardineshire in 1912, one near Peterhead, Aberdeenshire, in January 1935 and one in Hampshire during a partridge drive in December 1935.

Journal of the Glasgow Mathematical Association

We have only just received the first two numbers of this journal, although the first appeared so long ago as December 1936, and the second a year later. The Glasgow Mathematical Association is the successor to the "Euclidean Society" formed in Glasgow in 1927. Its objects form a curious contrast with those of the well-known Mathematical Association, which is the successor to "The Association for the Improvement of Geometrical Teaching". The objects of the latter might be described as revolutionary, in the first place to break away from the shackles of Euclid, and then to break away also from the traditional methods of teaching algebra, trigonometry and other branches of elementary mathematics. The Glasgow Association, on the other hand, is counter-revolutionary. Its original object was to adhere to Euclid's methods whenever the substitutes were considered unsatisfactory. An article by J. McWhan pleads also for a return to the "uninspiring but fundamental topics" in algebra and trigonometry, and claims that "the drill itself, and the concentration and self-discipline implied in it, are surely of the highest educational value", although "not in itself stimulating or pleasurable either to pupil or teacher". These views are supported by evidence as to the bad effects of modern methods of teaching.

The *Journal* may be warmly recommended even to those teachers who do not consider that what is pleasant is probably evil. There are interesting historical articles on Stirling and Monge, and a most valuable exposition of the "Intuitionist" point of view concerning the nature of mathematics. This, if accepted, would necessitate a drastic pruning and remodelling of the whole of abstract function theory, such as the Heine-Borel theorem, and would reject the theory of non-enumerable classes and Lebesgue measure as merely "verbal mirages". There is also an article on compass constructions, and notes on the teaching of geometrical progressions, medial section, the construction of triangles, the sums of powers of the natural numbers, and the binomial theorem.

Plague Research in India

In the report of the Haffkine Institute, Bombay, recently issued, the Director, Lieut.-Colonel Sokhey, summarizes the work of the Institute during 1936. It is the centre for the manufacture of plague vaccine for the whole of India, and more than 800,000 doses of vaccine were issued during the year. Much work has been done on the standardization of the dose of virulent plague bacilli for measuring the protective power of plague vaccines, and upon the preparation of a potent anti-plague serum for treatment. Investigations on the epidemiology of plague have shown that the house rat in some localities is resistant to plague, but that in them the small field rat is highly susceptible, and is probably responsible there for the spread of the disease.

The Night-Sky in May

The moon is full on May 14^{d} at $8{\cdot}6^{h}$ and new on May 29^{d} at $14{\cdot}0^{h}$ U.T. At full moon, a total eclipse of the moon occurs, but this is invisible from Europe. At new moon on May 29, a total eclipse of the sun takes place, but this phenomenon is likewise invisible from Europe, the path of totality lying in the southern part of the South Atlantic Ocean. The sun will be seen partially eclipsed from South Africa and the southern part of South America. Amongst the occultations visible from Greenwich this month may be noted the following: on May 2 at $20^{h}\ 5{\cdot}1^{m}$ the disappearance of 106 Tauri (mag. 5·3); on May 3 at $20^{h}\ 41{\cdot}8^{m}$ the disappearance of 68 Orionis (mag. 5·7); on May 12 at $20^{h}\ 57{\cdot}2^{m}$ the disappearance of B.D.—15° 3817 (mag. 5·1) and on May 17 at $1^{h}\ 39{\cdot}0^{m}$ the reappearance of 58 Ophuichi (mag. 4·9). Of planetary phenomena to be looked for is the unusually close approach of Venus and Mars on the evening of May 7, the actual conjunction taking place on May $8^{d}\ 0^{h}$, that is, about $2\frac{1}{4}$ hours after the planets have set below the horizon at Greenwich. Binoculars should be used to see this interesting phenomenon, and the difference in colour of the two planets will be observed. On May $1^{d}\ 19^{h}$ and May $31^{d}\ 16^{h}$, Venus is in conjunction with the moon; on May $2^{d}\ 1^{h}$ and May $30^{d}\ 18^{h}$, Mars is in conjunction. Jupiter, a morning star, is in conjunction with the moon on May $22^{d}\ 17^{h}$. In the middle of the month at 21^{h} a very interesting region of the sky is on the meridian. This region contains an assembly of nebulæ in Virgo and Coma Berenices and the loose cluster of bright stars that form the mythical tress of hair of Berenice. East of this cluster is the north galactic pole, in the direction of which the 100-inch telescope has explored the remote extra-galactic nebulæ to a distance of more than 500 million light years. Hubble states that, on long exposure plates taken under good conditions with the 100-inch reflector, the recognizable nebulæ in the direction of the galactic poles average about 2,400 per square degree and are more numerous than the stars!

Announcements

THE Gold Medal of the Royal Society of Medicine, given triennially in recognition of services to the science and art of medicine, has been awarded to Prof. Wilfred Trotter, director of the surgical unit at University College. Prof. Trotter is the seventh recipient of this medal, his predecessors having been Sir Almroth Wright, Sir F. Gowland Hopkins, Prof. J. S. Haldane, Sir Henry Head, Sir Thomas Barlow and Sir Archibald Garrod.

THE Gold Medal of the Institution of Mining and Metallurgy has been awarded to Prof. S. J. Truscott, "in recognition of his services in the advancement of the science and practice of mining and metallurgy, with special reference to his services in technological education". The Consolidated Gold Fields of South Africa, Ltd. Gold Medal has been awarded to Prof. H. V. A. Briscoe, "in recognition of his researches on the sampling and properties of industrial dusts"; The Consolidated Gold Fields of South Africa, Ltd. Premium of forty guineas has been awarded conjointly to Dr. Janet W. Matthews, Mr. P. F. Holt, and Miss Phyllis M. Sanderson, "in recognition of their work, in association with Prof. H. V. A. Briscoe, on the sampling and properties of industrial dusts".

THE following have been elected members of the Royal Danish Academy of Sciences and Letters, Copenhagen: Prof. Einar Lundsgaard, Copenhagen; Prof. H. O. Eilert Ekwall, Lund; Prof. Didrik Arup, Seip; Prof. V. M. Goldschmidt, Oslo; Prof. Haaken H. Gran, Oslo; Prof. Theodor Frings, Leipzig; Prof. Albrecht Götze, New Haven; Prof. R. L. Enno Littmann, Tübingen; Prof. Richard Goldschmidt, Berkeley; Dr. Peyton Rous, New York; Prof. August Thienemann, Kiel.

PROF. ALEXANDER W. EVANS, Eaton professor of botany in Yale University, known for his work on the Hepaticæ (liverworts), celebrates the seventieth anniversary of his birthday on May 17. A dedicatory volume of *Annales Bryologici* is being prepared to mark this occasion. This "Festschrift" contains a biographical notice and portrait of Prof. Evans together with about twenty-five contributions from leading American and European bryologists and hepaticologists.

AT a meeting of the Royal College of Physicians of London held on April 11, Dr. Robert Hutchison, consulting physician to the London Hospital and to the Children's Hospital, Great Ormond Street, was elected president in succession to Viscount Dawson of Penn.

A GENERAL COMMITTEE, consisting of the Council of the Royal Society of Edinburgh and a number of leaders in science and education, has been formed to further the project of securing a portrait of Sir D'Arcy Wentworth Thompson, president of the Society, to be hung in the Society's Rooms. The portrait is being painted by Mr. David S. Ewart. Dr. James Watt is treasurer of the Fund, and will be glad to acknowledge any remittances sent to him at the Society's Rooms, 22 George Street, Edinburgh, 2, marked "R.S.E. President's Portrait Fund".

MR. H. F. BROADBENT left Port Darwin on April 17 and flew to Lympne arriving at 10.51 on April 22, the actual flying time for the journey being 5 days 5 hours 21 minutes. He thus beat the record previously held by Miss Jean Batten by 12 hours 54 minutes.

AT its last general meeting, the Vienna Biological Society elected Profs. Harvey Cushing of New Haven, U.S.A., Sir F. Gowland Hopkins of Cambridge and C. G. Santesson of Stockholm as honorary members, and Profs. A. v. Muralt of Berne, G. Bayer of Innsbruck, H. Guggisberg of Berne, Barkar of Tartu and Anrep of Cairo as corresponding members.

THE Jugoslav State has allotted a sum of four million dinars to the Jugoslav Society for the Social and Scientific Campaign against Cancer to enable a cancer institute to be founded at Belgrade.

ON the occasion of the eightieth birthday of King Gustav V of Sweden on June 16, a Swedish fund will be organized for the investigation and control of common diseases, especially poliomyelitis and rheumatic disorders.

THE Vienna Sectional Meeting of the World Power Conference will, notwithstanding recent political events, be held on August 25–September 2, 1938, and the programme remains unaltered. At the recent annual general meeting of the British National Committee, it was decided to proceed with preparations for British participation in the Vienna meeting. Sir Harold Hartley has again been elected chairman of the British National Committee of the World Power Conference, to serve for a further term of three years.

THE lecture entitled "Some Carbohydrate Problems" arranged to be given by Prof. W. N. Haworth before the Chemical Society on May 5 at 8 p.m., has been postponed. Instead, Prof. J. Masson Gulland will deliver a lecture on "Nucleic Acids".

THE writer of the article on the "Teaching of Technical Optics" in NATURE of April 9, p. 654, regrets that by inadvertence he omitted the firm of Messrs. Aldis Brothers from among the makers of photographic lenses. This firm has made photographic lenses since 1902; it has a Cambridge graduate as designer and is, of course, well known for the high quality of these lenses. The name of the firm was mentioned in the article among those of other firms which have devoted particular attention to the design of lens systems.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 793.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Social Relations of Science

ABSENCE abroad has prevented me from responding sooner and expressing, as invited, an opinion on the proposals in the article entitled "Social Relations of Science" printed in NATURE of April 23. Though to me they come too late and too tainted with officialdom and regimentation to appear to be much more than a wish to be in at the shouting, it would be churlish not to express gratitude that they are, at least, explicit and capable of being intelligently discussed.

The effect of scientific discovery on the whole framework and content of sociology, economics and politics has been with me a major preoccupation for nearly twenty years. In that time, I have had the satisfaction of seeing grow from very small beginnings what is no exaggeration to say is an entirely new outlook and philosophy of life. Everywhere in the teeth of every sort of ignorance, prejudice and vested interest, academic, political and financial, I have witnessed the realization spread over the world like wildfire, since the Great War, of what the scientific civilization might be, but for the procrustean bed of a private, upstart and frustrating monetary system.

Academic scientists, I should judge, have much more to learn of the potentialities of an unfrustrated and deprocrusticated scientific civilization than they are able to teach. They seem still pitiful dupes of Procrustes, at best trying to mitigate the sufferings of those mutilated, rather than to provide a decent bed, and only now really interested because their own precious freedom from interference is being threatened.

The proposal is for a new sort of Royal Society to be formed to discuss these matters, having a large membership and all the usual paraphernalia of council, committees, "suitable" referees, regular meetings, symposia and publications. Though it has to deal with subjects which, not to put a gloss on it, affect everybody's pocket more or less and that of Procrustes very closely indeed, its attitude is to be strictly objective and scientific. It is not to express corporate "opinions" (decisions or conclusions, surely, would be less 'in the dreary and barren dialectical tradition') but everyone is to be left free to make up his own mind as an individual. It is claimed that what has worked well in the old field of knowledge for its own sake will, there is every reason to believe, meet with "like success" in the new. Accepting, so to say, the prospectus at the promoters' own valuation, "like success" means nothing beyond the creation and diffusion of a well-informed body of opinion. What is proposed is just another debating society in addition to the hundreds of societies studying this very problem all over the world, but distinguished by being composed preponderatingly of people to whom both the technique and methods of science are familiar, qualities which are rather more in evidence in the individuals engaged in the pioneering of new knowledge than in their organizations.

Well, the existing societies already studying these problems in much this way without, it is true, the qualification of mass scientific intellect, have come to a sort of consensus of opinion that it is the monetary system which is at the bottom of the whole hell's brew. Is the proposed society to be allowed to make a purely scientific and objective investigation into the existing money system ? The lack of specific reference to this in the agenda, and, indeed, the rather naïve idea underlying this new phase of the movement, that the massive intelligence of organized science should be shipped off on a quest into these uncharted seas, when as a matter of fact the whole thing already could be made clear to the uncorrupted mind of a child, makes me ask the question. If I may suggest the answer, it is that in a matter so nearly touching the very core of government, the new society like the old will be expected to be on the side of the Government of the day, whatever that may be, rather than on that of the veiled goddess.

Be that as it may, I am sure everyone who has already been independently examining the question with an open mind will want to know on which side of the fence the proposed society is expected to sit; whether, like the Royal Society in so far as, since the War, it has largely become an unofficial part of the Civil Service, it is to be concerned with the sort of knowledge most useful in preserving and strengthening the existing framework of society, or with changing that framework so as to make the world safe for a scientific civilization. I know that, theoretically, the two sides should be the same, but in practice they may be exact opposites.

When we come to what after all is the object, *the change of the system*, be it the monetary system or whatever else may be adjudged to be the prime cause of civilization running off the rails, what is the use of a debating society ? Are we still supposed to subscribe to the idea that "in this country at least", once a sufficient and sufficiently well-informed body of opinion exists as to what is wrong, it will come all right ? I suppose some people still think vaguely along these lines, but I am not among them, not in the present instance.

If we study actual examples of changes recently effected, associated with the names of Mussolini, Gandhi, Hitler, Lenin and his successors, much as they differ in method, they all seem to depend primarily on the creation or renewal of faith in the future destiny of their own particular race or civilization. So it would appear that, if the scientific civilization is to survive, scientific workers should strive to create a mass-belief in its superiority, as regards both material and spiritual satisfactions, alike over the hoary civilizations we are still imitating, and the meteoric substitutes since the War. All scientific thinkers must themselves feel this superiority intensely, but it would be a good thing if their allegiance was less clannish, and, in their external relations, they were less like the herd in thinking these threatened catastrophes as either inevitable or beyond the power of science to prevent. For, indeed, the amount of science required is, in my view, much of the two-plus-two variety. What is more wanted is not a new organization but a Crusade of Scientific Civilizers, a C.S.C. not an S.R.S.

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Complex Formation in Lipoid Films

It was shown recently[1] that when extremely dilute solutions of certain substances were injected into the substrate under monolayers of various types, the injected substance (for example, cetyl sulphate) penetrated the monolayer (for example, cholesterol), forming a mixed film containing equal numbers of the two molecular species. These experiments were carried out at constant area.

Two experimental methods have now been devised to study area changes in these mixed films formed by the penetrative process under various compressions. In one, a Langmuir trough is employed, the surface tension of the solution behind the barrier being separately determined. In the other, a thin strip of waxed paper attached to the sides of the trough by long vaselined silk threads serves as a barrier. The monolayer under examination is placed in front of the barrier, and behind it a lens and film of a suitable substance serves as a Langmuir piston to compress the monolayer. This piston film, for example, triolein (piston pressure 23 dynes/cm.), must consist of a substance which is not penetrated by the material injected into the substrate.

With a monolayer of cholesterol compressed by a triolein piston, the injection of a dilute solution of digitonin causes an immediate expansion of the monolayer to twice the area, and the previously liquid cholesterol film becomes solid. The triolein is unimpaired and continues to exert a compressive pressure of 23 dynes per cm. If instead of digitonin, cetyl sulphate in suitable concentration be injected and oleic acid is employed as piston (35 dynes/cm.) the area increase is only 50 per cent instead of 100 per cent. Here again, since the molecular areas of cholesterol, digitonin and cetyl sulphate are 40 A.^{2}, 40 A.^{2} and 20 A.^{2} respectively, a complex of 1 : 1 is formed. Replacing oleic acid by the less compressive triolein piston, it is found that on injection of the cetyl sulphate there is an immediate expansion of 50 per cent forming the 1 : 1 complex. This is followed at these lower pressures by a further slow expansion, indicating the formation of a less stable complex of the composition cholesterol, cetyl sulphate (1 : 2). Care has to be taken to avoid leaks, since the detergents in excess remove the liquid paraffins from the threads.

It is of interest to note that a solution of cholesterol in petrol ether spreads rapidly on water and on a solution of cetyl sulphate, but not on digitonin; hence surface peptization is only brought about by the formation of complexes which must be liquid and in order to spread must have stability pressures greater than the equilibrium surface pressure of the underlying solution. With the Langmuir trough it is possible to examine this complex formation over a wider range of areas and pressures. The following general types of complex emerge from this investigation.

(*a*) When both monolayer and penetrating molecules are ring structures, only 1 : 1 complexes are stable.

(*b*) i. When the penetrating molecules are chains penetrating into a monolayer of ring structure, complexes containing one, two, and possibly three chain molecules per molecule in the monolayer have been established.

(*b*) ii. In the inverse system to the above, two chain molecules in a monolayer can interlink with one ring structure molecule from the substrate.

(*b*) iii. Finally, if both monolayer and substrate molecules are linear, two, and possibly as many as three, molecules from the substrate can form from a complex with one in the monolayer, in agreement with a centred hexagonal packing.

(*b*) iv. Van der Waals forces play a large part in the stability of these complexes; thus if dodecyl sulphate instead of cetyl sulphate be used, only very weak 1 : 1 complexes can be established.

We may note that in chain-like molecules insertion of a double bond in the chain may reduce the penetrative power; thus cetyl sulphate penetrates readily a film of the *trans* elaidyl alcohol to form an 'interlocking' solid, 1 : 1 mixed film, but only penetrates with difficulty the *cis* oleyl alcohol, to form a liquid film readily decomposed by pressure. As is to be anticipated, the formation and stability pressures of a series of complexes is dependent not only on the surface pressure, but also on the bulk concentration of the penetrating agent. Again, the formation of complexes is in many cases extremely sensitive to quite minor changes in the *p*H of the underlying solution; thus bilirubin penetrates cholesterol with ease at *p*H 7·2 but has a negligible effect at *p*H 8·2. Biliverdin does not penetrate cholesterol at all. On the other hand, taurocholic acid forms no complexes with bilirubin as measured by these methods.

It is hoped shortly to give an account of the systems investigated, together with the data on the stability of complexes of cholesterol with various substances in respect to their hæmolytic activity and with natural pigments and bile salts as a possible factor in the formation of gall stones.

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[1] *Proc. Roy. Soc.*, B., 122, 29 (1937).

Isomeric Forms of Radio Rhodium

When bombarded by neutrons, rhodium gives two radioactive periods, 44 sec. (Rh_1) and 4·2 min. (Rh_2), both being associated with the emission of negative electrons.

Amaldi, Fermi[1], and Segrè[2] have shown that the ratio of the two activities produced in rhodium by *slow* neutrons does not change if the neutrons are filtered with cadmium or rhodium. This indicates that the resonance levels for the capture of slow neutrons which lead to the formation of Rh_1 and Rh_2 have about the same energy and breadth. This supports the hypothesis that the formation of Rh_1 and Rh_2 corresponds with the capture of neutrons in a single level of a definite isotope, that is, that Rh_1 and Rh_2 are two isomeric forms of the same isotope. The experiments of Frisch, von Halban and Koch[3] lead to the same conclusion. A possible explanation of nuclear isomerism has been proposed by Weizsäcker[4].

It is interesting to examine the significance of the ratio R of the saturation intensities of the two periods (all references will be to the 'true ratio', account being taken of the penetration of β-rays and neutrons; the details of the following experiments will be published elsewhere). When a neutron is captured, the compound excited nucleus may emit one or more photons before falling either to the state corresponding to Rh_1 or to that corresponding to Rh_2. The experimental ratio R will give the ratio of the probabilities of formation of Rh_1 and of Rh_2 from a capture level.

One may ask whether this ratio varies when the capture level changes, that is, when one varies the energy of the incident neutrons. There is evidently a close analogy between this question and the following: Does a change in neutron energy vary the spectral composition of the γ-radiation which is emitted by a nucleus in the capture of neutrons? An experiment on the capture radiation of slow neutrons in gold[5] has answered this question in the affirmative. Considering the experimental difficulty in studying γ-radiation in this case, it is easier to follow the same general investigation by means of new methods such as those described in the following. The rhodium (Dr. Jacquet kindly made an electrolytic deposit of 5 mgm./cm.^{2}) on the interior of a nickel cylinder was irradiated for 20 minutes and its activity was followed in a Geiger-Muller counter with a thin aluminium wall (the counting began 20 seconds after the end of the irradiation).

From the curve of decay of the total activity ($Rh_1 + Rh_2$) one can deduce the value of the ratio R of the initial intensities of Rh_1 and Rh_2. This ratio was determined:

(*a*) With a source of radon plus beryllium (or radio-actinium plus beryllium) in the presence of paraffin. In this case it is known that the ratio R does not depend upon geometric conditions[1]. The result $R_a = 11 \pm 0{\cdot}7$ confirms the value found by Segrè[2].

(*b*) With a source of radon plus beryllium placed on the axis of the cylinder of rhodium, in the absence of paraffin and all hydrogenous media. It is known that for a radon plus beryllium source the number of neutrons of energy greater than 10^5 e.v. is probably less than 10 per cent of the total number of neutrons emitted[6]. Moreover, as the capture cross-section in general is greater the slower the neutrons, one can say that the rhodium cylinder is bombarded by heterogeneous neutrons with a mean energy less than 10^5 e.v. The irradiation was made at the interior of a 'castle' of lead, thus augmenting the activity through the presence of neutrons diffused by inelastic collisions in the lead. The mean energy of these neutrons is smaller than that of the slow group of neutrons from radon plus beryllium, as one can determine by measuring directly the absorption in cadmium[7]. The value $R_b = 6 \pm 0{\cdot}5$ was obtained.

It should be noticed that in (*a*) the experimental value R_a is relative to the neutron capture by a *single level*. On the other hand, in (*b*), R_b represents a *mean value* referring to a great number of levels. This is due to the fact that the neutrons which excite Rh_1 and Rh_2 in the conditions (*b*) have a very complex spectrum. Moreover, in the case (*b*) the breadth of the levels is probably greater in the mean than is their separation. It might be expected that in an energy interval which is small with respect to the total excitation energy of the nucleus, the *mean value* of R should not change appreciably. Consequently, the result of this experiment ($R_a \pm R_b$) seems to show that the mean value of R in a certain energy interval differs from the value relative to a single level of this interval.

This is in accord with the experiment on the γ-radiation of capture in gold and with the experiments on the selective production of isomeres in uranium[8], that is, neighbouring levels show a difference of behaviour (in the sense already explained).

As Placzek has remarked[9], it seems that the nuclear levels can be grouped into different classes which cannot intercombine in the spectroscopic sense of the word.

After these experiments were finished, there was published the results of measurements of R in rhodium for neutrons of different energies[10]. Here, however, it is difficult to draw conclusions on the radiative properties of the nucleus, because the value of R was determined in one case for slow neutrons and in the other for neutrons of very high energy (neutrons from D + D : 2·4 M e.v.).

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March 30.

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[1] Amaldi and Fermi, *Phys Rev.*, **50**, 899 (1936).

[2] Segrè, *Ricerca Scient.*, 7, 389 (1936)

[3] Actes du congrès international du Palais de la Decouverte, Paris (1937).

[4] Weizsäcker, *Naturwiss.*, **24**, 813 (1936).

[5] Pontecorvo, *J. Phys. Radium*, 7, 511 (1936) and ref. (3).

[6] See, for example, Bjerge, *Proc. Roy. Soc.*, A, **164**, 243 (1938).

[7] Amaldi, D'Agostino, Fermi, Pontecorvo, Rasetti, Segrè, *Proc. Roy. Soc*, A, **149**, 522 (1935)

[8] Hahn, Meitner, Strassmann, *Z. Physik*, **106**, 249 (1937) and Curie, I, and Savitch, *J. Phys. Radium*, 8, 385 (1937).

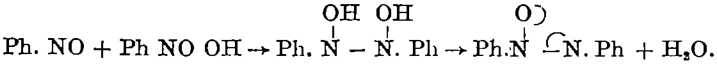
[9] Placzek, ref. (8).

[10] Reddemann, *Naturwiss.*, 8, 125 (1938).

Formation of Mesomeric Systems

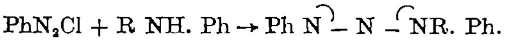
THE recent article[1] by Prof. Ingold on "Resonance and Mesomerism" prompts me to refer to an aspect of this subject which has presented itself in connexion with the study of aliphatic diazo-compounds[2].

The tendency to the formation of saturated systems (for example, of aromatic from dihydrobenzene or from quinonoid derivatives; and of conjugated from unconjugated dienes) is a commonplace of organic chemistry. The generalization, that mesomeric systems are likely readily to be formed from others closely related to them, not only embraces those just mentioned but is also much wider in scope and should prove to be correspondingly more valuable. Thus, adopting Ingold's notation, we at once comprehend the formation of azoxybenzene (I), or of diazoamino- (II) in preference to aminazo-compounds:



$$Ph.NO + Ph\,NO\,OH \rightarrow Ph.\overset{OH}{\overset{|}{N}} - \overset{OH}{\overset{|}{N}}.Ph \rightarrow Ph.\overset{O}{\overset{\uparrow}{N}} - N.Ph + H_2O.$$

(I)



$$PhN_2Cl + R\,NH.Ph \rightarrow Ph\,N - N - NR.Ph.$$

(II)

The transition from methyl diazohydroxide to diazomethane is exactly comparable with these :

$$CH_3.N = N.OH \rightarrow H_2\overset{\frown}{C-}N\overset{\frown}{-N} + H_2O.$$

Similarly, whilst ammonia and aliphatic amines merely form additive compounds with aldehydes, loss of water ensues when aromatic amines, hydroxylamine, etc., are employed, so that mesomeric systems

$$>\overset{\frown}{C-}N\overset{\frown}{-Ph},\quad >\overset{\frown}{C-}N\overset{\frown}{-OH}, \text{ etc.}$$

may be generated.

Their mesomeric character must also conduce to the generation of such systems by synthesis, and this is exemplified by the facile oxidation of nitrosobenzene, hydrazobenzene, azobenzene, isocyanides and *iso*acetylenes respectively to nitrobenzene, azobenzene, azoxybenzene, isocyanates, and ketenes. The formation of unsaturated systems is a special and particularly important case of this kind. The easy generation of styrene from boiling α-phenylethyl bromide, of stilbene from dibenzyl, of phenylbutadienes from the corresponding cinnamyl methyl carbinols, and of ethyl styrene by reduction of phenylbutadiene, are examples of long standing in the literature. Contemporary instances are readily discerned in the various syntheses of polyenes evolved by R. Kuhn and his collaborators[3], not the least noteworthy and significant being the adaptation of Klinger's synthesis of stilbene by reduction of thiobenzaldehyde. Similarly, it may well be that resonance is a determining factor in the biosynthesis of carotinoid and similar substances.

It would also appear that among inorganic compounds the familiar tendency of compounds representing intermediate stages of oxidation to pass spontaneously into others of lower and higher degrees, respectively; for example

$$3ClO' \rightarrow 2Cl' + ClO'_3,$$

is attributable to the greater resonance in the latter, as is also Luther's well-known rule, that in the conditions under which the transition occurs the intermediate stage of oxidation corresponds to a greater oxidation potential than the higher one. Similar considerations may explain the tendency of non-resonant anions derived from a single atom, for example, sulphur, halogen, or oxygen, to form resonant complexes by combination with elementary sulphur, free halogen, and atmospheric oxygen respectively. From this point of view, it might be anticipated that the ionic rather than the homopolar condition would be the predisposing factor, and it is noteworthy that, among the alkali and alkaline earth metals, it is the oxides of the most electropositive which most readily form higher oxides.

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[1] NATURE, 141, 314 (1938)

[2] Compare *Chemistry and Industry*, 59, 203 (1938).

[3] Compare the review in *Z. Angew. Chem.*, 50, 703 (1937).

Deuteron-induced Radioactivity in Oxygen

WHEN oxygen gas and several oxides (carbon dioxide, tungsten trioxide and water) were bombarded by 2 M.e.v. deuterons, which were obtained by the aid of our cyclotron, two periods for oxygen were definitely established.

A first period of one minute and a half is identified with that of ^{17}F, which has been already established by many authors[1,2].

A second period of 120 min. is shown by chemical separation to be also due to an isotope of fluorine and is close to the 112 min. period of ^{18}F found by Snell[2], when he bombarded neon with 5 M.e.v. deuterons, and also to the 107 min. period of the same isotope found by DuBridge, Barnes and Buck[3], when they bombarded oxygen with high-speed protons (1·4–3·8 M.e.v.). We thus identify the second isotope with ^{18}F.

The energy histogram of positrons emitted from this isotope was taken by the aid of a Wilson cloud chamber filled with hydrogen. The upper limit of the energy is found to be $0{\cdot}7 \pm 0{\cdot}05$ M.e.v. This is again close to 0·6 M.e.v.[3] and 0·5 M.e.v.[2], which were obtained from absorption experiments.

This isotope may possibly be produced according to the reaction :

$$^{17}O + {}^{2}H \rightarrow {}^{18}F + {}^{1}n$$
$$^{18}F \rightarrow {}^{18}O + e^{+}$$

The relative abundance of this isotope of oxygen is very small; hence to get an appreciable quantity of ^{18}F the cross-section of this reaction must be rather large. Further, when we consider the large abundance of the oxygen isotope ^{16}O, there remains a certain probability that it may be attributed to the following reaction, which has not yet been observed.

$$^{16}O + {}^{2}H \rightarrow {}^{18}F + h.$$

If this is the case, γ-rays of about 11 M.e.v. would be expected to be emitted during this reaction, according to mass defect consideration.

As for the third isotope of oxygen, ^{18}O, the reaction :

$$^{18}O + {}^{2}H \rightarrow {}^{18}F + 2{}^{1}n$$

must be abandoned according to the energy relation unless the kinetic energy of the deuteron exceeds 5 M.e.v.

The full account of the energy histogram and the Konopinski-Uhlenbeck plot of positrons emitted from ^{18}F will shortly be published, together with those of ^{13}N, in the *Scientific Papers* of this Institute. In conclusion, our thanks are due to Dr. Y. Nishina and other members of this Laboratory for their continuous interest and valuable assistance. We wish to thank the Japan Wireless Telegraph Company for the electromagnet and other equipment used for the cyclotron, and the Mitsui Ho-onkwai Foundation and Tokyo Electric Light Company for financial support.

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Feb. 28.

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[1] Newson, *Phys Rev.*, 48, 790 (1935) Wertenstein, NATURE, 133, 564 (1934). Kurie, Richardson and Paxton, *Phys Rev*, 49, 368 (1936). Pool, Cork and Thornton, *Phys. Rev.*, 52, 41 (1937).

[2] Snell, *Phys. Rev*, 51, 142 (1937).

[3] DuBridge, Barnes and Buck, *Phys. Rev*, 51, 995 (1937).

Sodium in the High Atmosphere

In the spectrum of the sky at twilight, a yellow radiation was found very near the mean wave-length of the sodium D lines ($\lambda = 5893$ A.). This radiation is relatively strong, but its intensity decreases abruptly in one or two minutes (Fig. 1), as if it was first excited, or rather considerably enhanced, under the action of the sunlight. Observations made at the Tromsø Observatory, in the autumn of 1937, have shown that the excitation occurs in a layer at the altitude of about 60 km.

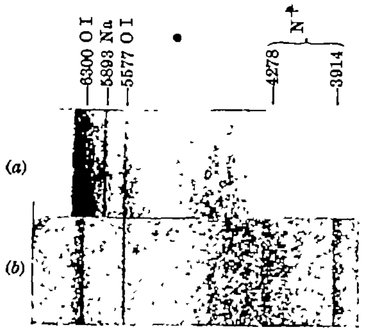
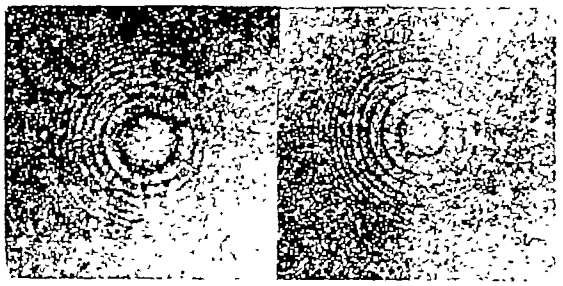


FIG. 1.

TWILIGHT SPECTRA (TROMSØ). (*a*) EXPOSURE, 15h. 47m.–15h. 52m. (*b*) EXPOSURE, 15h. 53m.–15h. 58m.

The same phenomenon was observed in December 1937 at Saint-Auban (Basses Alpes, France) and later in Lyons. In these latitudes, the shorter duration of twilight does not permit the determination with the same precision of the moment at which the yellow radiation practically fades. However, from a few spectrograms obtained in France, the altitude of the upper limit of the luminescent layer has been found again to be nearly equal to 60 km., in perfect agreement with the Tromsø measurements.

The yellow radiation was also studied by the interference method, using Fabry and Pérot interferometers (having glass plates 0·15 or 0·30 mm. apart) and also a quartz plate 1·5 mm. thick approximately. The results proved that this radiation really consists of the two D lines. In Fig. 2 are shown magnified reproductions of the rings from the twilight radiation, isolated by using special plates (sensitivity rapidly decreasing from the yellow to the red) and a suitable filter limiting the spectrum at 5750 A. On the left half of each picture, the rings produced by the yellow light of sodium (alcohol flame with sodium chloride) have been superposed on those of the twilight radiation. The coincidence is absolute and remains so, whatever the interferometer used.



(*a*) (*b*)

FIG. 2.

INTERFERENCE PICTURES OF THE TWILIGHT YELLOW RADIATION. (*a*) 0·15 mm. ÉTALON (D_1 AND D_2 DISTINCT); (*b*) 0·30 mm. ÉTALON (D_1 AND D_2 SUPERPOSED).

The D lines might be expected also in the night sky spectrum, on account of the presence of a yellow radiation having the proper wave-length (Slipher, Dufay, Cabannes). Their intensity would be only enhanced during twilight, probably by resonance excitation. In order to ascertain that this is so, the yellow radiation of the night sky has been studied (exposure: 11 hours, night almost without any moonlight), with one of the devices previously used for the twilight radiation. Rings perfectly clear, although less contrasted, have also been photographed under these conditions (Fig. 3). They are absolutely identical with those from the twilight doublet. In the two cases, the ratio of the intensities of the components D_2 and D_1 seems to have the normal value 2 : 1.

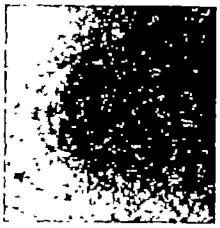


FIG. 3.

INTERFERENCE PICTURE OF THE NIGHT SKY YELLOW RADIATION (0·15 mm. ÉTALON).

These observations bring out the first decisive proof of the existence, in the high atmosphere, of an element distinct from the normal constituents of the air.

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Adsorption Potentials at Polar Liquid-Liquid Interfaces

A GREAT deal of work has been done by Hober, Cremer and many other investigators on the so-called 'oil-potential', that is, the potential difference (P.D.) between two aqueous solutions, separated by some water-insoluble organic fluid. The latter is for abbreviation called the 'oil'. The simplest type of such a cell is the following, a 'concentration cell':

Electrolyte, c_1, in water/'oil'/same electrolyte, c_2, in water. $c_1 > c_2$.

It has been generally assumed that the electrolyte involved diffuses very rapidly from the water into the oil so that the P.D.'s observed refer to a state of *partition equilibrium* of electrolyte immediately at the phase boundaries and of stationary diffusion inside the oil. From these assumptions the following formula has been derived for a (1–1) electrolyte:

$$\text{P.D.} = V = \frac{U_- - U_+}{U_- + U_+} \cdot \frac{RT}{F} \ln \frac{c_1}{c_2}$$

where U_- and U_+ are the mobilities of the ions in oil. However, the P.D.'s actually reported at different c_1 and c_2 often show a very poor agreement with any logarithmic formula. A great number of measurements have forced us to the conclusion that this classical theory is not consistent. In fact, we have been led to a different view.

We suggest that a great many of the 'oil potential' measurements, recorded in the literature, do not refer to a true partition equilibrium of the electrolyte on both sides of the interfaces, but only to an *ion adsorption equilibrium* between the aqueous phases and the interfacial layer. This should always be the case, when inorganic electrolytes are used and no special care has been taken to attain partition equilibrium, for example, by prolonged shaking of the phases. If, on the other hand, partition equilibrium is secured, P.D.'s are obtained different from the ion adsorption equilibrium P.D.'s and not so easily reproducible as these. The stability, the reproducibility and reversibility of the ion adsorption equilibrium P.D.'s within a few millivolts seem to indicate that the partition equilibrium of the electrolyte is not achieved even after a considerable time, even in the outer oil layers.

The interface oil/water can safely be assumed to consist of a single layer of 'oil' dipoles, the hydrophilic end groups pointing waterwards. If these are *negatively* charged (for example, CN, CHO, OH, NO_2, Cl), they should attract a monomolecular layer of positive ions, which are in turn coated by a diffuse cloud of negative ions. In a 'concentration cell' containing such an oil between dilute solutions of an electrolyte, the more concentrated solution should be the negative pole (as for the reversion of the effect at high electrolyte concentrations, see below). The P.D. should, moreover, be more dependent on the individual properties of different cations than those of the different anions. If an oil with *positive* hydrophilic end groups (for example, NH_2) is used, the conditions are reversed: concentrated electrolyte solutions are positive against dilute ones, and specific anion properties are prominent. These facts were discovered by Beutner and explained by him from a classical point of view as due to the 'acid' or 'alkaline' nature of the oils, but also non-acid oils like $ArNO_2$ and ArCl ($Ar=C_6H_5$) behave like Beutner's 'acid' oils.

We have derived the following approximate expression for the P.D. of each interface *c–n* (1–1) electrolyte in water/oil, the total P.D. being the difference of two such expressions:

$$V = V_0 + \Theta V^1 + \frac{2RT}{F}\sinh^{-1}\Theta\sqrt{\frac{K}{c}}\,;\ \Theta = \frac{c}{c+c_0}\,;$$

where R, T, and F have their ordinary meanings, V_0 is a characteristic of the oil and V^1, K, and c_0 are constants of both the electrolyte and the oil; c is the electrolyte concentration in water and Θ the fraction of the interface covered with ions. The second formula is simply the Langmuir adsorption isotherm.

Our experiments are in good agreement with the predictions of this formula. When the concentration c is raised, $\partial V/\partial \ln c$ (which should be a constant according to the classical theory) first rises to a maximum, then decreases and in several cases even passes through zero and changes its sign, as, for example, for acetophenone with potassium chloride in water at $c=0{\cdot}02$.

Methylene blue chloride, which is very insoluble in $ArNO_2$ and ArCl, will, if added to one side of a cell with one of these oils, give large negative P.D.'s amounting to more than 200 mv. The V ($\log_e c$) curve is certainly not linear and for $ArNO_2$ it is in one part more than twice as steep as would be possible by any classical formula. However, the P.D.'s are well described by the above formula and agree fairly well with the Θ's calculated from the figures of Gibby and Addison[1]. From the classical point of view it is quite inexplicable that, for example, $(C_2H_5)_2NH.HCl$, which is certainly about 10^4 times more soluble than methylene blue chloride in these oils, will give P.D.'s smaller by several orders of magnitude.

The addition of a non-electrolyte to one side of a symmetrical oil cell will often produce a high P.D. If $ArNO_2$ is used, dilute solutions of iodine and mercuric cyanide give positive potentials, di-ethyl sulphone, acetaldehyde, methyl cyanide and others give negative potentials, varying between 30 and 200 mv. This we ascribe to a change in the electrical moment of the interface by adsorption of non-polar or di-polar molecules.

The ion adsorption equilibrium P.D.'s may play a part in physiology, for example, in the mechanism of the olfactory and gustatory systems and the activity of local anesthetics, and may therefore be well worth studying. In contrast to the partition equilibrium P.D.'s they are distinguished by good and rapid reversibility. They are, moreover, sensitive to very small amounts of certain substances (even in concentrations of 10^{-7} mol.).

A full report of our investigations, which are proceeding, with additional support for our views, will be published elsewhere.

GÖSTA EHRENSVÄRD.
Inst. Exp. Zool.,
LARS GUNNAR SILLÉN.
Inst. Physics,
University of Stockholm.

March 13.

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[1] *J. Chem. Soc*, 119 (1936).

Amino-derivatives of Pentaerythritol

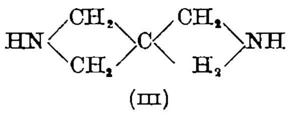
TETRAMINO-TETRAMETHYL-METHANE, $C(CH_2NH_2)_4$, was first prepared (in the form of its salts) by Govaert[1] by heating tetrabromo-pentaerythritol, $C(CH_2Br)_4$, with alcoholic ammonia in sealed tubes. This preparation has recently been repeated by van Alphen[2], who has isolated the free base and prepared various derivatives. The method of preparation is unsatisfactory, however, as the quantities of the tetrabromo-compound employed are limited by the use of sealed tubes, and the yield is low.

We have been investigating the amino-derivatives of pentaerythritol and their synthetic uses for some time, and have worked out a method for the speedy preparation of the tetramine in quantity.

When tetrabromo-pentaerythritol is heated with sodium *p*-toluene sulphonamide, $C_7H_7SO_2NHNa$, the tetrasulphonamido-compound (I), of m.p. 248°, is obtained in good yield, and on treatment with sulphuric acid is readily hydrolysed to the required tetramine. The latter can be isolated as the disulphate (II), which is almost insoluble in water.

$C(CH_2NHSO_2C_7H_7)_4$ (I)

$C(CH_2NH_2)_4,2H_2SO_4$ (II)

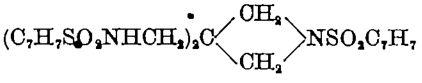


(III)

Govaert states that when aqueous solutions of the tetrahydrochloride of this amine are evaporated, ammonium chloride is broken off with the formation of the dihydrochloride of the spirocyclic diamine (III). We find, however, that the tetrahydrochloride can be recovered unchanged after it has been submitted to the following processes: (*a*) evaporated with water for 36 hours, (*b*) boiled with hydrochloric acid under reflux for 20 hours, (*c*) heated with hydrochloric acid in a sealed tube at 160° for 5 hours.

Methylation of the tetramine readily yields the octa-methyl compound, $C(CH_2N(CH_3)_2)_4$, which even with an excess of methyl iodide gives the bi-quaternary iodide $C(CH_2N(CH_3)_2)_2(CH_2N(CH_3)_3I)_2$: our attempts to prepare the quadri-quaternary iodide, $C(CH_2N(CH_3)_3I)_4$ have not at present succeeded.

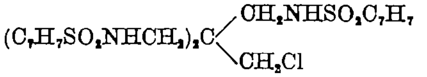
The preparation of the tetrasulphonamide (I) gives a small quantity of a trisulphonamide, $C_{26}H_{31}N_3O_6S_3$, of m.p. 214°, as a by-product. This compound has apparently the 4-membered ring structure (IV): hydrolysis with sulphuric acid opens the ring and gives the monohydroxy-triamine (V). Hydrochloric acid also opens the ring giving the chloro-compound (VI), which on complete hydrolysis followed by steam distillation undergoes ring closure again to give the monocyclic triamine (VII).



(IV)

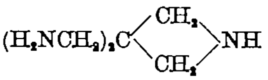
$C(CH_2OH)(CH_2NH_2)_3$

(V)



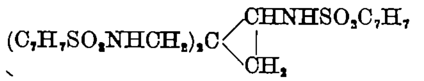
$$(C_7H_7SO_2NHCH_2)_2C\begin{matrix} \diagup CH_2NHSO_2C_7H_7 \\ \diagdown CH_2Cl \end{matrix}$$

(VI)

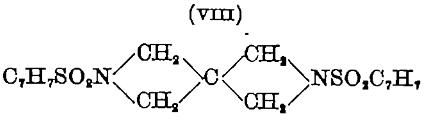


(VII)

Monoacetyl-tribromo-pentaerythritol, $C(CH_2Br)_3(CH_2OCOCH_3)$, when heated with sodium *p*-toluene sulphonamide, gives two derivatives. The first is a trisulphonamide, of m.p. 171°, isomeric with (IV), and having apparently the *cyclo*-propane structure (VIII): the second is the spirocyclic disulphonamide (IX), of m.p. 185°. Both (VIII) and (IX) on hydrolysis with hydrochloric acid followed by steam distillation give the spirocyclic diamine (III). The constitution which we have provisionally allotted to the isomeric compounds (IV) and (VIII) is supported by the fact that their sodium derivatives on treatment with benzyl bromide give a dibenzyl and a tribenzyl derivative respectively.



(VIII)



(IX)

The tetramine $C(CH_2NH_2)_4$ is now being used to investigate the stereochemistry of its spirocyclic organic and complex metallic derivatives.

F. G. Mann.
A. Litherland.

University Chemical Laboratory,
Cambridge.
March 23.

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[1] *Proc. Roy Acad. Sci Amsterdam*, **37**, 156 (1934).
[2] *Rec. Trav. Chim*, **57**, 265 (1938).

Purified Uricase

In the attempt to isolate the enzyme uricase from pig liver, I have obtained a preparation 550 times purer than the enzyme powder used as starting material. The purified preparation contains 0·15–0·18 per cent Fe, 14·4 per cent N, traces of copper, and no cobalt or manganese. It is almost colourless, and therefore is not a hæmin derivative. It is insoluble in water, almost insoluble in phosphate buffer *p*H 7·4, and soluble in borate buffer *p*H 10. Truszkowski[1] has already shown that uricase is soluble in alkaline solution.

The highest specific activity obtained, as measured by the oxygen uptake during the oxidation of uric acid in manometers, is 85 c. mm. per mgm. enzyme per minute as compared with a value of 0·15 c. mm. per mgm. per minute for the powder used as starting material. The test is arranged as follows: The main chamber of the manometer vessel contains 1·0 c.c. *M*/5 borate buffer *p*H 9 and 1·5 c.c. enzyme preparation plus water. The potash tube contains 0·2 c.c. 10 per cent caustic potash, and the side bulb 2·24 mgm. uric acid (as *M*/30 lithium urate). The gas space contains pure oxygen and the oxygen uptake is measured at 38° over a period of 30 minutes.

If it is assumed that the catalytic activity of the enzyme is due to the iron (although this has not yet been proved), then 1 mgm. iron brings about the reaction of 57,000 c. mm. oxygen per minute.

J. N. Davidson
(Carnegie Research Fellow).
Kaiser Wilhelm Institut für Zellphysiologie,
Berlin-Dahlem.
March 24.

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[1] Truszkowski, R., *Biochem. J.*, **28**, 62 (1934).

Lactoflavin in the Eyes of Fish

Some years ago we found[1,2,3] that the retinal pigment epithelium of the eyes of a number of fish contained relatively large amounts of flavin. Liver and kidney, which are known to be the materials richest in flavin, contain about 20 γ flavin per gm. tissue, while an approximate calculation of our results indicated in the pigment epithelium of some fish eyes 500 γ flavin per gm. tissue.

Flavin occurs in tissues almost entirely combined with protein as an enzyme which does not show the characteristic fluorescence of flavin and is not dissociated at neutral reaction. It was, therefore, a surprising observation that flavin of the pigment epithelium showed green fluorescence in water extract and was almost completely dialysable[2,3]. When the eye of a freshly killed fish was frozen in acetone - carbon dioxide mixture and cut by a meridional section the flavin contained by the pigment layer could be directly observed in the fluorescence microscope[4]. The spectrum of the green fluorescence light was identical with that of the flavin. The flavin from haddock eyes was also isolated and identified by Karrer[5] as lactoflavin. From these observations we concluded that flavin in the eye occurred in the free state or in the form of a highly dissociated protein compound but not as flavin enzyme. Thus the eye is the only tissue known which contains flavin mostly or entirely in the free form. Otherwise free flavin occurs only in milk and urine[6].

There was one detail of the problem not clear yet, namely, the question whether flavin in the fish eye originally occurs in the form of lactoflavin or as its phosphoric ester. The latter compound would show the same fluorescence as flavin itself, but during the isolation process it might have lost the phosphoric acid group.

Recently Emmerie[7] has shown that flavin can be easily separated from flavin phosphoric acid by means of certain solvents. Benzyl alcohol, for example, dissolves flavin[8] but not the flavin phosphoric ester.

The application of this simple principle to the present problem showed us soon that the flavin of fish eyes was free flavin and not flavin phosphate. The eye of a big cod was detached immediately after killing, frozen in solid carbon dioxide, and the separated retina and pigment layer were extracted by grinding with ice water. By shaking the sharply centrifuged yellow solution with benzylalcohol three times the flavin was completely extracted. When lactoflavin phosphoric acid* was added to the water extract of the pigment layer of another eye it remained in the water phase after a similar treatment with benzyl alcohol.

The occurrence of free flavin in the eye suggests that flavin phosphate taken up with the food is dephosphorylated for its deposition in the eye. According to Kuhn[9], free flavin may also form an active compound with the protein part of flavin enzyme. This compound, contrary to the flavin enzyme, which is a flavin phosphate protein compound[10], is highly dissociated into its inactive components. The occurrence of free flavin suggests, therefore, that its function in the eye may be not that of a redox catalyst but that it may take part in the visual processes by means of its photochemical properties[11,12], as fluorescence and light sensitivity.

E. ADLER.
H. v. EULER.

Biochemical Institute,
University, Stockholm.
March 28.

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* We are indebted to Prof. P. Karrer for the lactoflavin phosphate used in this experiment.

[1] Euler and Adler, *Svenska Vetenskapsakad Arkiv f Kemi*, **11**, B, No. 21 (1933).

[2] Euler and Adler, *Z. physiol. Chem.*, **223**, 105 (1934).

[3] Euler and Adler, *Z. physiol. Chem.*, **228**, 1 (1934)

[4] Euler, Hellstrom and Adler, *Z. vergl Physiol.*, **21**, 739 (1935).

[5] Karrer, Euler and Schopp, *Sv. Vet. Ark. f. kemi*, **11**, B, No. 54 (1935).

[6] Euler, Adler and Schlotzer, *Z. physiol Chem*, **226**, 87 (1934).

[7] Emmerie, NATURE, **141**, 416 (1938)

[8] Greene and Black, *J. Amer. Chem. Soc.*, **59**, 1820 (1937).

[9] Kuhn and Rudy, *Ber. deutsch chem. Ges.*, **69**, 2557 (1936).

[10] Theorell, *Biochem. Z.*, **275**, 344 (1935).

[11] Theorell, *Biochem. Z.*, **279**, 186 (1935).

[12] Zewi, *Finska Läkaresällsk. Handl.*, **80**, 923 (1937).

Spore Formation in a *Vibrio*

WHILST nitrate reduction is a property common to a large group of bacteria belonging to very divergent genera (*Micrococcus, Pseudomonas, Bacillus*, etc.), all investigators who have thoroughly studied the important natural process of sulphate reduction agree that the causal organism is in all cases the strictly anaerobic typically vibrio-shaped bacterium first described by Beijerinck in 1895[1]. It is true that the strains isolated sometimes show slight mutual differences which have led to the creation of one or two separate species or varieties, but this circumstance does not detract from the remarkable fact that these strictly anaerobic representatives of a genus which until now has generally been considered to be non-spore-forming (apart from a few quite equivocal cases in the older literature) are almost universally distributed in Nature.

Seen in this light, it seems worth reporting that during investigations carried out in the last six months, decisive proof has been obtained that spore formation occurs in *Vibrio desulfuricans*. This fact has first been ascertained for pure cultures of the thermophilic variety earlier described by Elion and by Baars. It was then found that soil, canal and ditch mud, and sewage after having been heated for 30 minutes in boiling water, readily yielded active cultures of sulphate-reducing vibrios, when inoculated into the usual lactate enrichment medium both at 55° C. and at 30° C. In these cultures various morphological variations occur leading ultimately to the formation of spindle-shaped or slightly bent cells with sub-terminal, highly refractive spores about $1{\cdot}7 \times 1{\cdot}3\mu$ in size. Subcultures could be obtained by transferring these original cultures after they had been heated in boiling water for an hour. Cells in these cultures were the typical actively motile vibrios and spirals. Pure cultures obtained by repeated plating continue to produce spores when grown in various media in the temperature region between 45°–55° C. However, continued cultivation in the lactate medium at temperatures below 40° C. makes the cultures rapidly asporogenous, and this circumstance may well be responsible for the fact that spore formation in this species has been entirely overlooked until now, even by such a highly competent bacteriologist as Beijerinck.

The new generic name *Sporovibrio* is proposed for the sporulating, anaerobic, Gram-negative, curved bacteria of this type.

The circumstance that under certain conditions cultures of *Vibrio desulfuricans* show a perfect and very regular spirillum-shape—hence the name of *Spirillum desulfuricans* as originally proposed by Beijerinck—makes it seem worth while to carry out renewed investigations regarding the spore-forming ability of other representatives of both the genera *Spirillum* and *Vibrio* (*Vibrio choleræ* !).

R. L. STARKEY.

Laboratorium voor Microbiologie,
Technische Hoogeschool,
Delft. March 28.

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[1] Beijerinck, M. W., *Centr Bakt.* (ii), 1, 1–9, 49–59, 104–114 (1895). For a review of later publications the reader is referred to J. K. Baars, "Over sulfaatreductie door bacteriën" (Delft, 1930); see also H. J Bunker, "A Review of the Physiology and Biochemistry of the Sulphur Bacteria" (London, 1936)

Ounce Molecular Weight of a Gas

IT does not appear to be generally recognized that an 'ounce molecular weight' of a gas will fill 22·4 cubic feet under a pressure of one atmosphere and at 0° C. This relationship is very useful as a starting point in many calculations of gas quantities in English units, and it might well be inserted in text-books of physics and chemistry at the same time as the more conventional statement involving gram-molecular and litre units is presented.

The existence of this relation must have been noted by various workers, but it has undoubtedly not received the prominence and general use which it deserves. Since noting it myself independently in 1920, I have always found that its existence and use have been regarded as surprising and novel by any to whom I have mentioned it, until recently when I have been informed that the relation has in fact received text-book publication and indeed appears in the form of a problem set on p. 999 of Partington's "Textbook of Inorganic Chemistry".

It is additionally interesting to observe that the volume of an 'ounce molecular weight' of gas under N.T.P. conditions may conveniently be visualized, within an accuracy of one half per cent, as the volume of a carpet of gas 15 feet square and one tenth of a foot thick: the weight of this quantity of oxygen is two pounds.

H. D. H. DRANE.

4, Brooklands House,
Brooklands Park,
London, S.E.3.
March 30.

Salaries in Soviet Universities

IN estimating the income and standard of life of Russian professors, Dr. L. H. Callendar, in NATURE of February 12, has been influenced by the two misconceptions most frequently held by foreign visitors to the U.S.S.R. One is an undue pessimism in gauging the true value of the rouble, due to the fact that a foreigner always comes up against the most expensive items in the Soviet citizen's budget; and the other is the fact that if a professor earns 1,200 roubles a month, his wife will most certainly be earning at least half that sum. As I have just returned from more than five years' residence in the U.S.S.R., I can guarantee the authenticity of the following figures, which enable a comparison to be made of the standards of life in the two countries. The distribution of items is, of course, more or less arbitrary.

The average income of a Soviet professor is greater than Dr. Callendar states. Those whom I knew were all earning at least 1,500 roubles a month, but I shall assume an income of 1,200 roubles and a wife's income of 600 roubles, and shall compare the expenditure of a Russian family, consisting of husband, wife and two children, earning 1,800 roubles a month with that of an English professor's family with a salary of £100 a month or £1,200 a year. The official equivalent of 1,800 roubles is £70. To facilitate the comparison, I assume that both families live in flats.

U.S.S.R. (Kharkov, Ukraine)	per month roubles
rent and services	120
(3-room flat with bath, kitchen and telephone)	
central heating	20
(yearly average)	
taxes and health insurance	50
4 per cent State loan ..	150
clothing	250
laundry	50
food and household ..	700
cigarettes	100
1 servant	60
sundries	300
	1,800

England (London)	per month £	per ann £
rent and rates ..	15	180
(5-room flat with bath and kitchen)		
coal, light, telephone	4	48
income tax	12	144
life insurance ..	5	60
(5 per cent of income)		
clothing	8	96
laundry ..	1	12
food and household .	24	288
tobacco and cigarettes	2	24
2 servants	8	96
education	7	84
doctor and dentist ..	2	24
sundries (car, etc) .	12	144
	£100	£1200

Education and medical service are free to all in the U.S.S.R. The clinics are served by the best specialists, and I have not found them overcrowded; for example, I have never had to wait more than 15 minutes at the dentist's, even if I came without an appointment. Moreover, urban transport, which is very expensive in England, costs practically nothing in Russia. In most cases a professor has a car at his disposal.

The monthly consumption of food, comprised in the 700 roubles mentioned in the list, includes the following:

Milk	50 pt.	Bread	40 lb.
Butter	20 lb.	Potatoes	100 lb.
Eggs	150	Vegetables	100 lb.
Meat	20 lb.	Fruit	50 lb.
Fish	20 lb.		

The items here listed cost 500 roubles in 1937 and refer to goods of the best quality, which are well up to English standards. The prices are falling steadily.

Cheap clothes are of poor material and good clothing is expensive. Scientific men and their families usually prefer a small assortment of good quality. Dress suits are not worn except by waiters.

Holidays are usually spent in the Caucasus or on the Black Sea coast, which are equivalent to Switzerland and the Mediterranean.

M. RUHEMANN.

30, Clifton Gardens, W.9.

A Binocular Illusion

IF an observer views a piece of linoleum, or pavement, marked out as a checkerboard in light and dark squares, it is possible by causing the lines of vision of the two eyes to converge, that is, locating the fixation point, above the linoleum, to produce the impression that the pattern is raised above the level of the floor, and that it is on a smaller scale than that of the actual linoleum. This occurs when the images of two neighbouring dark squares fall on the corresponding points of the two retinas. A still smaller pattern at a still higher level may be produced when the images of two dark squares, separated actually by two light and one dark square, are caused by suitable convergence to fall on corresponding points of the two retinas.

This illusion is probably known to many, but I can find no description of it in any general or ophthalmic physiology I have been able to consult; and it may be of interest that the phenomenon was brought to my notice by a boy aged nine years. He had discovered it quite independently for himself.

The raised patterns thus produced are seen to shift as the observer moves his head, as may be easily confirmed geometrically.

HENRY H. DIXON.

School of Botany,
Trinity College,
Dublin.
March 22.

Some Observations on the Rotating Pendulum

THE observations by Lythgoe[1] on the 'rotating pendulum' are almost entirely in accord with the hypothesis that the 'latent period' of vision varies in the same sense as the concentration of photochemical substance in the retina of the eye, and is controlled mainly, if not entirely, by this concentration. The concentration of photochemical substance is decreased (*a*) by a general increase in illumination of the field of view; (*b*) by the contemporaneous presence of one or more glare sources in the field of view; (*c*) by the previous presence of glare sources in the field of view. In case (*c*), of course, the concentration of photochemical substance is steadily returning to its equilibrium value in the absence of glare sources.

Lythgoe has found a relative decrease in the latent period when any one of these three conditions is applied to one eye of a subject. The case of dark adaptation of one eye does not appear to fall into line with this hypothesis, though more exhaustive experimental work might clear away the discrepancy.

If the above hypothesis is true, the observations of Lythgoe are of considerable interest, as they would provide a simple and instantaneous measure of the concentration of photochemical substance in the retina of the eye.

B. H. CRAWFORD.

National Physical Laboratory,
Teddington.
March 31.

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[1] Lythgoe, R. J , NATURE, 141, 474 (1938).

Clay in a Vegetable Diet

MESSRS. Lawson and Moon record in NATURE of January 1 (p. 40) the eating of clay by Quetchua Indians from Lake Titicaca, South America. A similar clay is eaten by the Baganda, who are also vegetable eaters, their staple food being plantains and sweet potatoes. The use of the clay appears in this case to be confined to pregnant women and is eaten after work almost as a sweetmeat, the clay having first been smoked in the hut fire.

G. AP GRIFFITH.

Kampala,
Uganda Protectorate.
Feb. 22.

Points from Foregoing Letters

COMMENTING on the proposed Society for the study of the Social Relations of Science, Prof. F. Soddy stresses the need of paying attention to the working of the monetary system and for strong leadership on the part of scientific workers.

Using new methods of applying constant lateral pressure to monomolecular surface films, Dr. J. H. Schulman, E. Stenhagen and Prof. E. K. Rideal have studied the formation of complex films by injecting dilute solutions of substances such as cetyl sulphate and digitonin into the substrate (water solution) upon which a film of cholesterol is spread. They find that the increased area of the film due to penetration of the second substance is, under controlled conditions, in a simple ratio (1 : 1, 1 : 2 and 1 : 3), depending upon the structure (ring or chain) of the organic molecules involved. Several factors apart from surface pressure, namely, bulk concentration and pH, affect the formation and stability of the complex surface film.

The ratio of the initial intensities of the two (presumably) isomeric radioactive forms of rhodium, with periods of 44 and 244 seconds, obtained by bombardment of rhodium with neutrons, are deduced by Dr. B. Pontecorvo from the total activity: (*a*) with a source of radon plus beryllium in the presence of paraffin, and (*b*) with radon plus beryllium placed on the axis of the cylinder of rhodium in the absence of paraffin. In the first case the ratio was eleven, agreeing with that found by Segrè. In the second case (where the mean energy of the neutrons was less than 10^5 e.v.) the ratio found was six.

The generalization that mesomeric systems may be readily formed from others closely related to them throws light, according to Prof. J. Kenner, on many organic reactions such as the formation of azoxybenzene, transition from methyl diazohydroxide to diazomethane, the facile oxidation of nitroso-benzene to nitrobenzene, the formation of unsaturated systems such as stilbene from dibenzyl, the various syntheses of polyenes, etc.

When oxygen is bombarded with deuterons (of 2 M.e.v. energy) two radioactive substances are produced, one with a period of 90 seconds which has been identified as due to fluorine of mass 17 and another with a period of 120 minutes. Chemical separation shows this to be due to an isotope of fluorine of mass 18, according to T. Yasaki and S. Watanabe. The upper limit of the energy of the positrons which it emits is 0·7 M.e.v., and the authors discuss the possible nuclear reactions by which it may be formed.

Photographs of twilight spectra and interference pictures of the twilight yellow radiation are submitted by R. Bernard to prove the presence of sodium in the high atmosphere. The *D*-lines of sodium can also be detected in the night sky spectrum.

The electrical potential difference obtained when two aqueous salt solutions of different concentrations are separated by a non-miscible oily solution are due, according to G. Ehrensvärd and L. Gunnar Sillén, to absorption potentials (that is, to the accumulation of oppositely charged ions on the two sides of the oil-water interface), rather than to the difference in the concentration of the ions in the bulk of the liquid. The authors submit a formula which, they state, agrees with the experimental results, and suggest that absorption potentials play a part in taste and smell sensations.

Dr. F. G. Mann and A. Litherland discuss the preparation and relationships of various amino-derivatives of pentaerythritol, including tetrasulphonamido-, bi-quaternary iodide-, and chloro-compounds.

The preparation of the enzyme uricase in a greatly purified form is reported by Dr. J. N. Davidson. The purest preparation contains 0·15–0·18 per cent iron and has a specific activity, under stated conditions, of 85 c.mm. per mgm. enzyme per minute.

E. Adler and Prof. H. v. Euler find that the lactoflavin, extracted by water from the retina and pigment layer of the eye of a codfish, is not taken up by benzyl alcohol when shaken with that solvent. They conclude that the pigment is not in the form of a phosphoric ester, serving as oxidation-reduction catalyst, but occurs in the form of free flavin, which by its fluorescent and light-sensitive properties may take part in the visual processes.

Spore formation is reported by Dr. R. L. Starkey in *Vibrio desulfuricans*, the bacterium which reduces sulphate to sulphide. The temperature of incubation seems to exert a marked effect on sporulation. This is claimed to be the first definite evidence of spore-formation by bacteria of the morphological group to which this and also the cholera organism belong.

Research Items

Clactonian Implements

On the basis of excavations at Jaywick Sands, Essex, in 1934 Mr. Kenneth P. Oakley and Mrs. Mary Leakey have discussed in detail the position of the Clactonian industry with special reference to the fauna and geological evidence of the Clactonian channel (*Proc. Prehist. Soc.*, 1937, **3**, 2). The deposits of the foreshore exposure of Pleistocene deposits at Clacton and Lion's Point were made famous through the investigations of Mr. Hazzledine Warren, and the gravels in the Clacton channel have yielded a contemporary palæolithic flake industry, which was recognized by the Abbé Breuil as identical in style with that of the gravels of the Middle Pleistocene of Mesvin, Belgium. To this the name of Clactonian has been given, and the style has since been recognized in many localities both in Britain and on the Continent. It is a widespread culture, possibly of Asiatic origin, and probably ancestral to Mousterian. The industry of the type station, Clacton-on-Sea, represents neither the earliest nor the latest stage, and it is important to establish its exact position in the Lower Palæolithic sequence. This involves an exact correlation with the terrace succession of the Lower Thames Valley. Warren has claimed that the Clacton deposits belong to the earlier part of the Taplow Terrace group, whereas Breuil has correlated them with the early Boyn Hill, or 100 ft. terrace. As a result of the present investigations it is concluded, especially on the evidence of the fauna, that the Clacton channel deposits belong to the same inter-glacial period as the 100 ft. terrace of the Lower Thames. The flint industry points to the same conclusion. A comparison of the industries of the two leads to the view that the type Clactonian industry is intermediate between the Clactonian industry of the Lower Gravel and the flake industry represented in the Middle Gravels of the 100 ft. terrace at Swanscombe. As regards the geological evidence, it is clear that the low level of the Clacton channel requires special explanation, if, as the evidence suggests, they post-date the Lower Gravel but predate the Middle Gravel. The only feasible explanation is an interruption of the aggradation of the gravels of the 100 ft. terrace by a phase of rejuvenation of the river, which resulted in the cutting of a sunk-channel in the lower reaches of the valley.

Cones from the Dutch East Indies

The posthumous work of Dr. Ph. Dautzenberg on the genus *Conus* (Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL.AA.RR. le Prince et la Princesse Léopold de Belgique. Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Hors Série, Vol. 2, Fascicule 18. Gastéropodes marins. 3—Family Conidae, 1937) was completed by Dr. E. Leloup and is now issued in a very handsome volume, a companion to the former work on the families Terebridæ and Mitridæ of this same series. There is an enormous amount of work involved here, with pages of carefully noted synonymy and criticisms, and some beautiful coloured plates. In 1937, Mr. J. R. le B. Tomlin published his catalogue of recent and fossil cones (*Proc. Malacol. Soc.*, 27; 1937) and there is not one species of those from the Dutch East Indies not included in this list, there being no new species. The genus *Conus* is so well known to conchologists that this is not at all surprising. The two authors are not always in complete agreement as to the authority for the species, although in most cases these coincide.

Phyllirhoidæ of the John Murray Expedition

These are described by H. G. Stubbings (John Murray Expedition 1933–34. Scientific Reports, 5, No. 1; 1937. British Museum (Natural History)). The family is represented by five specimens belonging to a new species of *Cephalopyge*, namely, *Cephalopyge arabica*. It is interesting in that it incorporates characters hitherto regarded as diagnostic of one or other of the two subgenera of *Cephalopyge* recognized by Thiele (1931). A detailed description of this new species is given and also a systematic revision of the genus. The family Phyllirhoidæ is divided by the author into two genera, *Phyllirhoë* and *Cephalopyge*, and a key is given to the species of the latter genus, of which there are four now recognized, two of which possess a radula and two, including *C. arabica*, are without it. Their distribution is almost world-wide in tropical and subtropical waters. They are all very small and all the records for which the time of year is known lie within the period autumn to winter in both northern and southern hemispheres. Mr. Stubbings suggests that it is probable that the species become adult, when they are a size most likely to be captured, during the autumn, and live through the winter. "The next generation would then be undergoing its larval development during the following summer when food conditions would be at their best." The specimens of *C. arabica* are from localities near the equator where there is no winter as such. They were obtained, however, during the period of the north-east monsoon, which is the coldest period of the year in the Arabian Sea.

Origin of Octoploid Wheat

The origin of an octoploid wheat has been described by Dr. G. S. Bhatia (*J. Genetics*, 35, No. 3). Reciprocal crosses were made between *Triticum vulgare* var. *graecum* and a new variety of *T. dicoccum* (Khapli emmer) from the Central Provinces of India, which is described under the name var. *Indicum*. It differs from other Indian varieties in having pubescent glumes and three awns per spikelet. The writer concludes that emmer wheats originated not in Abyssinia but in the Eastern Mediterranean region between Caucasus and Palestine. Khapli × *vulgare* gave 60 per cent setting of grain while the reciprocal gave only 40 per cent, the latter seeds being also much smaller. From 30 seeds of Khapli × *vulgare* only one germinated and it soon died. Three seeds from *vulgare* × Khapli were much larger than the rest and were sown separately. One of them germinated to produce the sturdy octoploid. The remainder produced 11 pale seedlings, all of which died within two months. The octoploid with 56 chromosomes probably came from a diploid egg of *vulgare* uniting with a haploid male cell from *T. dicoccum*. This plant resembles the Khapli parent in habit and grain colour, but in the shape of the glumes, ears and awns it resembled the *vulgare* parent. The plant showed regular meiosis with 28 bivalent chromosomes and produced good seeds.

Lintless Mutations in Cotton

A LINTLESS condition occasionally arises as a mutation in cotton. Seven types of lintless Asiatic cottons are described by Messrs. J. B. Hutchinson and P. D. Gadkari (*J. Genetics*, 35, No. 2), originating in strains of *Gossypium Mollisoni* (*G. arboreum* var. *neglectum*), in different parts of India. It is shown that at least four independent genes are involved, two of which are complementary genes for glabrous lintless, in which the plants produce no hairs of any kind, and two complementary for hairy lintless. Three represent independent mutations at the same locus. No satisfactory evidence of linkage was found, but there was strong association of another kind between a lintless gene, in the Punjab type, and leaf shape. In one lintless type the plants have almost full strength when grown in the mild climate of Trinidad, but in Central India they are semi-lethal. The Punjab lintless type has in eight generations undergone a remarkable change in the homozygote from complete lethality to complete viability. How this change took place is not clear, but its relation to theories of change of dominance is discussed.

The Apple Scab Fungus

THE fungus *Venturia inaequalis* is the cause of one of the major diseases of the apple crop. Two main sources of infection have been recognized, namely, pustules of conidia upon year-old wood, and ascospores from perithecia upon dead leaves of the previous season. Mr. R. McKay now shows (*Sci. Proc. Roy. Dub. Soc.*, 21, No. 57, 623; 1938) that a third source of infection in orchards at Glasnevin, Dublin, lies in bud scales which harbour the fungus. These provide a virulent source of conidia very early in the spring, when the young leaves first appear. It is possible that such a method of overwintering might explain many puzzling outbreaks of the disease in other regions. Attention of growers is directed to the control of bud infection by spraying with Bordeaux mixture or lime-sulphur. This is the usual method, but it should now be possible to apply it with more insight, and assess its action more exactly.

Secondary Causes of Earthquakes

Two papers have recently been published on the secondary causes of earthquakes. One, by V. Conrad (Union Geod. Geoph. Intern., Publ., Ser. A, fasc., No. 15, 118–123; 1937), deals with the effects of variations in atmospheric pressure. On a map of the epicentres of earthquakes in Hungary during the years 1919–28, plus signs are inserted at the epicentres when the pressure was rising during one or two days before the earthquakes and minus signs when the pressure was falling. The distribution of the signs in zones shows that the activity of the foci is affected by changes in atmospheric pressure. On the other hand, the earthquakes of the Menstrie and Invergarry districts in Scotland show no such effects (see NATURE of January 22, p. 167, for a note on similar zones in New Zealand). In the second paper (*Bull. Seis. Soc. Amer.*, 28, 15–22; 1938), R. Z. Kirkpatrick has examined the effects of tidal variations on the occurrence of 105 earthquakes recorded at Balboa, at the Pacific entrance of the Panama Canal. He finds that 30 earthquakes occurred within 1½ hours of low tide and 27 within 1½ hours of high tide. The average high tide for the year at Balboa is + 10·7 ft. and the average low tide − 10·5 ft.

Blue Solutions of Cobalt Chloride

MANY investigations have been carried out with the view of explaining the blue colour encountered with solutions of cobalt chloride under certain conditions. It has been suggested that the ion $CoCl_4^{--}$ is formed; also, that the colour is due to a different state of hydration of the cobalt ion. A recent paper by Pearce and Dawson (*J. Chem. Phys.*, 6, 128; 1938) contains a new explanation based on observations of the effects of adding different concentrations of hydrochloric acid, alkali and alkaline earth chlorides on the absorption spectrum of cobalt chloride. It has been found that the characteristic band is widened by the added salt, and that the extent of widening depends directly on the ionic charge and inversely on the ionic volume of the added cation. This increased absorption of light and consequent colour change is found to bear an intimate relation to the degree of hydration of the added cation. Equimolal concentrations of added chlorides do not produce equivalent colour changes, indicating that the formation of complex ions of the type, $CoCl_4^{--}$, is apparently not an adequate explanation. In dilute solutions the cobalt ion is strongly hydrated and the sheath of solvent surrounding it prevents it from approaching closely to the chloride ions. When strongly hydrating ions are added, they attract solvent molecules and thus render it easier for the cobalt and chloride ions to approach under the influence of electrostatic attraction. Under these conditions it is assumed that the chloride ions exert a distortion on the electronic system of the cobalt ion, causing it to absorb at a different wave-length, that is, to exhibit a different colour.

Lantern Adaptor for Film Strips

IN recent years, optical lanterns and their accessory parts have undergone a number of improvements. A new device which has been submitted to us is Dance's Patent Adaptor, by means of which film strips can be projected by any lantern or epidiascope as simply as glass slides. Film strips have many advantages over glass lantern slides: copies are much cheaper, there is no fear of breakage, storage room is negligible and as many as sixty pictures may be sent through the post for 2d. As the size of the picture has been laid down by the British Standards Institution, use of the film strip instead of the glass slide is likely to increase. With the adaptor referred to are supplied seven glass slides, each capable of holding four frames or pictures of the film strip. By this means the teacher or lecturer is not held to the order of the pictures comprising the complete strip but can select his own pictures, either from one film strip or a number of strips, in exactly the same way as he now selects his lantern slides from a number of sets. There are usually from twenty-four to thirty pictures on a strip, and these can, of course, be projected in the order in which they occur on the strip instead of cutting them up into sets of four. The whole adaptor, together with the glass slides, is packed in a box 7 in. × 5 in. × 2 in. in size. Particulars of the device can be obtained from Messrs. Pelly and Healey Ltd., 61/63 Blandford Street, W.1.

Precision Gauge for Measuring Liquid in Tanks

THIS gauge has been designed by Messrs. Negretti and Zambra in conjunction with the Production Department of the Iraq Petroleum Company for the measurement of bulk quantities of crude petroleum, or products derived therefrom, when contained in storage tanks of uniform cross-sectional area. It consists essentially of a manometer in which a mercury column is used to measure the equivalent weight of the head of oil. The gauge is rigidly mounted and two spirit levels are provided for levelling purposes. Other features include special illumination to obtain sharp definition of the mercury meniscus, vernier and scale for accurate measurement of the length of the mercury column, and thermometer for determining the temperature of the gauge. Each instrument is calibrated by the National Physical Laboratory. In addition, tables are supplied for correcting gauge readings to a standard temperature and for the conversion to equivalent weights of oil. All measurements are made from a fixed datum level and an overall accuracy within 0·005 inch is guaranteed. The range of the gauge is from 0 to 36 inches of mercury. The instrument facilitates measurement of oil in bulk and should find a wide application in the petroleum industry.

Pipe Thermostat

A PIPE thermostat has been designed by Messrs. Negretti and Zambra, which is intended for use where it is desired to operate certain mechanism whenever the temperature of the fluid in the pipe rises or falls outside predetermined limits. It is robustly constructed and is clamped to the outside of the pipe. Models are available to suit pipes from $\frac{1}{2}$ to 6 inches in diameter with one of three temperature ranges: 0–100° F., 100–200° F. or 200–300° F. The minimum differential is $\pm 2\frac{1}{2}$° F. of the setting point.

Higher Magnetic Permeabilities

THE magnetic permeability of a substance is the ratio of the magnetic flux density through the substance to that through air for the same magnetizing force. In the *Bell Laboratories Record* of March, R. M. Bozorth tells how a substance has been found experimentally which has ten times the permeability of the best commercial permalloys available. Since the discovery, more than twenty years ago, that certain alloys of iron and nickel have remarkable magnetic properties, the factors which control this unusual behaviour have been very carefully studied with the object of still further increasing the permeability. The material found was a single crystal of permalloy which contained 66 per cent nickel. This was purified by heat treatment at a high temperature in hydrogen, then cut so that its permeability could be measured. It was heat-treated again and afterwards at a relatively low temperature in a magnetic field. After this preparation, the permeability of this crystal was 1,330,000 for a definite magnetizing force. Although at present it seems improbable that commercial use will be made of single permalloy crystals, some of the factors which make for high permeability, such as crystal orientation, heat-treatment and chemical composition are commonly used in manufacturing magnetic materials. Recently some factories have begun to roll transformer sheet so that the crystallographic directions are aligned in desired directions of easiest magnetization with respect to the dimensions of the sheet. There is a distinct possibility that heat-treatment in hydrogen at a high temperature and in a magnetic field at a relatively low temperature will in the future be of value commercially.

Radioactive Constants of Uranium and Radium

IN a short paper (*Anz. Akad. Wiss. Wien*, No. 3, 7; 1938), S. Meyer discusses the mutual consistency of recent determinations of the radioactive constants of uranium and radium. The sources used in such determinations are calibrated by comparison with one of the international radium standards. In 1934, the standards at Vienna and Paris were replaced by new ones prepared by Hönigschmid, who also prepared standards for other national laboratories. Intercomparison of the old and new standards has not revealed any significant difference between them; some of the new standards are a few parts in a thousand larger than the old ones, while others are smaller by the same amount. It is suggested that measurements be referred to the old Vienna and Paris standards, which appear to have exactly the same value. In terms of these standards, the number of particles emitted per second by one gram of radium is $3\cdot68 \times 10^{10}$. Owing in part to errors of calibration of the sources, the accuracy of this measurement is not more than 0·5 per cent. Measurements of the corresponding quantity have been made in the case of uranium by Schiedt and by Kovarik and Adams. In order to relate these to the constant for radium, they have to be corrected for the α-particles emitted by U II and by actino-uranium. It is shown that, while Schiedt's corrected value is consistent with the radium : uranium ratio found in old minerals, Kovarik and Adam's value is too low. These considerations suggest that the most probable values of the constants for U I and Ra are: half value period: U I, $4\cdot58 \times 10^{9}$ years; Ra, $1\cdot59 \times 10^{3}$ years; number of α-particles emitted per gm. per sec.: U I, $1\cdot214 \times 10^{4}$; Ra, $3\cdot68 \times 10^{10}$; Ra/U equilibrium ratio $= 3\cdot3 \times 10^{-7}$.

Inclinations to Line of Sight of Non-Galactic Nebulæ

MR. F. G. BROWN has recently published a paper with this title (*Mon. Not. Roy. Astro. Soc.*, 98, 3; Jan. 1938), his study being based primarily on the catalogue of the Herschel nebulæ north of declination $-20°$, measured at Heidelberg on plates taken with the Bruce 40-cm. portrait lens and the 70-cm. reflector. All non-galactic nebulæ of 2′ diameter and greater have been extracted and classified from this catalogue, a total of 593, and these reveal an apparent large excess of small inclinations to the line of sight. In addition, 109 other nebulæ within the area covered by the catalogue down to the limiting diameter reveal the same characteristic. Although E. Öpik suggested some fifteen years ago that photographic selection is responsible for the excess of small inclinations, Mr. Brown shows fairly conclusively that this is not so, and that there is probably a real systematic orientation of the planes of the nebulæ in space.

The Rivers of India

THE material welfare of the people of India has always been in unusual measure dependent upon the amount of water available for agricultural operations at the right season. This fact chiefly led Prof. M. N. Saha to devote his recent presidential address to the National Institute of Sciences in India to "The Problem of Indian Rivers", for, as he points out, 66 per cent of the population are peasants and a further 23 per cent are villagers mainly dependent on a rural economy. While the normal rainfall suffices in parts of India to nourish the prevailing agriculture, the fact remains that this must be supplemented wherever possible by storage in 'tanks', as in most of the Deccan, by utilization of subsoil water from wells, and by the great canal systems providing irrigation water from the large rivers of the Indo-Gangetic Plain and the eastern coastal plain. The distribution of population density, therefore, may be very closely correlated with those of rainfall and irrigable land. Prof. Saha cites the estimate that of the total rainfall 60 per cent is evaporated, and of the 40 per cent which passes to the ocean only 6–8 is used for irrigation. He pays tribute to the long-sustained interest of the Government in irrigation as leading to the huge total investment of 150 crores (more than 113 millions sterling) in new works and in repairs to old works; but he quotes the Central Irrigation Board's report that, of the 30 million acres irrigated from artificial canals, 8 million, lying chiefly in Bengal, Bihar and Orissa, are 'unproductive', that is, produce no profit for the irrigation authority.

The lateral movements of river beds on alluvial plains is of course recognized as a gradual process incessantly at work, and the same is true of the downstream migration of meanders. Nevertheless, there are reasons for believing that in northern India deep-seated crustal movements account for some of the more spectacular hydrographic changes. Prof. Saha gives examples of the effects of river change in this region. Pataliputra, the capital city of India from the sixth century B.C. until the fifth century A.D., owing its importance to its position at a focus of communications along five rivers, now lies buried 17 ft. beneath the modern Patna. Gaur, 160 miles north of Calcutta, which as Pataliputra's successor was estimated to have contained more than two million people in the fifteenth century, is now smothered in jungle. The suggestion is made that its evacuation was due to sinking, slight but sufficient to render it unhealthy. Moreover, such subsidence relative to surrounding deltaic land seems to merit investigation, since it is reported from Calcutta, where the level is said to have declined from 2 ft. to 4 ft. in the last two centuries, and this has called for pumping to assure the discharge of sewage. Finally, the well-known disastrous effects of river changes of the Ganges-Brahamaputra delta are cited, by which the eastward migration of live rivers has left the western areas seamed with channels intermittently filled, and so with abundant stagnant pools leading to malaria and decadence of the region. How far this natural process could have been prevented is uncertain; but it is claimed that in one section at least, the Burdwan division, which lost nearly half its population from malaria between 1860 and 1870, the harm was due to an artificial cause, the building of the railway embankment without proper study of the consequences to the hydrology.

In stating that construction of weirs and bridges has too often been undertaken after insufficient and too localized study of the rivers, Prof. Saha quotes Sir Francis Spring in his plea in "River Training and Control", that the State ought "by consistent, logical and well-organized research to learn something more definite than is now known about the physics of long reaches of rivers". This in the nineteenth century; only within the last decade has effect been given to the suggestion and so far only by two provinces. The Punjab has its Irrigation Research Institute at Lahore, and Bombay has installed a hydrodynamic research station near Poona. No such laboratory exists as yet in the eastern provinces, where the need for hydrological research would seem to be greatest.

Prof. Saha concludes his address with a striking vision of India regenerated, socially and economically, by a process of industrialization analogous to that now under way in the U.S.S.R. In reviewing the present backwardness of Indian labour conditions he attempts an assessment of energy expended, and finds the amount per head per year to be less than 90 of the units adopted (man-power 60, animal 10, steam and oil 10, electricity 7). This he contrasts with Japan, 6–8 times greater, and Norway, nearly 19 times greater. He notes the vast increase in Russian output of electricity from 15 units per head in 1919 to about 300 in 1937, with a corresponding increase in the proportion of industrial population; and he considers that this points the way for India. He then discusses the very high average cost of the half-million kilowatts of electric energy already installed in India, which represent only about 2·5 per cent of the hydro-electric resources, if Meares' estimate be accepted, and he cites cases of installations unduly costly owing to inadequate study. The time is therefore ripe, he submits, for a systematic survey of water-power resources following the Russian plan of attack, for he holds that cheap power will go far to eliminate the root cause of poverty in India. It may be noted, however, that he here leaves many sides of the population problem untouched.

Nevertheless, Prof. Saha has directed attention to certain facts that appear to be insufficiently appreciated: that rivers possess strong individuality in the character of their basins and in their regimens; that the proper unit of study is the entire catchment area; that the uses which they offer to man—power, transport, supply for irrigation and industry—as well as the menaces of flooding and silting, are all closely interrelated; and finally, that the dependence of the Indian people upon the rivers is so tremendous that the whole subject merits thorough investigation. In conclusion, it may be noted that the question of soil fertility is intimately bound up with those which he discusses. Systematic observation would appear to be requisite throughout each basin upon such matters as soil erosion on one hand and silting on the other, as well as on the variations in the depth of the water table and their bearing upon alkaline and other incrustations.

Soil Toxicity in the Dorset Heaths

A MEETING of the British Ecological Society, presided over by Prof. A. G. Tansley, was held on April 20, in the Department of Botany, Bedford College, Regent's Park, London, N.W.1. The entire meeting was given to consideration of the problems of soil toxicity and its amelioration in the Dorset heaths. The researches now in progress have come about as a result of observations and experiments initiated by Dr. M. C. Rayner in the Wareham neighbourhood in 1931 on the lands of the Forestry Commission now known as Wareham Forest.

A considerable tract of country around the town of Wareham in Dorset is occupied by heathland. Certain areas of this were acquired by the Forestry Commission and sown with several species of pine in 1924–27. These original sowings gave very poor results, the seedlings for the most part showing no growth or dying outright. In addition, there were many puzzling inconsistencies of behaviour.

The meeting was opened by an informal account by Prof. Neilson Jones of some of the characteristics, including that of apparent toxicity, associated with Wareham soil, and was followed by a general summary by Dr. Rayner of the field and laboratory researches at Wareham Forest that have led to the present situation. Some of the exhibits, relating to mycological and mycorrhizal problems arising from the field experiments, have an important bearing on the nutrition and healthy growth of conifers in cultivation, for example, those on Sitka spruce and Lawson's cypress.

The accounts of the work were supplemented by a large number of well-displayed demonstrations illustrating various phases of the research work in progress. Among these were demonstrations of the inhibition of seedling and fungal growth by soil factors, growth effects produced by the addition of raw cellulose to soils, epinastic curvature reactions induced by soil constituents, the incidence of 'fused needle' disease, and the effects on seedling growth produced by soil inoculation with humus or mycelium from pure cultures.

Also illustrated were the remarkable effects on growth brought about by the use of certain organic composts on Wareham soil, with some of the evidence supporting the hypothesis that led to their use and now put forward to interpret their action. Pure cultures of a number of mycorrhizal and associated soil fungi were displayed.

A general discussion followed inspection of the demonstrations, in which a number of visitors and members of the Society took part.

In his concluding remarks, Prof. Tansley pointed out that a meeting such as that just held, in which the Society visited an institution to hear about the research work in progress there, was an innovation; the results of the experiment led him to hope that other meetings of the kind would be arranged in the near future.

Faunistic and Hydrographic Changes

By B. Storrow, Dove Marine Laboratory, Cullercoats, Northumberland

THE following faunistic records are of interest in connexion with recent hydrographic changes as described in the reports of the International Council for the Exploration of the Sea. Abnormal activity of Atlantic waters around the north of Scotland will bring oceanic and western species into the northern North Sea. When this activity is followed by a southerly extension of the influence of the Norwegian sea the recent additions to the fauna can be expected to retreat to the Atlantic or to move southwards before the influence of the colder waters. In this southerly movement before the advance of cold conditions they will be followed by the fauna of the colder waters. Records of a mixed fauna may be found still farther south after a suitable interval. The above outlines the probable cause for the following records which have been obtained for the Northumberland coast. Unless otherwise stated, the specimens mentioned have been obtained from North Shields trawlers.

Geryon tridens Krøyer. 25–30 years ago this crab was commonly called the Fair Isle pilot by North Shields skippers, who did not find it in their trawls until reaching the vicinity of Fair Isle. To the best of our knowledge it has not been recorded for the waters off Northumberland. The first specimen was obtained April 29, 1935, 31 miles N.E. ½ N. of the Tyne, which is to the east of Coquet Island. The second specimen was found on March 10, 1936, and the trawler had been fishing 10 miles N.E. ½ N. off the Tyne. No further records were obtained until October 1937, and from then until the end of the year 49 specimens were brought to the Laboratory from trawlers fishing off our coast. Some of these crabs are living in our tanks.

Chimaera monstrosa L. As a general rule, North Shields trawlers do not get the rat-fish until reaching the latitude of Aberdeen or thereabouts, and then not frequently. One was taken 10½ miles N.N.E. of the Tyne, January 22, 1938.

Urophycis blennoides (Brunnich). The greater fork-beard has never been a local fish and its presence in the catch of a North Shields trawler was associated with fishing in more northerly waters and often in the vicinity of the Norwegian deep water. One was caught 14 miles east-north-east of the Tyne, June 15, 1936.

Pristiurus melastomus (Rafinesque). According to Smitt the black-mouthed dogfish has a wide range and has been taken occasionally off the Norwegian coast and in the Skager Rack and Cattegat. One was taken in 42 fathoms east of Coquet Island, April 30, 1937.

Centrolophus niger (Gmelin). The black-fish of Couch is considered a fish of the Mediterranean and Atlantic. Occasional stragglers have been taken off our south coast and Day refers to specimens from the Northumberland and Yorkshire coasts. One of 56 cm. was taken on Berwick Bank, October 25, 1937.

Cetorhinus maximus (Gunner). It is generally supposed that the basking shark migrates northwards along the Atlantic seaboard as far as the Norwegian coast after its appearance off the west coast of Ireland in spring. Occasionally it enters the North Sea. One, 10 ft. 11½ in. in length, was caught in salmon nets, 2 miles off Souter, on June 13, 1934.

Ctenolabrus rupestris (L.). The goldsinny is found along the Atlantic coasts of Europe from the Mediterranean to Trondheim and in the southern Baltic. It has been recorded for Northumberland and Yorkshire, but not in our time. A specimen caught on July 3, 1935, 20 miles north-north-east of the Tyne, is living in the aquarium. Another was picked up on Whitley sands, January 31, 1937.

Maurolicus muelleri (Gmelin). The pearl-side has a wide distribution. According to Smitt, it has been found on both sides of the Atlantic and from the coast of Finmark to that of Sweden. It also enters the North Sea. It is far from common off our coast. Three specimens have been picked up on the sands of Cullercoats and Whitley Bay recently in March and April; one in 1936 and two in 1937.

Science and Industry

A SERIES of lectures arranged by the London Branch of the Association of Scientific Workers on the subject of science and industry has recently come to its conclusion. These lectures were arranged by the Association with the object of directing attention to the application of scientific methods and developments in industry, and the possibility of increased application; the allied question of the organization of research; and the question of the best types of scientific education to fit men for technical positions in industry.

The first lecture was given by Sir Richard Gregory. He opened with an enumeration of some of the outstanding benefits that science has conferred on society, and showed how the developments of industry have depended upon the developments of creative science. The extent, however, to which scientific discovery is used for industrial progress depends upon the capacity of industry to understand the results of research and the power to use them. The general principle that expenditure on science is a profitable investment may be said to have been conceded, but as yet science is not used as fully as it may be. Forty years ago the expenditure of the British Government on scientific investigation was about £45,000; at the present time the total amount is nearly two millions, of which the Department of Scientific and Industrial Research administers about £600,000. Sir Richard quoted a memorandum presented by the Parliamentary Science Committee, and supported its argument that the provision for scientific and industrial research in Great Britain is inadequate and that a bolder and broader financial scheme is needed.

Sir Richard went on to plead for the employment of men with scientific training and knowledge as directors and administrators. Industry suffers from administrators who have not a scientific outlook and do not realize the value of long-sustained expenditure on scientific research, although he admitted that it is difficult to find men who combine specialized knowledge on scientific and technical subjects with organizing or administrative capacity.

Sir John Russell traced the application of science to agriculture from the early investigation into artificial manures carried out on the same land now occupied by the Experimental Station at Rothamsted to the present day, when such research demands the knowledge of chemists, physicists, botanists, biochemists, pathologists, etc. The development of agriculture has not been devoid of chance discoveries, particularly in the development of wheat and in the use of such things as Bordeaux mixture, devised to scare away predatory boys. There has, however, been great advances in the knowledge and control of the processes of Nature as a result of the patient detailed work that has been carried out. Besides the effect of the well-known artificial manures, it has been discovered of recent years that traces of certain inorganic salts such as the compounds of cobalt and boron have a marked effect on the plant life and the subsistent animal life.

Under the title of "Science in the Chemical Industry", Major F. A. Freeth indulged in alternate attacks on and justification of the existence of industrial scientific workers. The attacks were, however, more of the nature of constructive criticism. That the existence of men of science is justified there is no doubt; but there is doubt whether they have the right attitude to their tasks. Men of science as a body lack rhetoric—they do not know how to capture the enthusiasm of the general public.

The chemical industry itself is the only industry that takes its name from the science on which it is based. It should properly be called the 'molecular industry', for it is chiefly the scientific study of the behaviour of molecules which forms the basis on which the large industries are built. Some of the heavy chemical industries date back for decades, but the modern organic chemist owes everything to the patient hard work of investigators which is continuing all the time. Fundamental scientific theory is required for any new development in the chemical industry, but before it can be put into practice it must be translated into terms of large-scale plant and teams of men, and there is often a considerable time-lag between the adoption of a new method and its achievement in practice.

Dr. E. A. Rudge spoke on the subject of training for the chemical industry and chemical engineering; and described an investigation he had conducted to find out the requirements of a number of chemical industries by way of recruits to their scientific staffs. With the great increase in scientific control in industry there has arisen a demand for a varied army of scientific workers, ranging from routine semi-skilled testers to fully trained research specialists. By means of a questionnaire Dr. Rudge has gained information that shows the distribution of the demand for scientific workers in the different grades.

This investigation produced the following main conclusions. A large proportion of the chemical firms in the area investigated employ small laboratory personnel (less than ten employees). These small organizations commonly employ unqualified recruits, and it is in the main the larger laboratories that require graduates and research workers. A great preference is shown for recruits of about matriculation standard with a knowledge of industrial method and technique. For every graduate required for the specialized work of research development more than nine undergraduates are required for laboratory routine. The question of the training of these unqualified employees is one that requires greater co-operation between industry and teachers, especially in the technical colleges.

Dr. F. S. Sinnatt, speaking on the Fuel Research Coal Survey, said that the work of the Department of Scientific and Industrial Research can be divided into two sections: the utilization of coal, and the survey of the coalfields of Great Britain. Different types of coal are needed for use in coking, gas manufacture, steam raising, household use and hydrogenation; wide variation may occur in the composition of a seam within the area covered by one mine, with consequent changes in its suitability for these different purposes. The control of such variation is of primary importance to the consumer and must be the basis of any improvement in the utilization of coal.

As a result of the work already done, it can now be said about certain important seams in different coalfields that every major variation in the composition is known, and that it can be forecast for any spot within narrow limits.

The Waite Agricultural Research Institute, South Australia

THE Waite Agricultural Research Institute was established at Glen Osmond, near Adelaide, South Australia, in 1925, as a result of the late Mr. Peter Waite's gift to the University of Adelaide for the purpose of furthering the cause of education and research in agriculture and allied subjects. The total value of the bequest was estimated at £100,000.

The University Council decided that the principal objective of the Institute should be to enlarge the stock of knowledge relating to agriculture in the widest sense, and pass it on to those actively engaged in production, as farmers or pastoralists. Two chairs were established: one in agriculture and one in agricultural chemistry. Prof. A. E. V. Richardson was appointed Waite professor of agriculture and first director of the Waite Institute; Prof. J. A. Prescott was appointed Waite professor of agricultural chemistry. Since the commencement of active work early in 1925, the number of research workers stationed at the Institute has risen from five to forty, and the annual income from £8,000 to approximately £25,000, apart from a yearly grant by the Australian Commonwealth Council for Scientific and Industrial Research for the maintenance of its Division of Soils, which has its headquarters at the Waite Institute. After thirteen years of eminent service, Prof. Richardson has now resigned to occupy the position of Deputy Chief Executive Officer of the Council for Scientific and Industrial Research, and Prof. Prescott has been appointed director of the Waite Institute.

Prof. Richardson is a graduate of the University of Adelaide and was acting director of agriculture in South Australia in 1911. From 1911 until 1924 he was superintendent of agriculture for Victoria and visited the United States and Canada to report on agricultural research and education in 1918. From 1919 until 1924 he was director of the School of Agriculture in the University of Melbourne. Prof. Richardson visited South Africa, Europe, America, Japan and Java in 1926 and was a delegate to the Imperial Agricultural Research Conference at London in 1927. He was appointed a member of the Executive of the Australian Council for Scientific and Industrial Research in 1927, shortly after its inception in 1926, and was official agricultural adviser to the Australian delegation to the Imperial Conference at Ottawa in 1932. He was elected first president of the Australian Institute of Agricultural Science, which was established in 1935.

Prof. Prescott is a native of Lancashire and graduated in chemistry at the University of Manchester. In addition to post-graduate experience at Manchester, he worked at Rothamsted Experimental Station with Sir John Russell and at the University of Leipzig with Dr. Wolfgang Ostwald. From 1916 until 1923 he was chief chemist to the Royal Agricultural Society of Egypt and superintendent of field experiments at the Society's Experimental Farm at Bahtim. His work in Egypt concerned problems of soil fertility associated with Egyptian agriculture and the manuring, spacing and irrigation of wheat, maize and cotton.

In 1929, Prof. Prescott was appointed chief of the Division of Soils of the Council for Scientific and Industrial Research at the Waite Institute. His work in Australia has related chiefly to the classification and geographical distribution of soils, and his bulletin on the soils of Australia, published in 1931, has become a standard reference book throughout Australia. Prof. Prescott has travelled extensively in Australia and New Zealand and is familiar with agricultural and pastoral conditions in all the Australian States and the Northern Territory. He was federal president of the Australian Chemical Institute in 1936–37.

The association of Richardson and Prescott over the first thirteen years of the Waite Institute has proved of immense value to agricultural science in Australia.

Science News a Century Ago

The Royal Institution

The anniversary meeting of the Royal Institution was held on May 1, 1838, Benjamin Bond Cabbell in the chair. The report of the visitors showed that the income of the Institution for the year exceeded the expenditure by £140. An endowment of £1,000 in three per cent Consols had been made by Mrs. Acton, of Euston Square. Repairs and improvements to the buildings had cost £1,853. Courses of lectures then being given or soon after to commence were those on geology by John Phillips, F.R.S., professor of geology in King's College, London; those on vocal harmony—on the English opera—by Edward Taylor, Gresham professor of music; and others on electricity by Prof. Faraday and on botany by Prof. Lindley.

Henry's Investigations on Electrical Induction

"In 1838, after Henry's return from his first visit to Europe, he discovered an entirely new class of phenomena in electrical induction; and as the field was entirely his own he entered into this work with great enthusiasm. In these researches he extends greatly our knowledge of electrical induction. He first showed that an induced current may excite a second induced current in a neighboring closed conductor, and this last may induce a third current in another neighboring closed circuit and so on. These various induced currents Henry styled currents of the first, second, third, fourth, fifth, &c., orders. He shows that these currents alternate in their directions in the successive orders,—at least when these currents are induced by the discharge of a voltaic battery. He investigates the differences in the properties of these currents according as they flow through conductors formed of few convolutions of low resistance or through many convolutions of high resistance. . . . These researches into the nature and laws of the induced currents of different orders are the most finished of Henry's works and will ever be regarded as models of careful and thorough scientific work" (A. M. Mayer).

The first account of Henry's experiments was given by him in a letter read to the American Philosophical Society on May 4, 1838, entitled "A Letter on the production directly from ordinary Electricity of Currents by Induction, analogous to those obtained from Galvanism".

The Ornithological Society

At a meeting of the Ornithological Society held on May 5, 1838, J. R. Gowen being in the chair, the report of the Council was read. In this it was stated that the Commissioners of Her Majesty's Woods and Forests had caused some ponds and shallows to be made in the islands in St. James's Park, in compliance with a request made to them by the Council. Mr. Blyth then exhibited specimens of three wild British geese allied to the domestic breed, namely, the grey goose (*Anser cinereus*), the bean goose (*A. segetum*) and the white-fronted goose (*A. albifrons*), all of which are promiscuously sold in the markets under the general name of 'wild geese'. The first of them was stated to be the primitive stock of the domestic goose, and to have become of exceedingly rare occurrence in the British Islands, although it formerly bred plentifully in the Fens. Until very recently, no specimen of it existed, that he could learn of, in any of the London museums; but aged examples of the bean goose, that had the terminal *nail* of the beak white, were commonly ticketed with its name. During the severe weather of the preceding winter, thousands of bean geese were brought to market. Though it had never heretofore been known to breed when domesticated, it was stated that two females were then incubating upon one of the islands in St. James's Park.

Hancock's Steam Gig

Under the heading "Steaming Extraordinary" the *Mechanics' Magazine* of May 5, 1838, said: "Yesterday afternoon Mr. Walter Hancock, the enterprising steam carriage engineer, accompanied by two friends, rode from Stratford, and through the principal streets of the city in a steam gig. Mr. Hancock remained a considerable time with this novelty of science in front of the Guildhall, now and then guiding it adroitly around the open space. . . . Everyone seemed surprised at the ease with which Mr. Hancock threaded his way through the crowd of carts, omnibuses, cabs and other vehicles in Cheapside, Leadenhall Street and other crowded thoroughfares. The gig stopped opposite the bank for a few minutes, when the machinery was inspected by Mr. Oldham, the engineer who has fitted up all the printing apparatus of that establishment to be worked by steam."

University Events

Leeds.—Prof. Mouat Jones, of Manchester, has been appointed vice-chancellor, in succession to Sir James Baillie, who retires under the age limit. Prof. Jones, who was born in 1882, has been for seventeen years principal of the Manchester College of Technology, in addition to being dean of the Faculty of Technology of the University of Manchester.

London.—The following doctorates have been conferred: D.Sc. in zoology on Miss D. R. Crofts, a recognized teacher at King's College of Household and Social Science; D.Sc. (Engineering) on Mr. W. B. Pollard, an internal student, of the Imperial College—Royal School of Mines.

St. Andrews.—The Senatus Academicus of the University has resolved to confer the honorary degree of LL.D. on the following, among others: Prof. E. D. Adrian, Foulerton research professor of physiology and fellow of Trinity College, University of Cambridge; Prof. R. G. Collingwood, Waynflete professor of metaphysical philosophy and fellow of Magdalen College, University of Oxford; Dr. W. H. Fyfe, principal of the University of Aberdeen; Dr. A. D. Lindsay, master of Balliol College and vice-chancellor of the University of Oxford; Dr. R. T. McKenzie, emeritus professor of physical education in the University of Pennsylvania; Sir Gilbert Morgan, head of the Chemical Research Laboratory, Teddington; the Marquis of Willingdon, Viceroy and Governor General of India, 1931–36.

Societies and Academies

London

Royal Society (*Proc.*, A., 165, No. 921, April 5).

Harold Jeffreys: Significance tests when several degrees of freedom arise simultaneously.

P. A. M. Dirac: A new basis for cosmology.

P. M. S. Blackett and J. G. Wilson: The scattering of cosmic ray particles in metal plates.

R. J. Schmidt and O. A. Saunders: Motion of a fluid heated from below.

E. Glückauf and F. A. Paneth: Identification and measurement of helium formed in beryllium by γ-rays.

J. W. J. Fay, E. Glückauf and F. A. Paneth: Occurrence of helium in beryls.

M. H. L. Pryce: The neutrino theory of light.

W. C. Price and Miss D. M. Simpson: Absorption spectra of sulphur dioxide and carbon disulphide in the vacuum ultra-violet.

M. Born: A suggestion for unifying quantum theory and relativity.

D. A. Jackson and H. Kuhn: Hyperfine structure, Zeeman effect and isotope shift in the resonance lines of potassium.

Paris

Academy of Sciences, February 28 (*C.R.* 206, 633–704).

Gustave Choquet: The prolongation of homeomorphs.

Marcel Brelot: The extensions of *balayage*.

François Leja: Certain extremal rational functions.

Hubert Delange: Certain categories of series of polynomials.

Bernard Kwal: A generalization of the variational principle and of the canonical equations of Hamilton. Application to the relativistic theory of corpuscular assemblies.

Marcel Sédille: The development in series of the movement round an aeroplane wing placed in any field whatever.

Robert d'Adhémar: The theory of the gyroscopic movement of projectiles. The indeterminations.

Bernard Lyot: Observations of the solar corona and the prominences made at the Pic du Midi during 1937. 240 hours observations under the best conditions were available. 125 spectra and 13 direct photographs of the corona were taken, and 60 metres of kinematographic film showing the movements of the prominences. A preliminary discussion of the results is given.

Marcel Matricon: Application of the method of the self-consistent field to atomic nuclei.

J. Géhéniau: Spherical waves in the wave mechanics of the photon.

Jean Villey: A method for the measurement of the adiabatic compressibility of liquids.

René Lucas: Longitudinal waves of very high frequency in viscous fluids.

Maurice Dodero: The preparation by electrolysis at a high temperature of metallic phosphides, in particular, of the manganese phosphide MnP. Fused mixtures of manganese chloride, sodium metaphosphate and an alkaline chloride give manganese phosphide, MnP, capable of isolation in crystalline form and giving theoretical figures on analysis.

Mlle. Marguerite Quintin: The radius of the copper ion in solutions of the benzene-sulphonate.

Charles F. Squire: The diamagnetic anisotropy of an aromatic molecule.

Georges Simon and Jean Bouchard: The influence of a transversal magnetic field on the thermoelectric power of nickel and of various ferronickels submitted to traction.

Mme. Zina Soubarew-Chatelain and Alain Berton: The ultra-violet absorption spectra of the system MoO_3—NaOH in dilute solution. The conclusions previously drawn from the study of the variations in the electrical conductivity of solutions of molybdic acid during neutralization with alkali are confirmed by the study of the absorption spectra.

Paul Rumpf and Félix Trombe: A free radical of a new type. The paramagnetism of tritolylammenium perchlorate. If the ammenium cation exists in the monomeric form, it is true free radical, a compound with an odd number of electrons, and, according to G. N. Lewis, should be paramagnetic. Tritolylammenium perchlorate is now shown to be paramagnetic.

Mlle. Suzanne Thévenet: The influence of a given electrolyte on the viscosity of an arsenic sulphide sol at different stages of its evolution.

Augustin Boutaric: The application of the dilatometric method to the study of colloidal gels. The expansion of resinous products is related to the quantity of water present in the sample. Only thoroughly dried samples give an increase of length which is proportional to the rise of temperature.

Louis Meunier and Georges Vaissière: The polymerization of vinyl acetate.

Mlle. France Bloch: On thioacids. Discussing the two possible constitutions for thioacids, R.CS(OH) and R.CO(SH), the latter is regarded as in better agreement with experimental facts.

Const. Zenghelis and Mlle. Catherine Stathis: Catalytic hydrogenations by colloidal rhodium. Colloidal rhodium is a hydrogenation catalyst much more powerful than other precious metals. It reduces the carbonyl group easily at ordinary temperature and pressure. Aniline is reduced to ammonia and cyclohexane.

Henri Wahl: The synthesis of 9-methoxy-5-keto-5, 6, 7, 8-tetrahydrophenanthrene.

Jean Cuvillier: The discovery of lepidocyclines in the Oligocene of Egypt.

Georges Deflandre: The microplankton of the Jurassic seas preserved in the state of organic matter in the marls of Villers-sur-Mer.

Mlle. Madeleine Fourcroy: The mode of reduction of convergents.

Daniel Danielopolu and Ion Marcou: The action of adrenalin on the coronary vessels and the general circulation after the injection of diethylaminomethylbenzodioxan (883 F.).

René Guy Busnel: The influence of the food regime on the biochemistry and the biology of *Leptinotarsa decemlineata* in the fully developed insect. The action of *Solanum demissum* and of the hybrids of this plant.

Paul Wintrebert: The ring of mitogenetic induction of the amphibian egg and bipartite gastrulation.

Albert Berthelot and Mlle. Germaine Amoureux: The formation of 3-indol-acetic acid by the action of ultra-violet radiation on tryptophane. Indol-acetic acid is formed by the action of light of wave-length less than 2900 A. on very dilute solutions of tryptophane.

Albert Demolon and Antoine Dunez : Agronomic observations on the bacterial symbiosis of the Leguminosæ.

Brussels

Royal Academy (*Bull. Classe Sci.*, 23, No. 12 ; 1937).

E. De Wildeman : Abortion of the ovaries in some phanerogams (2).

A. Baudet : Cyclic homography of space of period five and on some birational transformations deducible from it.

Th. De Donder : Velocities of reaction. A general thermodynamical treatment based on the author's previous treatment of affinity.

V. Willem and R. Boolaert : Respiratory manœuvres of *Periophthalmus*.

M. G. E. Cosyns : Study of the specific primary ionization due to cosmic radiation. The particles constituting the soft and hard groups of cosmic rays are of different kinds, since the specific primary ionization is different for the two groups.

Th. De Donder : Affinity, velocity of reaction and power.

H. de Winiwater : Determination of sex.

Sydney

Royal Society of New South Wales (71, 1937).

J. A. Dulhunty : (1) Notes on the stratigraphy and physiography of the Talbragar fish-bed area. This area lying to the west of the Main Divide between Cassilis and Mudgee, exhibits a plateau at 1,700 feet in which mature topography was developed prior to the late tertiary basalt flows. The plateau falls to the west merging with the western plains, the head-quarters of the western rivers showing no late Tertiary rejuvenation. The Main Divide is almost imperceptible, being determined by an anticline which has up-warped the plateau surface. The area is occupied by an east-west trough which lagged behind during the Kosciusko Epoch. The stratigraphical sequence is complete from Mid-Kamilaroi to Lower Jurassic, exhibiting well-defined units. The chert of the fossil fish-beds forms an isolated mass occurring 30 feet above the base of the Jurassic. (2) Stratigraphy and physiography of the Goulburn River district. The area concerned is that drained by the Goulburn River. A plateau at 1,600 feet is dissected by mature valleys which post-date tertiary Alkaline Intrusives but pre-date late Tertiary Basalts. The streams show a general absence of epi-tertiary rejuvenation, and the Goulburn River occupies the axis of a tectonic trough which lagged behind during the Kosciusko Epoch. Contrasting valley types exemplify marked geological control of topographical development. Low anticlines, pitching to the north, form predominant structures which have produced undulations in the plateau surface. Kamilaroi strata are followed by Triassic Sandstone, which is separated from Lower Jurassic Sandstone by a well-marked horizon of clay shales.

H. G. Raggatt : Occurrence of glendonites in New South Wales, with notes on their mode of origin. Glendonites are believed to have formed under cold conditions on the floor of shallow and more or less isolated basins. Their alternation with calcareous concretions suggests alternation of cold (glauberite decomposition) and warm (calcium carbonate deposition) conditions. The occurrence of 'glendonites' and calcareous concretions in the Cretaceous offers confirmation of views reached from consideration of the Permian.

A. R. Penfold and J. L. Simonsen : Constitution of a phenol isolated from various Australian essential oils by Penfold and Morrison (*J. Proc. Roy. Soc. N.S.W.*, 56, 87 ; 1922). This substance, for which the name 'Bæckeol' is proposed, has melting point 103°–104°, and molecular formula $C_{13}H_{18}O_4$. It crystallizes in yellow prisms. Bæckeol contains two methoxy groups and one hydroxy group giving a monoacetyl derivative, m.p. 71°–72°.

A. Birch : Structure of origanene. (1) This paper describes the isolation of origanene in a state of approximate purity from commercial α-phellandrene, and the preparation of a number of characteristic derivatives. The evidence shows that the substance is distinct from any known terpene, and is probably bicyclic, with one double bond. Much of the published work on origanene is shown to be erroneous, many of the results obtained being probably due to the presence of impurities.

A. R. Penfold and F. R. Morrison : Essential oils of *Eucalyptus australiana* (Baker and Smith) and its physiological forms (2). Essential oils obtained from *Eucalpytus australiana* (Baker and Smith) growing in Victoria. The yield and chemical composition of the essential oils examined differed considerably from those obtained from New South Wales (*J. Roy. Soc. N.S.W.*, 49, 111 ; 1935). The principal constituents identified were l-α-phellandrene and piperitone 32–52 per cent and piperitol (the principal constituent of New South Wales trees is cineol 70 per cent). The yield of oil varied from 0·4 to 1·8 per cent, very much lower than that obtained from *E. australiana* in New South Wales, namely, 3 per cent.

G. D. Osborne : Some major geological faults north of Raymond Terrace and their relation to the structure of the Stroud–Gloucester Trough. The Williams River Fault and the Tarean Fault which break through the Upper Palæozoic rocks north of Raymond Terrace are shown to have interesting structural relations with the Stroud–Gloucester Trough, a remarkable, narrow basin which runs more or less meridionally from Gloucester southward towards Stockton. Evidence is given of the former being the older of the two faults and connected with an early phase of the Late Palæozoic diastrophism while the Tarean Fault is regarded as of epi-Newcastle age.

J. G. Churchward : Studies on physiological specialization of the organisms causing bunt in wheat and the genetics of resistance to this and certain other wheat diseases (1). Physiological specialization studies. Four wheat varieties which acted as differentials when inoculated with spores and grown in Australia and the United States separated out four physiological races of *Tilletia levis* and three of *T. tritici*. Biometrical analysis and studies of the shape, size and consistency of the bunt balls of the seven different races did not show any constant differences. Studies in the constancy of reaction, in different seasons, of bunt collections showed that some give a constant reaction while others vary within limits set by environmental conditions.

Forthcoming Events

Monday, May 2

Royal Institution, at 5.—Annual Meeting.

Royal Geographical Society, at 5.30.—Lord Moyne: "Travel Films in Kodachrome from Greenland to Rio."

Tuesday, May 3

Royal Society of Arts (Indian Section—Dominions Section), at 4.30.—Dr. R. Maclagan Gorrie: "The Problem of Soil Erosion in the Empire with Special Reference to India".

Institution of Civil Engineers, at 6.—Sir Frank Smith, F.R.S.: "Disorderly Molecules and Refrigerating Engineering" (James Forrest Lecture).

Wednesday, May 4

Imperial College of Science and Technology, at 5.30.—Prof. S. J. Truscott: "Metal Mining Enterprise" (Warrington Smyth Memorial Lecture).

Institute of Metals (at the Institution of Mechanical Engineers, Storey's Gate, S.W.1), at 8.—Prof. G. I. Taylor, F.R.S.: "Plastic Strain in Metals" (Annual May Lecture).

Thursday, May 5

Chemical Society, at 8.—Prof. J. Masson Gulland: "Nucleic Acids".

Friday, May 6

Royal Institution, at 9.—Dr. H. W. Melville: "The Nature of Chemical Reactivity".

Erratum.—Entries referring to meetings of the Institution of Civil Engineers, the Chemical Society and the British Psychological Society were inadvertently inserted in this column last week. The announcements were incorrect.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistants (grades II and III) to the War Department Chemist—The Under-Secretary of State (C.5), The War Office, Whitehall, London, S.W.1 (April 30).

Assistant (grade II, engineering—ref. *B.* 33), **Assistant** (grade II, test methods—ref. *B.* 34) in the Directorate of Technical Development, Air Ministry, Adastral House, Kingsway, W.C.2—The Secretary (S.2.D) (May 6).

Assistants (grade I—ref. 13 O), (grade II—ref. 14 O) at the Royal Aircraft Establishment, South Farnborough, Hants (May 6).

Lecturers in Biology, Physics, Mathematics, Building Science, and Chemistry in the South-West Essex Technical College and School of Art, Forest Road, Walthamstow, E.17—Mr. E. H. Finch, 263 High Street, Walthamstow, E.17 (May 7).

Chemist in the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (May 7).

Assistant Lecturer in Agricultural Engineering in the University of Leeds—The Registrar (May 12).

Lecturer in Mathematics in the Heriot-Watt College, Edinburgh—The Principal.

County Adviser in Horticulture in Buckinghamshire—The Agricultural Organizer, County Offices, Aylesbury.

Vice-Principal of Chadacre Agricultural Institute, Bury St. Edmunds—The Principal.

Teacher of Chemistry in the Polytechnic, Regent Street, London, W.1—The Director of Education.

Lecturer in Horticulture in the University of Reading—The Registrar.

Assistant Lecturer in Social Psychology and **Assistant Lecturer** in **Statistics** in the London School of Economics, Houghton Street, Aldwych, London, W.C.2—The Secretary.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

British Museum (Natural History). John Murray Expedition, 1933–34 Scientific Reports, Vol 4, No 9: Asteroidea By T. T. Macan. Pp. 324–435+6 plates. 10*s* Scientific Reports, Vol. 5, No. 2: Pteropoda. By H. G. Stubbings. Pp 15–34. 1*s*. 6*d*. Scientific Reports, Vol. 5, No 3 Crustacea, Penæidæ By Dr M. M. Ramadan. Pp. 35–76. 2*s* 6*d*. (London: British Museum (Natural History).) [74

Philosophical Transactions of the Royal Society of London Series B Biological Sciences. Vol. 228, No. 556. Studies on the Onychophora, 4. The Passage of Spermatozoa into the Ovary in Peripatopsis and the early Development of the Ova. By Dr S. M. Manton (Mrs. J P. Harding) Pp. 421–443+v+2 plates. 7*s* 6*d*. Vol. 229, No. 557: The Royal Society Expedition to Montserrat, B.W.I; The Volcanic History and Petrology of Montserrat, with Observations on Mt. Pelé, in Martinique. By A. G. MacGregor. Pp 90+9 plates. 21*s*. (London. Cambridge University Press) [134

Fifth Annual Report of the New Commonwealth Society and Institute, 1936–37 Pp. 93+2 plates. (London: The New Commonwealth.) [144

National Union of Teachers. Margate Conference, 1938. Exemptions and Beneficial Employment: an Address delivered to the Meeting of Members and Officials of Local Education Authorities. By Dr. Evan Davies. Pp. 18 (London: National Union of Teachers.) [144

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1937, presented to the Annual Meeting, February 14 1938. Pp. 59+11. (York: Yorkshire Philosophical Society.) [194

Falmouth Observatory. Report of the Observatory Committee to the Royal Cornwall Polytechnic Society and the Falmouth Town Council, by H. Dent Gardner; with Meteorological Notes and Tables for the Year 1937, with Mean Values for 65 Years (1871–1935), by W. Tregoning Hooper. Pp. 13. (Falmouth: The Observatory.) [194

Other Countries

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1937. Pp. xlvi+161+10 plates. (Bern: Paul Haupt.) [74

Parliament of the Commonwealth of Australia Eleventh Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1937. Pp. 89. (Canberra Government Printer) 3*s* 9*d*. [74

Institut de France Académie des Sciences. Annuaire pour 1938. Pp 668. (Paris: Gauthier-Villars) [84

Union of South Africa: Department of Agriculture and Forestry, Division of Plant Industry. Botanical Survey Memoir No. 17: The Vegetation of the Divisions of Albany and Bathurst By Dr. R. A Dyer. Pp. 138+42 plates. 2*s*. 6*d*. Botanical Survey Memoir No. 18. Notes on the Vegetation of the Kamiesberg By Dr. R. S. Adamson. Pp. 25 2*s*. 6*d*. Report of the Low Temperature Research Laboratory, Capetown, for the Year June 1935 to June 1936 Pp. 215. (Pretoria: Government Printer.) [134

Observatoire de Zi-ka-wei. Annales de l'Observatoire Astronomique de Zô-sè (Chine) Tome 21, Fasc. 1: Perturbations générales par Jupiter et Saturne de 40 Petites Planètes. Par Le P. E. de la Villemarqué. Pp. iii+75. (Chang-Hai: Imprimerie de la Mission Catholique.) [134

Indian Forest Records (New Series). Vol. 2, No. 7: A Synecological Study of the Forests of Western Singhbhum, with special reference to their Geology. By H. F. Mooney. Pp. vi+259–356+13 plates. 4 rupees 2 annas; 7*s*. Vol. 3, No 8: Immature Stages of Indian Coleoptera (23) (Carabidæ, cont.) By J. C. M Gardner. Pp. ii+149–157+2 plates. 8 annas; 10*d*. (Delhi. Manager of Publications.) [134

Memoirs of the American Philosophical Society. Vol. 9: A Preliminary Consideration of Aboriginal Australian Decorative Art By Prof. Daniel Sutherland Davidson. Pp. xiii+147. (Philadelphia American Philosophical Society; London: Oxford University Press.) 9*s*. net. [134

Suppléments au Bulletin Biologique de France et de Belgique Supplément 22: Hormone ovarienne et Caractères raciaux du Plumage chez le Coq et la Poule domestiques, Étude de Génétique Expérimentale. Par Dr. V. Régnier. Pp. ii+214+5 plates. 100 francs Supplément 23: Recherches sur la Morphogénèse des Yeux Composés d'Arthropodes; Developpement, Croissance, Réduction. Par Francis Bernard. Pp ii+162+6 plates. 75 francs. (Paris: Laboratoire d'Évolution des Êtres Organisés.) [134

Proceedings of the U.S. National Museum. Vol. 84, No. 3024 Hydrocorals of the North Pacific Ocean. By Walter Kenrick Fisher. Pp. 493–554+43 plates. (Washington, D C.: Government Printing Office) [194

Smithsonian Institution: U.S. National Museum Vol 6, Part 9, Bulletin 100: The Tree Snails of the Genus Cochlostyla of Mindoro Province, Philippine Islands. By Paul Bartsch. (Contributions to the Biology of the Philippine Archipelago and Adjacent Regions). Pp. ii+373–583+27 plates. (Washington, D.C.: Government Printing Office.) [194

Catalogues, etc.

Entomologia Generalis. (Catalogue No. 94.) Pp. 90. (The Hague: Antiquariaat Junk)

Catalogue of Books on all Technical Subjects and Applied Science. Pp. 116. (London: W. and G. Foyle, Ltd.)

B.H D. Vitamin Products. Pp. 44. (London. British Drug Houses, Ltd.)

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The State and Wild Life

IN so far as science is organized knowledge, it is a reasonable assumption that it could best be attained by the organization of scientific workers for particular purposes. Such a view has received tardy recognition in Great Britain, where faith has rested upon individual effort unhampered by official allegiances (it has been nobly rewarded for its trust), and where State-controlled scientific research is still looked upon by many with a modicum of distrust. Indeed as regards the biological sciences, the influence of the State has made itself increasingly felt in directing scientific investigation only in recent years, through the creation of such bodies as the Medical Research Council, the Development Commission and the Agricultural Research Council, and there the touch-stone has been the benefit of the people through researches directly or indirectly of economic importance.

Other nations have found that State organization of biological research has been fruitful to science as well as to the people, and have developed far-reaching schemes which have become integral parts of the nation's activities. The extraordinary expansion of the United States Department of Agriculture is a case in point. Founded in 1862, the functions and work of the Department had so increased in variety and extent that, even before the Board (now Ministry) of Agriculture and Fisheries was established in England as an independent unit in 1889, it had already developed special "Divisions" each with a staff which concentrated its attention upon one particular set of problems, of chemistry, entomology, botany, forestry, pomology, animal industry, statistics. Under this policy of devolution there grew up in the U.S. Department of Agriculture an organization which has been of supreme importance for the wild life of the United States, and of which no counterpart exists in Great Britain.

On July 1, 1886, the Division of Ornithology and Mammalogy was established by law "for the promotion of economic ornithology and mammalogy, an investigation of the food habits, distributaries [? distributions] and migrations of North American birds and mammals in relation to agriculture, horticulture and forestry"[1]. It might be thought that such an investigation was limited in scope and was remote from the interests of the populace and from major problems of farming, but that has not been the experience of the United States. The work and contacts of the old Division so widened that in 1904 its place was taken by the Bureau of Biological Survey, with its own Divisions of Administration, Public Relations, Wildlife Research, Land Acquisition, Migratory Wildfowl, and Game Management, and with at the present moment a technical staff of some two hundred and fifty persons, most of whom are stationed at field headquarters in the various States.

It is pertinent to our inquiry into the relationship of the State to wild life to glance at the activities of the Biological Survey, for its functions reveal an unexpected scope and correlation of interests, along lines some of which might well be developed in Great Britain. "The Bureau of Biological Survey, the wild life service of the Federal Government, engages in research relating to the habits, economic status, and diseases of birds and other wild animals, including studies in the propagation of fur and game species; it acquires and maintains refuges for migratory birds and other forms of native fauna; conducts work in game management, under regional directors, including control of injurious species and the administration of laws for the conservation of vertebrate wild-life (except fishes). Its work is undertaken in the interest of agriculture, horticulture, stock-raising, forestry, and recreation, and to meet the natural requirements of the wild-life itself. . . . It maintains more than 100 refuges in the United States, Alaska, Hawaii and Puerto Rico for the protection of birds and of game and other mammals, conducts educational and investigational work in enforcement of laws for wildlife conservation, and develops more effective methods for the control of stock-killing wild animals, destructive rodents, and injurious birds, cooperating with State and other organizations."[2]

Although problems of economic biology in the United States differ from those in Great Britain in vastness if not in essence, the question compels attention whether some organization such as has proved so successful in America would not further investigations necessary for the understanding of the wild life of this country in its human relations.

It must not be thought that the absence of organization implies that such investigations have been neglected. The Vole Commission of 1892, the work of W. E. Collinge and others on the food of birds, the botanical surveys of W. G. Smith, A. G. Tansley, W. Davies and others, the inquiries set afoot by the British Trust for Ornithology and the Bureau of Animal Population of Oxford, and the researches upon insects and parasites of importance to farmer and forester conducted independently or with the support of the Agriculture Research Council, these and many others have added their mite to the sum of knowledge. But the fact that the majority of such researches depend upon the initiative and isolated work of individuals, or are conducted by bodies the tenure of which rests upon the insecurity of private donations, tends to make the investigations casual, incomplete, and planned for the short rather than the long view.

This unsatisfactory position could be remedied and that at no great expense to the State. In his brief address to the meeting convened by the University of London Animal Welfare Society on March 22 to discuss "Man's Relation to Nature", Prof. F. A. E. Crew properly pointed out that almost everything we need for the creation of a biological service already exists, that it should consist of men and not of masonry, and that it should make the most of biological departments in the universities, of museums, and of institutions like the Bureau of Animal Population and the British Trust for Ornithology, all of which are actually or potentially workers in the field of ecology.

It would be a mistake to develop an independent biological survey, for the essence of its investigations is that they must not be independent, but must be linked up with the efforts already being made by the State for the benefit of the people, through agriculture, forestry, the preservation of food-stuffs and materials from animal pests, and so on. The botanists have been calling for a permanent Botanical Survey[3]; the interest and variety of the problems tackled by the severely limited staff of the Bureau of Animal Population at Oxford are referred to in another place (p 822); the demand for the establishment of national parks and of Nature reserves in face of the steady encroachment of industry and human habitations upon the open spaces of the country; the possible effect upon fauna and flora; the acquisition by the State of vast areas for afforestation; these suggest some of the many problems that await the consideration of a Biological Survey. That some form of organization in these diverse and yet interrelated matters is desirable must be obvious to anyone familiar with the casual development of British economic biology.

In 1793 Pitt, with great foresight, established a Board of Agriculture with Sir John Sinclair as president, a chief object of which was to collect information respecting the agricultural conditions of each county. That Board came to an end in 1822 during a long period of agricultural depression, but the need for studying agricultural conditions, particularly in regard to wild life, still remains, although a new interpretation has been given to "agricultural conditions" by modern methods of botanical surveys and of precise analysis of animal populations in relation to climate, vegetation and other influences still unknown.

For the elucidation of all such problems of economic biology in Great Britain, we envisage a body organized, as in the United States, under the State departments dealing with agriculture, which will adopt, encourage, direct and initiate activities, botanical and zoological, bearing upon the relationship of plants and animals—the living environment—to the human population, and will keep in mind at the same time the interests of the wild life itself.

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[1] From *Misc. Pub., U.S. Dept. Agric.*, No. 223.

[2] From "A History of Agricultural Experimentation and Research in U S.A.—1607–1925". True, A. C., *Misc. Pub., U.S. Dept. Agric.*, No. 257 (1937).

[3] See Fenton, E. Wyllie, "The Need for a Permanent Organization for Undertaking Periodic Botanical Surveys of Great Britain", *Scot. Forestry J.*, 49, 121–126 (1935).

Darwin Misunderstood

Charles Darwin, the Fragmentary Man
By Geoffrey West. Pp. xiii + 351 + 8 plates. (London: George Routledge and Sons, Ltd., 1937.) 15*s.* net.

THE author has evidently spent much time and labour in writing this life of Charles Darwin and presenting it in a moderate-sized volume of 351 pages, printed in a type pleasant to read, with eight illustrations, including three of Darwin (in 1840, 1854 and 1881), one of his wife and three of his ancestors. The list of "works quoted or otherwise utilised" on pages 333–342 is an indication of the ground which was traversed in its preparation, with the fruitful results shown in the excellent choice of significant passages for quotation.

The most unfortunate feature of the book is the word "fragmentary", given prominence in the title but only fully explained at the end, where on page 329 we read—"Werner Sombart has written of 'the fragmentary man' who is the type of the capitalist executive, seeing all in acquisitive terms, subordinating the whole to the part, making the quantitative aspect the total consideration till 'all else within him dries up' and 'everything about him becomes a wilderness, all life dies, all values disappear'." The author then proceeds to his preposterous conclusion: "The resemblance of this 'fragmentary man' to Darwin is evident. The business man lives for the acquisition of wealth; the Darwinian scientist for the acquisition of knowledge—each irrespective of human consequence."

Nothing in truth could be more unlike the Darwin of whom we know so much and feel that we love, than the type described in Sombart's embittered words—the Darwin who "for nearly forty years . . . never knew one day of the health of ordinary men", and yet in the hours spared from his scientific researches, had pleasant relationships with his poorer neighbours, taking an interest in their welfare, helping to found a friendly club and acting as its treasurer for thirty years, "keeping its accounts with minute and scrupulous exactness", and explaining the position to its members on Whit-Mondays when he received them in the garden. His friend the vicar wrote of him that in all parish matters he was an active assistant and that his liberal contributions were ever ready. Darwin also acted for some years as a county magistrate, and Major Leonard Darwin informs me that it was during the drive from one of the meetings that the creative thought upon divergence of character suddenly flashed into his mind.

In his "Memories of Down House"[*], Major Darwin recalled with especial vividness a walk with his father and sister in a secluded valley beyond the "Sand Walk" at Down House, and how his father, moved by the peaceful beauty of the scene, said "that if he had to live his life over again he would make it a rule to let no day pass without reading a few lines of poetry", quietly adding that he wished he had "not let his mind go to rot so". On this Major Darwin wrote, recording his "firm conviction—a conviction which certainly was shared by all my brothers and sisters—that not only did my father thus give a decidedly erroneous impression of the changes which had taken place in his mind, but that the passages in his autobiography dealing with this subject have been constantly misunderstood and misinterpreted in the Press".

It is right to point out—and I am glad to emphasize it—that the author, again and again throughout the volume, creates an impression of Darwin which is entirely inconsistent with the "fragmentary man" described on page 329, and it is to be hoped that in any future issues the word and its definition will be omitted.

The conclusion conveyed on pages 121, 168 and 276, that Darwin was afraid of his father and treated him with an exaggerated deference, is not supported by the memories, written about 1877 or 1878, and quoted in the "Life and Letters"[†]—still less by the preceding paragraphs in which his son Francis records that "Charles Darwin had the strongest feeling of love and respect for his father's memory"; also—"his reverence for him was boundless and most touching"; and his daughter, Mrs. Lichfield, "describes him as saying with the most tender respect, 'I think my father was a little unjust to me when I was young, but afterwards I am thankful to think I became a prime favourite'." She had "a vivid recollection of the expression of happy reverie that accompanied these words, as if he were reviewing the whole relation, and the remembrance left a deep sense of peace and gratitude".

I am indebted to Major Leonard Darwin for the permission to quote the following words from a letter of November 12, 1937: "My memory of my father's attitude to his father was most certainly that he felt the strongest affection and indeed reverence for him. I myself do not remember a hint of any feeling that his father had been 'a little unjust' to him, as stated in my sister's excellent words on the situation." Also, referring to the author's words on page 168 about the purchase of a suitable property and Darwin's "diffidence towards his father in money matters", Major Darwin wrote: "At that date my father could hardly have earned enough to cover his expenses for a month, and all the capital expenditure on Down House must have come from the long and arduous labours of his father. Was it in any way surprising that he wanted to have a say in the matter ?" It should be added that Darwin's only living son enjoyed reading the book, and fully appreciates the truthful picture of the exceptionally happy home at Down House.

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[*] "Nineteenth Century," July 1929, pp. 118–123. An attempt to explain the misunderstanding referred to in this paragraph was made by the present writer in "Darwin and the 'Origin'", London, 1909, pp. 59–66, 79–83, 256–8.

[†] Vol. 1, pp 11–20.

In addition to the serious mistakes which have been here corrected, a few minor errors were noted : "draw" for drawn (p. xii), Christ Church "College" (p. 14), Floreat "Entomologie" (71), "Maderia" (96), "Arachnidæ" (196). F. W. Hope was not the "first Professor of Zoology at Oxford" (71), but founded the chair and nominated J. O. Westwood as its first occupant. It is also to be hoped that the words in which Fitzroy's suicide is described on p. 110 will be modified.

In conclusion, I am anxious to state my belief that the author has done valuable work which will bring comfort to many readers by giving them in a book of moderate size so complete an account of the life of Charles Darwin. E. B. POULTON.

An Index to Scientific and Technical Constants

International Annual Tables of Constants and Numerical Data:

Tables Annuelles Internationales des Constantes et Données numériques. Vol. 11 (Years 1931–1934). Part 1 (Sections 1–25). Pp. xiv + 492 + xv–xxv. n.p. Index to Vols. 6–10 (Years 1923–1930). Pp. xxiv + A48 + B304. 300 francs ; £3. (Paris : Hermann et Cie. ; New York : McGraw-Hill Book Co. Inc., 1937.)

COMMENCED in 1909 as an annual supplement to existing handbooks, in course of time this work has become in itself a comprehensive encyclopædia, or, actually, more than an ordinary encyclopædia, because new volumes are continually being added to keep the information up to date. The work constitutes a classified repertory containing references to the whole of the numerical values of physical and chemical constants, since determined, in the course of scientific investigations all over the world, with critical observations.

The realization comes to every scientific worker of experience of the overwhelming mass of information published every year in thousands of transactions of societies, Government and commercial reports and independent periodicals. In a single year perhaps three quarters of a million original scientific articles and fifteen thousand books are thrown into the weltering confusion of fact and theory. True progress must be founded on a basis of existing knowledge as wide and full as can be achieved. Study of what is known is the necessary preliminary to the discovery of the unknown, and, in that study, the student needs the help of the bibliographer in increasing measure as the sources of information become greater and more diverse. During a single life-time, the physical sciences have altered nearly out of recognition. Concurrently with an unprecedented increase in the technique of accurate measurement, the volume of knowledge has increased in an almost incredible ratio. There was a time when the chemist was both expected and able to read the whole of the significant literature of his subject. Now, he is fortunate if it is possible for him to keep abreast of a particular part of it, with the aid of a voluminous bibliographical literature, produced especially for that purpose.

A comprehensive bibliography, as the means of making a thorough study of existing information, has become an indispensable preliminary to the greater task of extending the boundaries of knowledge. Yet, incredible as it would seem, the practice of bibliography is still a thankless task. He who is willing to spend his time in collecting and classifying the records and results of the work of the experimentalist is looked upon askance by those for whom he works, and the products of his labours are rejected.

In libraries provided with elaborate subject catalogues, the reader prefers to ask for a book he knows, rather than look in the catalogue, in case there may be a better or a more recent work. The more extensive a bibliography, or, the more comprehensive an information service, the less advantage is taken of it. Smaller handbooks, and information centres of limited scope, lacking both in organization and in resources, may be consulted, while comprehensive bibliographies, and bibliographical services based on the scientific study of the problems involved and an elaborate international organization, are almost unused.

If presented with a bibliography of even a hundred references to the literature of a special subject, many experimentalists are taken aback and demand instead a critical bibliography, forgetting that selection is a dangerous practice, except by omniscience, or, by the individual specialist himself.

An invaluable work, such as this before us, has been described as "ponderous volumes". Scientific workers are aware that nobody knows very much. But do we realize that we do not even know what is to be known ? The bibliographical habit needs still to be acquired. The application of the well-worn principle of trial and error would indicate very soon that a few hours or days devoted to study of the literature would be repaid tenfold in saving of time and expense. If none were permitted to enter a laboratory before having acquainted themselves with the literature of their subjects, the need for critical bibliographies would disappear.

In the present work a happy mean has been drawn between the critical and the complete. For example, under the viscosity of mercury, Erk's accepted data, obtained by experiments in glass tubes, are quoted, while only a reference is made to the paper in which Tamann and Hinüber describe the higher values they obtained in copper capillaries, although these figures may yet prove to be correct.

The "Annual Tables" were founded at the Seventh International Congress of Chemistry, held in London, on the motion of Dr. C. Marie, who became their first editor and gave so much enthusiasm to the work. The task of collecting, classifying and editing the whole of the numerical data published each year on the physical properties and physico-chemical reactions of biological, chemical, industrial and mineral substances was entrusted to a single international organization, comprising representatives of national scientific associations under the auspices of the International Union of Chemistry and the International Council of Scientific Unions. The co-operating countries comprise : Argentine, Australia, Austria, Belgium, Brazil, Canada, Chile, Czechoslovakia, Denmark, France, Germany, Great Britain, Greece, Holland, Hungary, Italy, Japan, Norway, New Zealand, Poland, Portugal, Rumania, South Africa, Spain, Sweden, Switzerland, U.S.S.R., United States of America and Yugoslavia.

In 1936, by a resolution of the Twelfth Conference of the International Union of Chemistry, the management of the Annual Tables was entrusted to a managing board, having its offices in Paris, under the chairmanship of F. Joliot, with N. Thon as editor-in-chief and P. Auger as general secretary.

The first series of Annual Tables comprises volumes 1 to 10 and the years 1910–1930, to which two indexes have been issued, for volumes 1 to 5 and 6 to 10. These indexes are classified both alphabetically by names of substances and by formulæ. The texts are in two languages, French and English. The indexes are in French, with cross-references from English, German and Italian names. The access to the data contained in the tables by means of the indexes is very easy. In fact the work is in no way more difficult to use than the larger of the proprietary handbooks. It differs from them in being more comprehensive, up to date and in having critical notes.

The second series of Annual Tables, representing the years 1931–36, is being published in two forms: (i) in two volumes, 11 and 12, comprising the data for 1931–34 and 1935–36 respectively ; and (ii) in the form of a series of "Monographs", each one containing the whole of the data appertaining to a section, or to several related sections, of the "Annual Tables". In the new series the format has been reduced from 4to to 8vo, which is certainly more convenient to handle.

The monographs vary in size from about thirty to eighty pages. They enable research workers to acquire, at reasonable cost, those sections of the tables in which they are more particularly concerned. Some of the monographs cover the periods 1931–34 and 1935–36 separately, while others include the whole period in one book. Those already issued deal with the subjects of rotatory power ; Raman effect ; radioactivity and nuclear physics ; deuterium ; dielectric constants ; free energy, heat content, entropy and activity ; heat conductance, specific heat ; elasticity, compressibility, thermal expansion, density, viscosity, surface tension ; vapour pressure, boiling points, gas laws ; Volta effect, thermo-electricity, piezo-electricity, electrical conductivity of metals, supraconductivity ; paramagnetism, diamagnetism, ferromagnetism, Hall effect ; electromotive forces, oxidation-reduction potentials ; thermochemistry ; molecular spectra and molecular structure ; Faraday effect, magnetic and electric birefringence, photo-electricity ; combustion and detonation of gases ; scattering of light, reflection and refraction ; conductance of electrolytes ; melting temperatures ; electrolytic and chemical equilibria.

The numerical data are compiled from original papers by eminent authors, selected solely on account of their competence in each particular branch of science and irrespective of nationality. The data are arranged in sections, according to subject. Each section includes a survey of definitions and fundamental concepts. The data are classified by a rational system, which enables the desired information to be located with ease. They are accompanied by indications of the methods used in their determination and critical observations, which are of the greatest value. It is claimed that the complete literature is cited on every subject. While no bibliography yet produced has attained that perfection, this one is surely very comprehensive. Another commendable feature is that articles are not ignored because their titles do not indicate them to be sources of new constants. Moreover, the printing and compact arrangement of the material are everything to be desired.

The work is the only publication which furnishes periodically new physical, chemical, physiochemical and technical data, with comments and comprehensive references to the literature. In this way it renders services which are performed by no other collection of numerical data. It is designed for all who make use of quantitative values of the properties of substances and magnitudes occurring in biological, chemical or physical phenomena, whether in pure or applied science. The work should find a place in every library that caters for such needs, where it should be given a position on the shelves in the reading room, easy of reach and near a table, and not be relegated to an inaccessible book store. The individual monographs on special subjects are indispensable to scientific workers for their everyday use.

S. C. BRADFORD.

Properties of Matter in Modern Guise

Elasticity, Plasticity and Structure of Matter
By Dr. R. Houwink. With a Chapter on the Plasticity of Crystals, by Dr. W. G. Burgers. Pp. xviii + 376. (Cambridge: At the University Press, 1937.) 21*s*. net.

THE title of this book, although a little lengthy, describes its contents with accuracy; it is essentially a study of structure approached through the phenomena of elasticity and plasticity. To give an adequate impression of the wealth of information which it contains is very difficult; perhaps the best way is to state that the substances discussed range from brass to bakers' dough. But, materials apart, the author (with the help of Dr. Burgers) has produced a remarkable treatise upon molecular physics, showing at every step how directly observable quantities like viscosity, tensile strength and so forth are connected with the type of structural unit in complex bodies, especially those of technological importance. It is the outlook of the physicist, sharply focused upon the chemist's problems. This point of view suggests something of the penetration of Kelvin, combined with a touch of Mendeléeff's power for anticipating the unknown.

The treatment is naturally to some extent synthetic, since the researches of a large number of workers are reviewed, and at fréquent intervals their compatibility or otherwise is appraised. Though the bibliography is extensive, the authors have achieved far more than a mere account of the results obtained by other people. For example, Houwink has developed a theory to account for the difference between the theoretical and observed stress-strain relationships in resin macromolecules, akin to Smekal's *Lockerstellen*. He points out that the actual number of CH_2 'bridges' present may not be equal to the number theoretically possible; again, the chance that a single molecule can be added at each active spot of a growing complex obviously diminishes as the molecule about to be added itself begins to increase in size. Many factors of this kind occur in compounds of high molecular weight, and lead to discrepancies between the 'ideal' and the 'actual', as in crystallography.

In a different connexion entirely, the appearance of this volume is particularly opportune. This is on account of the interest which is now taken by those concerned with the technical side of art in the polyvinyls, lacquers and other rheological products. For them, these pages are of great significance. Thus, a relationship is suggested—on very reasonable assumptions—between the depth and width of a brush mark (in paint), the surface tension and the yield value, in order to obtain satisfactory levelling. In this, and a number of other instances, the property of thixotropy, or the re-coherence of a substance after shaking or stirring, is of consequence, and its effects receive detailed consideration.

It is almost impossible to imagine any investigation into the properties of existing materials, or the quest for new ones, which would not be advanced by consulting this book.

F. IAN G. RAWLINS.

Wonders of the Great Barrier Reef

By T. C. Roughley. Pp. xiii+282+51 plates. (Sydney and London: Angus and Robertson, Ltd., 1936.) 15*s*.

THIS is a popular book on living animals by a writer who is interested in them as such. It undoubtedly achieves its object, which is stated in the introduction, namely, the encouragement of interest in the Great Barrier Reef and the explanation of its magnificent fauna and its flora in such a way that the lay visitor can understand what he is looking at.

Mr. Roughley's style is of a pleasing simplicity touched here and there with a subtle humour. His calm narration of startling events, such as that of the diver who had his head in a shark's mouth and escaped (p. 226), might well serve as a reproach to the impassioned journalism found in some accounts of 'foreign parts' and their animals. Chapter xvii, "Wealth from the Reef", contains a useful summary of the fisheries and the value of their products, which range from vitamins to shirt buttons. One may be allowed a little doubt as to the incessant activities of killer whales mentioned on pp. 137 and 265.

Special mention must be made of the thirty-six coloured plates. Although unfortunately one or two are out of register, the remainder are examples of photographic reproduction of a very high order. The resemblance to life achieved by some is quite startling.

Mr. Roughley must be complimented on the production of a pleasing, interesting and informative book.

Food Values:

What they Are and How to Calculate Them. By the late Margaret McKillop. Revised and brought up to date by Elsie C. Mottram. Pp. xi+155. (London: George Routledge and Sons, Ltd., 1936.) 3*s*. 6*d*. net.

ON the death of Margaret McKillop in 1936, the publishers of this book entrusted its revision to Mrs. E. C. Mottram. Considerable alteration in format, as well as the addition of new tabular matter and the modernization of the text that one of the most rapidly moving of applied sciences demands, have resulted in as useful and handy a volume as could well be required by housewife or student of social science.

The reviser has, for the most part, eschewed controversial matter, confining herself to the statement of universally accepted dietetic principles and the publication of well-established figures for the composition and analysis of food. She has, however, drawn one false conclusion from the complementary investigations of the Mellanbys and of Bruce and Callow: it is certain that bone-meal, for example, or any other food source of assimilable phosphorus would be as effective as cod-liver oil, or other form of vitamin D, in combating any rachitogenic effect of brown bread. The remarks of the author on this matter savour a little of the 'faddism' that she so rightly condemns and otherwise rigorously eschews.

A. L. B.

Projective Geometry

By Prof. Boyd Crumrine Patterson. Pp. xiii+276. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 17*s*. 6*d*. net.

PROF. CRUMRINE PATTERSON declares that his motive in writing this text-book of projective geometry was "the feeling that a more complete discussion than is usual in elementary text-books is desirable". He thinks that in this way the supplementing of the text does not occur so often and the instructor has more time to devote to discussion, analysis and solution of problems.

The method adopted is that of synthetic geometry, and the development of this method is intuitional and based on the student's earlier knowledge of the elementary geometry of the schools. As distinguished from the usual elementary treatment, there is a careful distinction made between projective and non-projective ideas, while the principle of duality is developed in some detail. Further, the proofs of some of the earlier theorems are separated into steps and that of the fundamental theorem is built up on the concept of a net of rationality as a line. The theory of the imaginary elements is also introduced in some detail and is applied to various construction problems. Finally, there is a short discussion on the general projective group transformations on a plane and some of its sub-groups, of which the most notable is, of course, the metric group. In this way, the geometry of Euclid is shown to be a special case of projective geometry. There is material enough in the book for a full year's course.

Reactions of Hydrogen with Organic Compounds over Copper-Chromium Oxide and Nickel Catalysts

By Prof. Homer Adkins. Pp. ix+178. (Madison, Wis.: University of Wisconsin Press, 1937.) 3 dollars.

THE present volume deals with the development of high-pressure hydrogenation as a tool for use in synthetic organic chemistry and more particularly with the use of black copper-chromium oxide catalyst. Prof. Homer Adkins, his staff, and research students, have made this catalyst peculiarly their own: it is particularly suitable for the hydrogenation of aldehydes and ketones to alcohols, of esters to alcohols, of amides to amines, but is notably inactive for the hydrogenation of the benzenoid nucleus, so that it may be used to hydrogenate aryl compounds without saturating the ring. The procedure for the preparation of this catalyst is given in detail, as also the details of the pressure apparatus and the method of operation.

The bulk of the book is given over to the description of the various types of reaction studied, and the conclusions reached. It is essentially a practical treatise, and therefore all the more valuable; actual figures of temperature, time, quantities taken, yields, are all given.

The reviewer's treatment of it has been to write his name in it and put it on the shelf reserved for books frequently consulted; there will be many others who will do the same.

E. F. A.

Motor Spirit from Coal

By John L. Strevens and Arthur C. Cross

THE report of the Falmouth Committee has disappointed that large section of public opinion which hoped that motor spirit might be produced from coal in sufficient quantities to render Great Britain independent of foreign supplies, either in peace or in war. On the other hand, the report recognizes the immense amount of scientific activity that is being expended on the subject, and it is therefore opportune to consider the position as it is to-day.

Apart from the three branches of the carbonizing industry—gas, coking and low temperature—all of which produce a certain amount of spirit as a by-product, there are three commercially proved systems now at work for obtaining motor spirit from coal, (*a*) hydrogenation, (*b*) coal-oil distillation and (*c*) synthesis.

Research work has brought one of the authors (J. L. S.) into intimate contact with all these processes. He was in Germany in the early days of hydrogenation developments studying the subject in conjunction with the Dye Trust and Dr. Bergius, and supervised research work in this connexion at the Kaiser Wilhelm Institute. During the past two years he has enjoyed welcome entry to the plant, where he has observed the work carried on by the Synthesis group under Dr. Martin, whose immense industry at Oberhausen may be classed as one of the wonders of the modern technical world, and he is one of the technical advisers to the British group who have developed the Cannock process of coal-oil distillation and now have plants at Tipton and Erith.

It is estimated that since Dr. Bergius's original discovery, between £20,000,000 and £30,000,000 has been spent upon hydrogenation, which in Great Britain has culminated in the plant of Imperial Chemical Industries, Ltd., at Billingham. About £10,000,000 has been spent on synthesis since its inception and approximately £1,000,000 on coal-oil distillation processes.

HYDROGENATION

Hydrogenation of coal and oil was first developed in Germany by Dr. F. Bergius and brought to Great Britain by the energy and foresight of the late Lord Melchett some twenty-five years ago. The process as operated to-day is the outcome of the pooling of all the patents and technical information acquired by international chemists and oil technologists in Great Britain, Germany and America, through the medium of International Hydrogenation Patents, Ltd. The part played by the coal industry in this development has been negligible, a fact which the industry will probably regret in time to come.

In the hydrogenation process a paste of coal and coal-oil is submitted to the intense action of hydrogen under high pressure (275 atmospheres at present at Billingham, though pressures up to 350 atmospheres are contemplated in future plants) in the presence of catalysts of the tin or molybdenum series, whereby partial liquefaction and reduction of the coal substance takes place and corresponding changes occur in the associated coal-oil. At the temperatures employed, simultaneous 'cracking' of the liquid constituents takes place and the ultimate result is the production of motor spirit and gas on one hand and an intractable residue of ash, catalyst, unconverted coal substance and heavy oil on the other.

Hydrogenation requires expensive plant of great strength and complexity to withstand the enormous pressure developed and the intensive action of the processed materials on the equipment. Once hydrogenation is effected, the rest of the plant, dealing with the hydrogenated and cracked oil products, is analogous to that of modern oil refineries.

Apart from the enormous capital cost of the plant, the complicated technique and working of the process—requiring as it does very large additional quantities of coal for power, hydrogen, steam and ancillary purposes—places a cost burden on the venture which is reflected in the very high production figure for the motor spirit obtained.

In 1936, 100,000 tons of coal were processed by hydrogenation at Billingham, and 325,000 tons of coal were utilized in the processing as well as 20,000,000 gallons of creosote and coal-oils. The production of 33,300,000 gallons of motor spirit was equivalent to 60 gallons for every ton of coal and oil utilized.

Although the progress of hydrogenation applied to bituminous coal and coal-oil mixtures has been a brilliant technical achievement, in Great Britain where the raw materials available are much more difficult to treat and much more expensive than they are in Germany, it seems unlikely that it can ever become an economic proposition, even with the excise discrimination intended for the express purpose of encouraging its development.

Any new hydrogenation plant in Great Britain would, according to the Falmouth Committee report, have to be designed to use coal only, as supplies of creosote or low-temperature tar are not available in sufficient quantities to provide for another mixed coal and tar plant, and from an economic point of view it would have to be of a minimum capacity of 150,000 tons of petrol, such plant estimated to cost £8,000,000.

The only by-products of note obtained in the hydrogenation process are the propane-butane gases, which are marketed in the form of compressed gas for household and industrial use in isolated locations; for example, Calor Gas.

COAL-OIL DISTILLATION

Coal-oil distillation is an entirely British process, organized and financed by W. B. Mitford and a group of colleagues. Eight years have been spent in bringing it to commercial completion. For the past two years much of the work has been done with the co-operation of Universal Oil Products, of Chicago, the well-known American oil cracking authority.

Coal-oil distillation *cum* cracking requires as its raw material a mixture of coal and coal-oil. In the coal-oil distillation plant of the National Coke and Oil Co. this mixture is converted into a coal-oil distillate which, because of changes brought about by its processing, is 'upgraded' into the class of naturally occurring oils amenable to the normal cracking operation. As a result this 'upgraded' distillate refines in a similar way to a medium quality petroleum, yielding a large percentage of high-grade motor spirit. Olefinic gases are also produced, from which further quantities of aviation and polymer spirits are obtainable.

This particular type of coal-oil treatment lends itself to development in widely scattered units, and is only limited by the availability of the coal-oil with which the coal needs to be pasted. If, according to a precedent already established, crude petroleum or its products are used in association with this coal-oil, then in the event of tax discrimination being exercised in favour of motor spirit produced from coal by this means, the possibilities of coal-oil distillation are limited only by the availability of such oils.

Why, it may be asked, is the oil from coal under this process changed into the character of a natural petroleum? This phenomenon has been discussed in scientific circles in the United States, Germany and Great Britain. The probable explanation is that the primary oil constituents of the coal have been 'soaked out' by the associated coal-oil and the deleterious material removed in the processing treatment. The coal-oil distillate 'upgraded' stock yields 43 per cent motor spirit when treated in a modern cracking plant. Thus by this process there has been obtained from coal and coal products (creosote, etc.) an oil stock that is, so far as motor spirit production is concerned, akin or similar to many natural crude petroleums. For the treatment of our huge supplies of suitable coal this development should prove eminently successful.

A standard unit for a process of this description consists of a coal-oil treatment plant having a daily throughput of 400 tons of 'paste' (50 per cent coal and 50 per cent oil), and a refinery with a capacity of 1,000 barrels of dephenolated 'upgraded' oil stock per day.

On the basis of a yield of 78 gallons of motor spirit per ton of stock treated, such a unit would produce 5,000,000 gallons of high octane product per annum. This yield is guaranteed by Universal Oil Products after testing the stock produced.

No account of coal oil distillation would be complete without reference to the smokeless fuel residuum, phenols, and rich gaseous by-products derived from the process.

The smokeless fuel is, on test, superior in every way to that obtained by ordinary dry methods of coal treatment. Apparently a proportion of oil absorbed in the coke residue imparts valuable properties which are reflected in its higher calorific value, complete combustibility, intense reactivity and high radiant heat value.

The phenols are equal to those produced from high-temperature coal tar, whilst the gas is rich in those higher hydrocarbons, making it particularly suitable for industrial metallurgical operations and as a motor transport fuel when compressed into portable cylinders.

SYNTHESIS

Synthesis, or coal-gas treatment, is essentially a German development which has taken fifteen years to come to commercial practicability. It is based on experiments conducted over a number of years by Prof. F. Fischer and Dr. Tropsch, of the Kaiser Wilhelm Institute. This process forms part of the Four-Year-Plan now being carried out in Germany.

The synthetic processes are based on the well-known fact that oxide of carbon can be hydrogenated *at normal pressures* in the presence of catalysts of the eighth group of the periodic classification of elements to form a mixture of gaseous, liquid and solid hydrocarbons analogous to crude petroleum. The initial gases can be prepared in various ways from all types of carbonaceous material such as coal and coke, or from oil and gaseous hydrocarbons. Once a mixture of carbon monoxide and hydrogen in predetermined quantities (usually one part carbon monoxide to two parts of hydrogen) of the right degree of purity is available, the production of 'synthetic oil' is an open field.

One form of this development which has been brought to a state of almost technical perfection on an extensive commercial scale is operating in Germany under the name of the "Fischer" process, but only small-scale experiments along similar lines have so far been carried out in Great Britain.

The synthetic products of the Fischer process consist of 9–10 per cent of gaseous hydrocarbons, 60 per cent 'straight' open-chain paraffinic motor spirit, 28 per cent high-grade Diesel oil fraction and 2–3 per cent wax, but slight modification in processing influences these proportions greatly.

COST PER GALLON

No attempt has been made in the Falmouth Committee report to compare the normal costs per gallon of producing motor spirit by the various processes examined. A fair estimate of the cost for the motor spirit produced by hydrogenation would be approximately 11*d.* per gallon, remembering that in all new plants it is difficult to assess the amortization figure. The octane rating of this spirit is 70 plus.

The outstanding feature of coal-oil distillation *cum* cracking is that from one ton of coal and one ton of coal-oil make-up there is produced 78 gallons of motor spirit. The approximate cost of this spirit, allowing average price for all other products, is 7·2*d.* per gallon, and the octane rating is 73–74.

A feature of synthesis is that 5½ tons of coal are required for the production of one ton of synthetic oil product. The yield of finished motor spirit is 40–45 gallons per ton of coal, and the cost may be placed at between 10½*d.* and 1*s.* 1½*d.* per imperial gallon. This range in the estimated price is advisable owing to the fact that in Germany the synthetic industry is very closely associated with the benzole industry and it is not easy to determine the net cost of the synthetic motor spirit. The best octane rating of this spirit is 62.

LIMITATIONS OF THE PROCESSES

Each of the processes considered has its peculiar limitations which must be borne in mind in surveying the economic position.

In the case of hydrogenation, the capital cost is enormous. There are definite limitations to the percentage of coal in the coal-oil paste which it is advisable to treat. There are difficulties in the treatment of the residue and the recovery of the catalyst. It may be that the success of the process will ultimately rest upon the finding of an economic method of separating the catalyst from the residue and the means of handling it.

With coal-oil distillation *cum* cracking an important limitation lies in the supplies of creosote or similar coal-oil products at economic prices. In a state of national necessity the major portion of coal-oil produced would doubtless be made available for the preparation of home-produced motor spirit. If in the interests of the coal industry it were felt wise to make available, unhindered by tax, imported natural petroleum, the field for both hydrogenation and coal-oil distillation would be unlimited.

So far as synthesis is concerned, the motor spirit produced is of low octane rating. It is obvious that there would always have to be available 'upgrading' material at an economic price, such as benzole, alcohol, tetra-ethyl lead, iso-octane, etc. The synthetic process may always be limited by the high cost and availability of the necessary catalyst.

ADVANTAGES

The synthetic process is the only one so far developed which produces from coal a Diesel oil of first quality.

The coal-oil distillation process is the only one of the three under review which produces economically a large quantity of smokeless fuel of high radiant heat value and complete combustibility.

The valuable phenols so essential to the nation's needs in times of peace and war can only be obtained from coal distillation processes and the tar industry, and not from hydrogenation or synthesis.

Plants of the Sand Dune and why they Grow There*

By Prof. E. J. Salisbury, F.R.S.

THE vegetation of a sand dune is unique not only because of the rapidity of the changes that it exhibits but also because, from the manner of dune development, the phases present an arrangement in space corresponding to their sequence in time, so that the plant succession can be ascertained with certainty.

The embryo dune frequently begins around seedlings of either *Agropyron junceum* or *Ammophila arenaria*. Both are characterized by an important reaction to burial by sand, namely, that they are stimulated to grow through to the new surface. The projecting leaves by reducing wind movement not only shelter the surface from erosion but also bring about further deposition. *Agropyron junceum* can grow normally in 1·5 per cent of salt and tolerate considerable periods of inundation by sea-water, whereas the marram grass cannot. But *Agropyron*, owing to its drooping habit, as contrasted with the erect habit of marram grass, is not so efficient a collector of sand and has much less capacity for vertical growth. Hence it only forms low dunes at low levels on the beach, whereas the marram grass is the successful pioneer at greater elevations and indeed is always the dominant species on English dunes in their early stages. It not infrequently brings about a rise of more than a foot a year in height, whilst its lateral spread may exceed 36 sq. ft. a year. Other grasses that play a part in the early stages are *Elymus arenarius* and *Festuca arenaria*. All these grasses spread by means of rhizomes from which at intervals tufts of leaves are given off above and roots below.

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* From a Friday evening discourse delivered at the Royal Institution on February 4.

Measurements of a number of plants over a period of years indicates that both the pioneers *Agropyron junceum* and *Ammophila arenaria* have a remarkable capacity for rapid spread in their early stages of growth, which must render them peculiarly fitted for the occupation of a mobile habitat. The average areas occupied by twenty plants of *A. junceum* in the first few years of their development were : 1 sq.ft. ; 5·7 sq. ft. ; 18·4 sq. ft. ; and 37·4 sq. ft. ; the maximum annual increment, amounting to about 600 per cent, being exhibited during the second year's growth. The rate of radial extension gradually rises during the first three years to about a foot a year. The marram grass, though spreading at a slightly slower rate, namely, about 0·7 ft. per year, exhibits a maximum radial extension in the second year of growth which, in the plants studied, amounted to an average increase of area of no less than seventeen times. *Agropyron junceum*, through its greater toleration of sea water, can not only colonize at lower levels but also tends to occupy sand that is normally moister and hence firmer than that higher up where the marram grass is the dominant pioneer. The remarkable initial capacity for rapid spread of the latter may therefore be of some significance in its more mobile station.

The sand dune, though it may receive as much precipitation in the form of rain and dew as an inland situation, can be aptly described as an edaphic desert—a desert that is due, not to climatic but to soil conditions, since the coarse texture and very low organic content render sand a very poor retainer of water.

Data that I have obtained respecting the actual natural water content of dunes from a number of different localities around our coasts, shows that even after heavy rainfall the supply at the surface of a young dune rarely exceeds 10 per cent. Normally, however, the amount of water available to the plant is less than 4 per cent and frequently much less. For example, if there is a spell of dry, cold, windy weather the amount of water in the first two inches may fall to below 1 per cent, of which only a small part is available to the plant. On the other hand, the water content at six inches is normally between 4 and 5 per cent, and in warm sunny weather, which tends to promote rapid water-loss from the plant, there is an important compensatory phenomenon which plays a fundamental part in maintaining a fairly constant, if low, supply of water for these dune species. Owing to the large size of the sand particles and the dryness of the surface grains, these constitute a very bad conductor of heat. Hence the heat of the sun received by the superficial layers is not conducted downwards, as in normally moist soil, but results in very high surface temperatures being attained.

Excessive heating of the surface grains raises the temperature of the air in the interstices and the rising convection currents draw in warm moist air, from over the sea and adjacent tidal lands, into the interior of the dune. Here the moisture-laden air impinges upon the cooler sand grains and brings about a phenomenon known as internal dew-formation. Just because this is most pronounced in conditions of prolonged sunshine, internal dew-formation takes a most important role in stabilizing the moisture supply at a time when it might be expected to attain a minimum.

Compared with the shortage of water, the other factors adverse to plant growth, such as the mobility of the substratum, the changing level and the poverty in nutrients, are less inimical to plant life. Further, it must be emphasized that the high temperature attained by dune surfaces accentuates the effect of the small water content. We are not surprised that the number of these pioneer species is very few, but rather that these few can withstand the rigours of the habitat and even flourish despite them. In what way are these pioneer species equipped so that they can endure these very specialized conditions ?

Owing to their extensive rhizomes, the risks consequent upon the mobile habitat are minimized. Further, a single plant thus exploits by its roots a very large volume of sand. Penetration of the sand by the rhizomes is facilitated by the structure of their apices, which are woody with a sharp point well suited for piercing the sand and capable of withstanding the inevitable abrasion. But the feature which more than any other fits these pioneers for growth on a dune is that they all possess leaves which automatically flatten out when their water content is high and curl into a cylinder when their water supply is low. On a dry windy day the leaves of the grasses appear like narrow tubes split along one side, and this split widens or narrows in exact relation to the increase or diminution of the ratio between water absorption and water loss. This feature is of most importance when conditions are most extreme, but some idea of the efficiency of the mechanism can be gained from the fact that experiments with *Elymus* have shown that even under slight air movement the rolled leaves transpire only about a tenth of the water lost by the leaves when flat.

The only plants of these early phases which have not such automatic transpiration checks are those of the drift line on the dune face. These species are able to survive during periods of shortage by storing up copious internal water reserves, the presence of which renders the leaves succulent. The two most frequent are the sea rocket (*Cakile maritima*) and the prickly saltwort (*Salsola kali*). Both are very tolerant of sea water.

By the activity of the pioneer species, three main changes result. The embryo dunes rise in height, extend laterally and the hummocks coalesce to form a definite ridge, which may attain to heights of from sixty to one hundred feet in Great Britain. The decaying leaves, rhizomes and roots add organic material to the sand mass. Thus the dune becomes not only less mobile but also its capacity to retain the water that either falls upon its surface or condenses within is continually being augmented. So the extreme conditions become ameliorated and sooner or later, on advancing shores, the establishment of new dune ridges seawards of those already formed gives some protection both from sand removal and from rapid accretion.

The less specialized conditions which thus ensue are marked by the advent of other perennial species only slightly less specialized than the grasses. Of these the most characteristic are the sand sedge (*Carex arenaria*), the convolvulus (*Convolvulus soldanella*), sea spurge (*Euphorbia paralias*), sea holly (*Eryngium maritimum*) and rest harrow (*Ononis arvensis*). The sand sedge is remarkable for the rapidity of its growth and the extent of its rhizomes. From the parent plant the rhizomes radiate out like the spokes of a gigantic wheel and grow horizontally a few inches below the surface of the sand, sending up tufts of leaves at intervals of about four to six inches throughout their length. With the passage of time some of these tufts form the centres of origin of further radiating rhizomes, thus in a few years the sand is occupied by a sort of network bearing tussocks that constitute an efficient wind-break so that this species is an important stabilizer. The sea spurge and sea holly, not being rhizomatous species, have little capacity for lateral growth and so are more susceptible to sand removal, but they both exhibit rapid response, by new growth, to burial. In common with the other dune perennials, they meet the low water supply by means of a deeply penetrating and extensive root system (in the sea holly this may penetrate 2·7 m.); also they both possess leaves with a thick protective cuticle.

Up to this stage of dune development, a considerable area of bare sand is still obvious between the tufted growths. This implies great vulnerability to high winds and consequent risk of rapid erosion or accretion, thus precluding the development of species incapable of rapid growth. However, with the passage of usually about half a century, conditions have become sufficiently stabilized and the rate of accretion sufficiently diminished to permit the growth of dune annuals. These dune annuals are all characterized by germinating in the autumn, and passing through their life-history during the winter months, flowering in the spring and perishing with the surface drought of summer. They evade the adverse period in the seed state. The capacity of the dune annual to grow during the colder months of the year is enhanced by the warmth of the surface sand in sunshine. This brings about a rise in temperature of the air just above the sand. As a consequence, the leaves of these annuals are sufficiently warm to carry on active photosynthesis when this would be quite impossible for plants on other soils with a more normal capacity for heat conduction. Readings taken on the Norfolk dunes in April indicate that the temperature immediately surrounding the dune annuals may frequently be 10°–15° C. higher than the air generally.

All these dune annuals afford a striking contrast to the dune perennial by reason of their shallow roots, which only penetrate to an average depth of about four centimetres. They are enabled to flourish partly because of the frequent rains and high average humidity of the winter months, but even more because by the time of their arrival the pioneer species have added to the surface sand sufficient organic matter to augment appreciably the water-retaining capacity. Moreover, all these dune annuals are rosette species with foliage close to the ground, thus occupying the most humid layers of the air and a level least exposed to wind action.

It has been possible to obtain data as to the water loss by various species when in sand of a normal water content. Such data show that a plant of *Cerastium semidecandrum* may, on a sunny day, lose water at the rate of more than two grams per 100 sq. cm. of surface per hour. If we allow for the normal volume of soil exploited and the average water content, this rate of loss involves complete removable of the available water supply within about a day. Since this species will survive a period of more than a week without rain, it is evident that it must depend on internal dew formation and upon the movement of water from beyond the immediate vicinity of the root system. The maintenance of such a flow requires some motive force, but this is supplied by the osmotic suction of the roots, which in various dune plants has been found to range from 9 to 20 atmospheres, or a force of from about 130 lb. to 290 lb. per sq. inch. Much higher osmotic pressures equivalent to 630 lb. to the sq. inch have been observed in dune plants of Algeria and California.

By their carpeting of the dune surface during the season of frequent high winds, the annuals materially diminish the risk of surface erosion, and they in turn add further to the humus in the soil. Their protective action, which ceases when they shrivel in summer, is augmented by certain mosses, of which *Tortula ruraliformis* is the most important, which endure periods of severe drought quite unharmed.

The prevalence of lichens also on the more advanced stages of stabilized dunes has given rise to the name of 'grey dune' in contrast to the younger 'yellow dune'. The vegetation carpet is quite efficient so long as unbreached by the tracks of man or the activities of the ubiquitous rabbit The latter is often the source of exposure that permits wind entry and erosion, leading to a so-called 'blow-out', that either results in complete removal or initiates a 'secondary succession'.

A striking feature of earlier dune phases is the frequency of comminuted shell fragments among the sand grains. The proportion of calcium carbonate thus furnished varies greatly from one dune system to another. Some in Dorset contain practically none, and heather appears quite early in the dune succession, whilst other dunes contain a high proportion (up to 17 per cent at Bundoran in Ireland). In Portuguese dune samples from Comporta I found up to 27 per cent $CaCO_3$ in the young dunes and 0·2–0·4 per cent in the leached sands of the old. According to J. A. Van Steijn, the dunes of Holland show a similar range to those of Britain; he gives 0–18 per cent as the range of lime content. Where the calcium content is high, for example Tenby dunes, there are usually a number of calcicole species.

Before passing to the final stages of dune development, we may pause to consider a feature that will in most dune systems have already appeared. We shall note that dunes tend to develop as ridges parallel to one another. This usually intermittent formation is partly due to the presence of the main dune ridge, which by upward deflection of the on-shore wind produces a relatively calm condition at the ground-level immediately in front, so that embryo dunes starting here would exhibit little accretion. Still more, perhaps, it is due to the fact that the sloping sand in front of the ridge has the effect of pushing the main drift line farther out, and it is usually in relation to the buried drift that the new dunes begin to form. Thus the marram grass seedlings which arise along the drift line exhibit rapid growth and rapid accretion, and so form a young dune ridge separated from the pre-existing one by an interval. The parallel ridges often rest on a relatively impermeable substratum, and the water, of which the dune ridges are the catchment area, drains into the intervening hollows and sometimes forms what are known as 'dune slacks'. They naturally exhibit a marsh and aquatic vegetation which is beyond the scope of our present treatment, but there are a few special features to which attention must be directed. These slacks are the especial home of the creeping willow (*Salix repens*), which by its mode of growth and extensive root system (it will form roots more than 25 ft. in length) is able to spread into the dunes proper and can even grow successfully in mobile sand, but its apparent role as a pioneer is probably illusory, despite all statements to the contrary.

Into these slacks the drainage water from the dune ridges brings the nutrients, particularly the calcium salts leached from above, and to this fact we must, I think, attribute the presence of species that we more particularly associate with dry chalky soil. Such plants as *Chlora perfoliata*, *Linum catharticum*, *Gentiana campestris*, even *Carlina vulgaris* and the lady's tresses (*Spiranthes autumnalis*) are to be found growing even in free water. In such a 'slack' the soil contained 3·0–3·7 per cent calcium carbonate and the reaction was *p*H 7·5. The dune ridges on either side of the 'slack' contained about 0·3 per cent of carbonates and were appreciably acid (*p*H 6·8).

The dune slacks are the especial home of the bog pimpernel (*Anagallis tenella*) and the brookweed (*Samolus valerandi*). Here too in the southwest grows the giant spiked rush (*Juncus acutus*), whilst in similar situations in the Southport dunes occurs a remarkable habitat form of the grass of Parnassus (*Parnassia palustris* f. *condensata*) and also a sand form of the beautiful *Pyrola rotundifolia*. There are also certain liverworts which are peculiar to this situation, notably the rare *Petalophyllum Ralfsii*, which exhibits perennation by means of tubers. The shallower slacks often become dry during the summer months and here occur remarkable depauperate forms of many species.

Throughout the dune development, certain continuous changes have been going on apart from the diminishing mobility and increasing water-retaining capacity to which I have especially directed attention. These are the progressive leaching out of the soil carbonates and the augmentation of the acid products of organic decay, and so it is that we find that the prevailing alkaline condition of the young dune passes gradually into an acid state of the old. In the regions of higher rainfall, peat accumulation leads to the development of heather moor as on the old dunes of the Culbin Sands on the Moray Firth.

The progressive changes in the character of the dune soil with the passage of time are shown by the two series of data summarized below. These show the increasing acidity (diminishing pH value), increasing organic content, and decreasing content of calcium carbonate, in two dune systems. One (Blakeney) with an initially low carbonate content, and the other (Southport) in which the initial carbonate content is comparatively high.

SOUTHPORT DUNE SYSTEM

Approximate age of dunes in years	$CaCO_3$ %	Organic content %	Reaction
2	6·3	0·53	8 2
6	4·15	0·33	8·2
14	3 17	0 68	8·15
25–55	2·6	0 74	7·8
100	1·14	4 0	7·2
200–280	0·28	5 9	6·4
BLAKENEY POINT DUNE SYSTEM			
5	0·42	0·36	7·2
80	0 34	0·5	7 0
160	0 03	0·86	6 9
235	0 01	1·15	6·4
340	0·01	2·7	6·2

Whereas the young yellow dunes only possess a flora of about ten species, the later yellow dunes can support between fifty and sixty different kinds of flowering plants, and the comparatively stable grey dunes have a flora of more than a hundred, exclusive of those confined to the 'slacks'.

The specialization imposed by the physical attributes of the habitat itself have been permanently modified; but the final occupants may themselves create specialized physical conditions which once more restrict the supportive capacity of the habitat.

Landscape at the Royal Academy

IN considering pictures from the point of view of science, one is glad to subscribe to what appears to be Ruskin's central doctrine, which may be put thus: a creative artist in portraying natural subjects, whether figure or landscape, should base his work, except in so far as it is meant to be symbolic, on a scientific realism expressing the love of Nature, and should carefully restrict the selection of particular effects to the suppression of others where this is rendered necessary by the limitations of the medium.

There can be no question but that both scientific realism and the love of Nature are apparent in the pure landscape work which has figured so prominently in British art since the time of Constable, and that the annual exhibitions of the Royal Academy reflect this tradition The 1938 exhibition has the usual large proportion of landscapes amid figures, portraits, historical scenes and coronation pageantry, and in this short notice attention may be directed to a few of the landscape canvases, leaving out of account the quite strong representation in water-colour.

Mr. Sydney Lee's "Lulworth Cove" (274) well suggests location in the midst of a stretch of the Dorset coast-line, as high, rugged and fierce as any in England. The rock-contortions about the cove should please geologists, but the general alignment of the cove in relation to the open sea will certainly force attention on the laws of perspective.

Another pleasing Dorset scene is that in a small picture by Major C. E. Phillips, secretary of the Royal Institution, entitled "On the Purbeck Hills" (76). The general conformation of the land, as well as the line of stone walls in the background, would place this scene, not in the range of chalk downs that sweep round by Corfe Castle, but in the limestone ridge the upturned edge of which forms the splendid high coast between Swanage Bay and St. Aldhelm's Head.

In "Bibury Bridge" (26), Miss Kathleen M. Pearson presents a typical Cotswold scene: the delightful oolite stone, ever dominant, never out of harmony with other elements, the backing of stately elms gloriously grouped, and the foreground touch of animation given to the precincts of the village by two lads with a dog. The "Sutherland" (314) of Mr. Borlase Smart shows an inlet of the sea overlooked by mountains, but the whole power of the picture to the present writer lies in its suggestion of the wild tract of the Northern Highlands that lies behind the scene depicted. The grand simplicity of the title hints, indeed, that this is precisely the reaction the artist intends. "On the Moors, Skye" (760), by Mr. Arthur T. Nowell, is a skilful rendering of the beautiful lighting effects so typical of showery weather in the wild hills of the Western Highlands.

The background of Mr. Walter Goodin's "The River, Beverley" (429) is occupied by intensely black thunder-cloud, and the foreground, beneath brighter sky, by a great poplar obviously waving and rustling in the wind against which the storm is coming up—a most realistic example of landscape meteorology. Dazzling lightning, with the branching structure revealed in photographs, leaps across the mountains in Mr. Frederick C. Tilney's "Nothing Matters to a Machine" (571), in which a motor-car is seen speeding through a rugged defile. If it be objected that the landscape artist should paint what he sees of lightning, not what he knows about it, one can retort that some artists have extraordinary sight for lightning structure, as evidenced by Turner, in whose time photography was in its infancy.

There are various snow scenes from different parts, but that exhibited in J McIntosh Patrick's "An Exmoor Farm" (313) is peculiarly charming by reason of the delicate contrast of the expanse of misty glaucous sea, very true to type, seen away in the distance. "The Bow in the Clouds" (192) of Victor Weingott, wherein a rainbow with secondary arc appears over a number of well-portrayed human figures, may be mentioned because it is very unusual in pictures to find the luminosity of the sky so accurately graded as between the inside of the primary, and outside of the secondary, bow.

The convolutions, rifts and gulfs in the white surface of a magnificent chain of cumulo-nimbus cloud are rendered with some success in Mr. James Bateman's "Farm Yard" (227), but it may be questioned whether the lower mass of cloud to the right of the picture is in the correct plane. Lawn and trees in a midsummer setting of deep blue sky and small radiant cumulus clouds are given in Mr. Algernon Newton's "Wimpole Hall, Cambridgeshire" (407), and it is interesting to note the same type of study by the same artist on foreign soil in "The Villa Starhemberg, Bad-Ischl, Austria" (144). Lawn and trees are in brilliant sunlight in front of the villa, but stormy-looking clouds are beginning to rear up over the Alps behind, and very intense shadow is being cast by the mountain shoulder on the left—an impressive illustration, to be sure, of Ruskin's "mountain gloom". The fault of this telling picture is the uniform dull brown colour in which the foliage of the trees in front and the mountain slopes behind are painted.

Landscape art makes a unique contribution, not so well appreciated as it ought to be, to meteorological science, in fixing just those subtle scenic aspects of atmosphere and weather, in short, those imponderable elements in climate, that not only produce profound psychological reactions but also inevitably leave their stamp on the development of art and literature.

L. C. W. BONACINA

Obituary Notices

Mr. T. H. D. La Touche

WITH the death on March 30 at the age of eighty-two years of Thomas Henry Digges La Touche, the Geological Survey of India has lost its oldest member. Educated at Shrewsbury and St. John's College, Cambridge, that breeding-place of geologists, he was appointed to the Geological Survey of India in 1881, promoted superintendent in 1894 and acted as director in 1906 and 1909, retiring in 1910.

During his service of almost thirty years, La Touche acquired an exceptionally wide acquaintance with all aspects of Indian geological problems, scientific and economic. His work extended from Baluchistan in the west to the Burma-Chinese frontier in the east, and included investigations of the coal-measures of Assam, Kashmir and the Northern Shan States; the sapphires of Kashmir; oil in Baluchistan; the great silver-lead-zinc deposits of Bawdwin in conjunction with Dr. Coggin Brown; and the Lonar Lake with Dr. Christie. He also investigated the geology of western Rajputana, and his account includes a detailed petrological description of the igneous rocks of that region.

La Touche's greatest work, and the one which he himself looked back upon with legitimate pride, was the survey of the Northern Shan States of Burma. This was undertaken during the later years of his service, and from time to time he had the assistance of other members of the Department. The results, embodied in *Memoirs, Geological Survey of India*, vol. 39, part 2, with descriptions of the fossils by various specialists in the *Palaeontologia Indica*, opened up an entirely new chapter in the geological history of Burma and embodied "many valuable discoveries bearing on the question of the extension of Asian Zoo-geographical provinces during the Palaeozoic era"

In addition to his official publications, La Touche found time to edit for the Asiatic Society of Bengal, of which he was president, the journals of Major James Rennell, the first Surveyor General. He was also a superb amateur photographer, and his ingenious adaptation of the Walker balance to the rapid determination of the specific gravity of rock specimens is well known to all his colleagues.

After his retirement, La Touche's services were not lost to India. In 1914 he published "A Bibliography of Indian Geology and Physical Geography with an Annotated Index of Minerals of Economic

Value". This was followed by the index to genera and species described in the *Palaeontologia Indica*; an index to the *Records*; and finally, the last proof reaching him just before his death, the index to the *Memoirs*. This series of publications is of inestimable value to all interested in Indian geology, and the Survey can congratulate itself on being the best documented service in existence. In addition, he prepared for the Geological Society a list of literature added to its library during the War period.

La Touche's interest in geology was very wide, and his knowledge was always at the disposal of any inquirer. His work is characterized by a minute attention to detail, a scrupulous accuracy of observation, and a strict regard for truth. He received no recognition from official nor from non-official bodies, but he has left behind him a record of a lifetime's work which can rarely have been equalled, and a lasting monument to his industry, the more surprising as he suffered throughout his career from greatly impaired sight.

La Touche married Miss Handy, an Irish lady of great charm, and had five children, two boys and three girls. One son was killed in the War while the other carries on the family tradition of service in the East as a member of the Burma Forest Service. To his widow and the surviving members of the family the sympathy of all his old colleagues is respectfully tendered.

G. H. TIPPER.

Prof. John Taylor

BY the death of Prof. John Taylor on April 11, Irish engineering has lost one of its best known figures. Born near Gask, Perthshire, in 1865, he received his early engineering training in Glasgow at the Cowlairs Locomotive Works of the late North British Railway. In 1888 he won a Whitworth exhibition from the Anderson Technical College, Glasgow, and a Royal scholarship tenable at the Royal College of Science for Ireland, and proceeded to Dublin. He took the associateship of that College in 1891, after which he received a junior appointment on the staff and in 1902 became lecturer in engineering. In the University of Dublin, in 1903, he gained the large gold medal and senior moderatorship in experimental science. In 1929, a few years after the Royal College of Science for Ireland had been taken over by University College, Dublin, he was appointed professor of mechanical engineering in the National University of Ireland. About two years ago he received the degree of D.Sc. (*honoris causa*) of the National University.

Prof. Taylor did much work on the causes behind the failure of materials, and his technical advice was frequently sought by Irish public bodies. He conducted tests necessary for the planning of the dam in connexion with the proposed hydro-electric undertaking of the Liffey scheme at Poulaphouca, and carried out experiments with fish passes for the Shannon hydro-electric scheme. In recent years he devoted a considerable amount of his time to an investigation into the efficiency of turf burning appliances, a study which he undertook at the request of the Industrial Research Council of Eire, of which he was a member. His work in this connexion has already resulted in efficient domestic cooking ranges, suitable for the Irish turf consumer, being placed on the market.

In his teaching work, Prof. Taylor was noted for his thoroughness and enthusiasm. During his long career as a teacher a very large number of students passed through his hands, by all of whom he will be remembered as a man of the highest character with the most conscientious devotion to duty.

Mr. F. J. Gould

MR. F. J. GOULD, who died on April 6, was one of the most devoted and persistent workers in the cause of humanism and world peace. He was born in 1855 and kept up his activities in writing and speaking for his faith to within a few weeks of his death. He himself published annually an account of what he had done in the way of writing, editing and above all giving moral lessons to the young, and this amazing record moved large numbers of persons to subscribe to a sustentation fund which had become necessary for him when his uneasy relations with the London School Board came to an end in his early years. He had been an assistant master in East End elementary schools, and the kind of religious teaching which was required of teachers in those days was much more hotly debated than it is now in less dogmatic days. But Gould's ideal was never in doubt and never changed. He advocated from first to last the teaching of a sympathetic outline of the chief faiths of the world and the education of the young mainly by moral and historical lessons based on the admirable features of the past.

Gould had in early years been deeply influenced by the Englishmen, who, like Frederic Harrison, owed their spiritual direction to Auguste Comte. To this he added a strong socialist leaning and a faithful association for more than fifty years with those who defended the claims of free thought in the pages of the *Literary Guide* and elsewhere. His apostolic journeys took him over the greater part of the United States as well as India, while for many years he laboured as secretary for the International Congress of Moral Education. He acted in this capacity in London, The Hague, Geneva, Rome, Paris and Cracow. Before the Hitler régime he had been co-operating with liberal-minded Germans on a plan for an improved and more international method of teaching history. This perhaps was his deepest and most abiding motive.

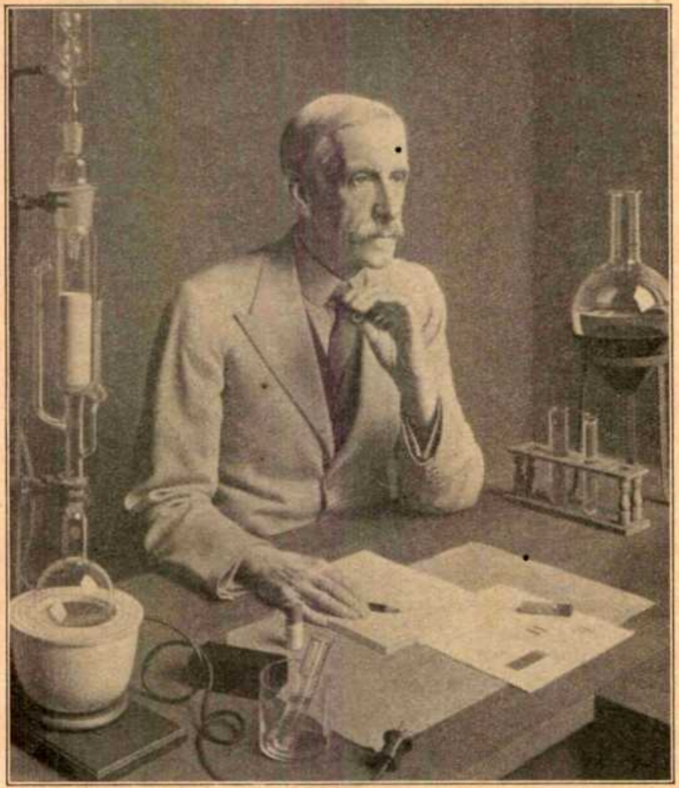
Gould's mind was a rare compound of peaceful and loving appreciation of men and opinions of every type, combined with an unbending and untiring tenacity in promoting the type of thought to which as a young man of just over twenty he had given his allegiance. It may be safely predicted that one day—and not very far distant—his name and work will be more loudly acclaimed and recognized than they have been in the first days following his demise.

F. S. MARVIN.

News and Views

Scientific Associations of the Royal Academy

Among the portraits of men of science and others known in scientific circles in this year's Royal Academy Exhibition, that of Sir Frederick Gowland Hopkins (196), by Meredith Frampton, a reproduction of which appears on this page, has led to considerable discussion as to extent to which a portrait should dominate its background. Other portraits to which reference may be made in these columns are: Sir David Milne-Watson, Bt., governor of the Gas Light and Coke Company (166), by Harold Knight; Sir Joseph Barcroft (263), by R. G. Eves; Lord Wakefield (371), by I. M. Cohen; Sir Frederick Moore (600), by Dermod O'Brien; and Havelock Ellis (1094), by Robin Guthrie. There is a sculptured head of Sir Michael Sadler (1571), by Loris Rey; and a head of Kelvin (1564), by Norman Tyrrell. Among the medals are that of the Institute of Metals (1471), by Harold Stabler; and the Hele Shaw Medal of the Institution of Mechanical Engineers (1485), by H. Paget. The architectural drawings include the National Institute for Medical Research at Mill Hill (1260), by Maxwell Ayrton; Beaumont Street extension of the Ashmolean Museum, Oxford (1277), by Stanley Hall and Easton and Robertson; the completed scheme of the house of the British Medical Association (1317), by Douglas and J. D. Wood; and the Palaces of Engineering (1360) and Industry (1366) of the Empire Exhibition, Scotland, 1938, by Thomas S. Tait.



Sir Frederick Gowland Hopkins, O.M., F.R.S.
By Meredith Frampton, A.R.A.
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Dr. W. F. K. Wynne-Jones

Dr. W. F. K. Wynne-Jones, whose election to the chair of chemistry in University College, Dundee, in succession to Prof. A. McKenzie is announced on p. 843, was educated at Monkton Combe School, Bath, whence he proceeded to the University College of Wales, Aberystwyth, and to Balliol College, Oxford. Later, as research assistant to Prof. J. W. McBain at the University of Bristol, he carried out experimental work on the Gibbs adsorption equation. In 1927–28, during the tenure of a Rockefeller fellowship, Dr. Wynne-Jones undertook a research on the problem of acids and bases under the direction of Prof. J. N. Brønsted in the University of Copenhagen. In 1933, he was awarded a Leverhulme fellowship which he held at Princeton University; where, in the laboratory of Prof. H. S. Taylor, he worked on the extent of the electrolytic dissociation of heavy water and the comparative rates of ionization of hydrogen and deuterium. In 1935 he published, in collaboration with Prof. H. Eyring, an important paper on the absolute rate of reactions in condensed phases. His recent work has furnished new information on the mechanism of ionic reactions. Since 1928, Dr. Wynne-Jones has held a lectureship in physical chemistry at the University of Reading.

Coal and Smokeless Fuel

The Coal Measures of Great Britain, for all the depression in the coal industry, are still a great national asset. The article on "Oil from Coal" on p. 812 of this issue brings up once again the question of their proper utilization. It is common knowledge that it is technically possible to produce motor-spirit from coal: the difficulty is to find a reasonably satisfactory method. It appears, however, that we are now reaching a stage when it is legitimate to regard our seams of coal in the light of a series of oil-bearing deposits, since 'crudeable' products can now readily be produced from them. If the estimates of production costs given by Mr. Strevens and Mr. Cross are correct, and the coal-oil distillation process is the cheapest available, then, on the basis of this process, the Coal Measures of Great Britain are comparable with good medium-grade oil sands or shales.

The economically workable oil deposits of the world yield crude petroleums giving from 20 to 70 per cent of motor-spirit; the crude distillates produced from British coals by coal-oil distillation give 35–45 per cent or more; thus they fall in the middle of the range, on a par, for example, with Southern California oil stock. We should also recollect two further points. First, the hazards of extracting coal from the coal measures are, in general, considerably less than those of extracting petroleum from oil deposits. These latter hazards may be visualized by recalling that nearly a third of the million or so oil wells drilled in the U.S.A. are stated to be dead or abandoned. Secondly, the world's total reserves of motor-spirit to be extracted from coal are considerably larger than those to be extracted from petroleum.

There is another aspect of the question. The coal-oil distillation process yields a considerable amount of high-grade smokeless fuel. Thus its development might serve a triple function. It might in the first place (like any other satisfactory process of obtaining motor-spirit from coal) render Great Britain less dependent on external supplies of motor-spirit. In the second place, at any rate so long as tax discrimination in favour of home-produced motor-spirit is continued, it opens up the possibility of establishing an export trade in cheap smokeless fuel, thus helping materially to relieve unemployment and economic distress in the coal industry. In the third place, like any other process yielding cheap smokeless fuel, it holds out a hope of ridding Britain of much of the smoke which is not only productive of so much waste and material damage, but also so destructive both of health and of amenity. It is clear that we are entering on a new phase as regards coal. In the first, pre-industrial stage, coal was little more than a curiosity—a combustible mineral which here and there was used in preference to wood. In the second place, coal became the mainspring of industry, but was regarded simply as a fuel. In the third phase, now dawning, we must accustom ourselves to think of coal as a raw material generally demanding special treatments for its proper utilization. The new concern for health and social welfare is demanding that methods for preventing smoke shall be adopted, even if at some economic sacrifice. Coal-owners and public alike must learn to regard coal as a store of riches which it is for science and technology to unlock and make available.

Bureau of Animal Population

The modest report of the Bureau for 1936–37 contains much of practical as well as of scientific interest, and this is vouched for by the contributions made towards its upkeep by the Medical Research Council, the Forestry Commission, the Agricultural Research Council, Imperial Chemical Industries Ltd., the Partridge Research Fund, and Hudson's Bay Company Ltd. At the same time, these varied patronages suggest something of the extent of interests served by Mr. Elton and his colleagues. The research on vole populations in itself touches upon many interests: fluctuations in numbers of voles are of immediate concern to the farmer and forester, and to the ecologist they present problems still awaiting solution; the discovery of a disease closely resembling tuberculosis in a large proportion (22 per cent) of voles trapped in areas ranging from the north-east of Scotland to Buckinghamshire, may give a clue to the high death-rate which closes a vole plague, and may have some relationship with human and bovine tuberculosis. These and other vole matters are engaging the attention of a strong team of scientific workers. Research on partridge fluctuations continues, and from 1938 for a period of three years at least, data are to be collected and a much-needed analysis is to be made on the periodic fluctuations of rabbits and hares in Great Britain. It says something for the desirability of scientific investigation and propaganda, that in the report from the Select Committee of the House of Lords on Agriculture (Damage by Rabbits), running to some 270,000 words, less than a hundred were devoted to research.

Apart from its British inquiries, the Bureau has given its help to investigations in North America on fluctuations in numbers of the snowshoe rabbit, an arctic wild-life inquiry, and on the evidence in the Hudson's Bay Company's archives of a ten-year cycle in fur-bearing animals. The only unsatisfactory feature of the report is concerned with finance. Although in this respect the position of the Bureau seems more assured than in former years, the fact that it is kept in being by grants drawn from fourteen different sources, suggests that the collecting of moneys must occupy an undesirably large proportion of the time and energy of the scientific worker responsible for its organization, and that the staff must be labouring under some uncertainty as to their future. Neither condition is conducive to the best scientific work, and we look forward to a day when the Bureau will become an integral part of a State-organized biological survey.

The Ebro and Zi-Ka-wei Observatories

It has been from time to time a pleasure during the protracted civil war in Spain to receive the *Boletin del Observatorio del Ebro* and to realize that the famous Jesuit observatory was working away peacefully in Republican Spain. Father Rodés and his staff have been carrying on their heliophysical, meteorological and seismological work steadily with support from the Government—last year their grant was paid in full—the autonomous Government of Catalonia and the municipal councils of Villanova and Geltru, though they have been faced with severe difficulty in securing necessary scientific material and have been naturally unable to collect meteorological data from their observers scattered throughout Spain. Now comes the sad news, reported by the Burgos correspondent of *The Times* (April 25), that the tide of war has swept over them and that instruments have been dismantled and damaged during the hostilities, while the director, Father Rodés, has been taken to Barcelona. It is to be hoped that he will soon be released and enabled to return to his observatory and to restart the many series of observations of international importance that have been thus forcibly interrupted. Nothing much has been reported about another famous Jesuit geophysical observatory, that at Zi-Ka-wei, close to Shanghai, with its astronomical sub-station at Zô-Sè, some forty miles away. They, too, have lain in a ravaged war zone, but their latest publication from Zô-Sè ("Perturbations générales par Jupiter et Saturne sur 40 petites planètes", par le P. E. de la Villemarqué, *S.J.*) received less than a week ago, suggests that the astronomers have been allowed to carry on unmolested.

Royal Institution

THE annual meeting of the Royal Institution was held on Monday, May 2. In the unavoidable absence of the president, the chair was taken by Sir Robert Robertson, treasurer and vice-president. The customary report of the Committee of Visitors and statement of accounts were presented at the meeting. It was stated that the vacancy in the professorship of natural philosophy caused by the death of Lord Rutherford has not yet been filled; Sir James Jeans has been re-elected professor of astronomy and Sir Frederick Keeble has succeeded Sir Edward Mellanby as Fullerian professor of physiology. An important addition has been made to the equipment of the lecture theatre by the installation of a talking cinematograph projector, which it is expected will be of increasing value as talking films and films with sound effects come more generally into use for lecture illustrations. Early last year, a fire at No. 19 Albemarle Street, which is partly occupied by the Institution, was fortunately discovered and extinguished before it had become extensive; the damaged books and other effects have now been restored, and the loss was fully covered by insurance. The treasurer's report showed that the legacy of the late Mr. Harry Brown, now completed, has resulted in an addition to the funds of the Institution of no less than £30,987 3*s*. 2*d*. Important subsidies for the researches in progress include £500 per annum for a further period of three years from the Anglo-Iranian Oil Company, £500 per annum for five years from the Leverhulme Trustees, and a Coronation gift of £2,000 from Sir Robert Mond.

"MEMBERS are less familiar with, because they see less of, that important part of the Institution's activities, the research work which is carried on under Sir William Bragg's direction," say the Visitors in speaking generally of the Royal Institution's work. The wide range and great interest of the researches may be gathered from the report of the Davy Faraday Laboratory, printed as a supplement to the Visitors' report. Researches quoted include those on the X-ray structure analysis of nickel phthalocyanine and stilbene; on the dielectric polarization of long-chain ketones, and on the X-ray study of metals, beginning with the elastic properties of single crystals of sodium. The optical work on methane and CH_3D has been further developed, and a new type of absorption tube, using the Rowland grating, has been employed. It is recorded that the large X-ray generator has now been tested to its full capacity of 50 kilowatts; and a research programme in connexion with this generator, including high-dispersion measurements on metals, is spoken of. The following officers were elected at the meeting: *President*, Lord Eustace Percy; *Treasurer*, Sir Robert Robertson; *Secretary*, Major Charles E. S. Phillips; *New Managers*, Sir Frederick Berryman, Dr. F. H. Carr, Prof. F. L. Hopwood, Mr. P. V. Hunter, Sir Richard Paget, Dr. A. O. Rankine, Dr. R. Seligman, Prof. G. P. Thomson; *New Visitors*, Dr. W. R. Bisschop, Mr. E. R. Bolton, Dr. W. A. Caspari, Prof. C. D. Ellis, Dr. W. Hall, Prof. J. T. MacGregor-Morris, Dr. L. C. Martin, Mr. C. Rowntree.

Exhibition of Buddhist Paintings

IN the exhibition of Buddhist paintings now open in the Edward VII Gallery of the British Museum (Bloomsbury) the examples shown have been selected with the view of demonstrating the different types of religious painting which have been produced by Buddhist thought and belief in the varying environment of, so far as possible, the whole of mid- and farther Asia. It covers the manifestations of Buddhist religious art in China, Japan, Korea, Siam, Tibet and Turkestan. No equally comprehensive exhibition has ever been held previously in England. The opportunity for such a display has arisen through the acquisition of several important paintings from Korea and Siam with the Eumorfopoulos collection, which also includes the first two examples to reach the Museum of the wall paintings recovered from Turfan by A. von Le Coq. Tibetan painting is represented by a selection from a series of the sixteen Arhats and the four Lokapalas from a temple at Shigatse, deposited on loan by Mr. J. C. French. They are much earlier than those usually seen in Europe. Of great interest to the student of early Far Eastern painting are the Japanese reproductions in collotype of the famous eighth-century wall paintings from the Buddhist shrine at Hōryūji. The five shown are each twelve feet high. These paintings are especially remarkable, owing to the fact that they are examples of the fresco art of the T'ang period of China, which has vanished from her own soil. In an official account of the exhibits, it is justly pointed out that the key to the exhibition is the full selection from the paintings recovered by Sir Aurel Stein from the sealed chamber of the Caves of the Thousand Buddhas, near Tun-huang in Sinkiang. Some of the woodcuts from the same source are the earliest known in the world. To round off the demonstration, reproductions of the Ajanta frescoes are shown as an indication of the different kind of painting produced in the original home of Buddhism. The common bond in the religion which all these schools of painting served, indicates the extent to which these parts of Asia formed a cultural unity; while the examples themselves illustrate the richness and variety of religious painting in the East.

Special Libraries and Information Bureaux

THE Association of Special Libraries and Information Bureaux held a luncheon on April 27 at which a company of more than eighty was present. After saying that he hoped the luncheon would become an annual event, the president, Sir Harry Lindsay, director of the Imperial Institute, spoke of the three stages of science: first scholasticism, dominated by the great men of science, then the period of the authoritative text-books, now the era of the individual specialist. The results of modern scholarship are scattered in innumerable technical journals and, in order to keep abreast, search must be made over a very wide field. The same is no less true of other spheres of knowledge. ASLIB was therefore formed to act as a guide to specialist sources of information. The next speaker, Sir Clement Hindley, chairman of the Racecourse Betting Control Board, mentioned his connexion, as vice-president, with the Institution of Civil Engineers. The Institution's abstracting service, started so long ago as 1877, he said, has recently been considerably expanded in collaboration with other institutions representing different branches of engineering. This expansion should interest all who, as members of ASLIB, are eager to facilitate the dissemination of knowledge. Sir Ian MacAlister, secretary of the Royal Institute of British Architects, stated that in the nineteenth century people created every sort of institution and machine, political, social and mechanical. In the post-War years of disillusionment, we realized that machines are of no use unless they work, museums are a costly extravagance unless their treasures can be made intelligible, and libraries are mere hoards of books if inaccessible to those who need them. A new desire to make the instruments of civilization work is now awake, and ASLIB is a valuable and essential part of this great movement.

Prehistoric and Primitive Iron Smelting

IN a paper bearing the above title read to the Newcomen Society on April 20, Mr. E. W. Hulme reviewed the history of the use and manufacture of iron through a period of about 3,000 years, from the date of the earliest known examples of beads made of meteoric iron down to about the first millenium. The first example of terrestrial man-made iron, he said, was the iron dagger found by Woolley at Tell Asmar in Mesopotamia. Unlike objects made from meteoric iron, this is free from nickel. Besides the objects found in tombs and the fragmentary records such as the diplomatic correspondence recorded in the clay tablets of Egypt and Asia Minor, Mr. Hulme dealt with the sites and processes associated with early iron making. These included the Egyptian by-product iron process by which very small amounts of iron were obtained from sands containing magnetite and gold; the Wootz steel-industry of southern Central India, the Chalybian steel process described by the Pseudo-Aristotle (fourth century B.C.), the iron industry of Persia and the Gerar forges of Southern Palestine. The claims of Persia to rank amongst the earliest makers of iron have been overlooked, but if they can be substantiated the migration of the industry to China, India, Syria and Palestine becomes explicable. When referring to the Gerar forges of Palestine described by Sir Flinders Petrie, Mr. Hulme said that though his interpretation of the purposes of the furnaces differed from that of Sir Flinders, "for the recovery of these dateable sites and for the meticulous accuracy in the description of the large output of these forges, all metallurgists owe a warm debt of gratitude to the veteran explorer who has done so much to recreate for them the history of Egypt and the Near East".

Paris Television Transmitter

ACCORDING to a note in the *Wireless World* of April 21, a new television transmitter at the Eiffel Tower, Paris, was inaugurated on April 8 by the Minister of the French postal and telecommunications service. The transmitter, which has been in regular operation since September 1937 with reduced power, will shortly be broadcasting with its peak output of 30 kw., thus making it one of the most powerful television stations in the world. The aerial is supported by the Eiffel Tower and connected to the transmitter by a cable 380 metres long. Two new studios with the most up-to-date equipment are situated at distances of 2·5 and 5 kilometres from the transmitter, to which they are connected by co-axial cables. The vision modulation frequencies are impressed on a carrier frequency of 5·5 Mc./sec., the total band transmitted down the cable being from 3 to 8 Mc./sec. The transmitter is designed to operate on a frequency between 40 and 50 Mc./sec., at its continuous peak power output of 30 kw. The frequency is maintained constant within narrow limits by a quartz crystal oscillator, followed by two doubler stages, which raise the frequency to the final carrier value. Some further technical details of the transmitter are given in the article to which reference is made above.

X-Ray and Radium Protection

THE fifth revised report (January 1938) of the British X-Ray and Radium Protection Committee shows that the Committee is alive to the necessity of continually adjusting its recommendations to the expanse of its subject. The chief additional items in this report are to be found in Section v, dealing with the necessary electrical precautions in X-ray rooms, in Section viii (*C*), which deals with radium teletherapy, and in Section ix, where the incidental dangers in the use of electro-medical apparatus, especially apparatus activated from the mains circuit, are considered. This report contains a valuable appendix giving the equivalent thickness of lead and materials in use for general radiation protection; the data are supplied by the National Physical Laboratory. The services of the Laboratory are largely made use of by those in charge of radiological departments, both in a consultative capacity in planning, and for purposes of test when the assembly of apparatus is completed. Copies of the report are sent free on application to the Hon. Secretaries of the Committee, 32 Welbeck Street, W.1.

Pests of Ornamental Plants

THE attention of garden lovers and horticulturists is directed to Bulletin 97 of the Ministry of Agriculture and Fisheries, entitled "Pests of Ornamental Garden Plants" (1937). This publication deals with an aspect of horticulture seldom adequately treated in text-books on insect and other pests. The problem of controlling pests in gardens is, moreover, different from that of the commercial grower. The author of this work is Mr. G. Fox Wilson, entomologist to the Royal Horticultural Society, and he has provided authoritative and practical advice on the pests in question. General measures of control are discussed and the different pests are described under their respective headings, such as lawns, the annual border, rock garden, glass houses and so on. The work is well and fully illustrated, while the price of 3*s*. 6*d*. net is very reasonable for a Bulletin strongly bound and containing more than 100 pp. of letterpress. It can be obtained from H.M. Stationery Office, Adastral House, Kingsway, W.C.2, or through any bookseller.

A Binocular Illusion

REFERRING to Prof. H. H. Dixon's letter in NATURE of April 30, Miss E. Armitage, Dadnor, Ross, Herefordshire, writes to suggest that the checkerboard appearances may be akin to that commonly observed when studying photographs of lunar phenomena, the 'walled plains' sometimes appearing as convexities and sometimes as concavities, according to which side the shadow appears to fall.

World's Congress of Faiths

A WEEK-END Congress of the World's Congress of Faiths (Continuation Movement), of which Sir Francis Younghusband is chairman, will be held at Regent House, Cambridge, on June 24–28, when the subject under discussion will be "The Renascence of Religion". Addresses will be delivered by representatives of the various religions, with discussions to follow. Among the speakers who have already promised to address the Congress are Sir Sarvepalli Radhakrishnan, Spalding professor of eastern religions in the University of Oxford, for whom Canon C. E. Raven, regius professor of divinity in the University of Cambridge, will take the chair, and Baron E. K. Palmstierna, formerly Swedish Minister to the Court of St. James, for whom the Master of the Temple, Canon H. Anson, will preside. Members of the Congress will be accommodated in St. John's College (men) and Newnham College (women). Particulars of membership and other arrangements may be obtained from the Secretary, World's Congress of Faiths, 36 Victoria Street, London, S.W.1.

Presentation of Kelvin Gold Medal

THE Kelvin Gold Medal for 1938 was presented to Sir Joseph Thomson, master of Trinity College, Cambridge, in recognition of the eminent services he has rendered to engineering science, by Lord Rayleigh, in the Great Hall of the Institution of Civil Engineers on May 3. The executive committee of the memorial fund to Lord Kelvin, representative of nineteen British and American Institutions, decided that the balance of the Fund, after defraying the cost of a window unveiled in Westminster Abbey to the memory of Lord Kelvin in July 1913, should be applied to the establishment of a Kelvin Gold Medal to be awarded triennially as a mark of distinction in engineering work or investigation of the kinds with which Lord Kelvin was especially identified. The award of the first Kelvin Medal was delayed by reason of the War, and it was not until 1920 that the first award was made to the late Dr. W. C. Unwin (Great Britain). The following awards have since been made: Dr. Elihu Thompson (United States); Sir Charles Parsons (Great Britain); M. André Blondel (France); Marchese Marconi (Italy); Sir Ambrose Fleming (Great Britain).

Presentation of James Alfred Ewing Medal

MR. S. B. DONKIN, president of the Institution of Civil Engineers, presented the James Alfred Ewing Medal to Mr. Charles Samuel Franklin immediately before the delivery of the James Forrest Lecture by Sir Frank Smith. This Medal was founded in 1936 in memory of Sir Alfred Ewing, an honorary member of the Institution, and is awarded for specially meritorious contributions to the science of engineering in the field of research, on the recommendation of the presidents of the Royal Society and of the Institution of Civil Engineers. Mr. C. S. Franklin is well known for his inventions and developments in connexion with beam wireless. The rotating beam aerials installed experimentally at Poldhu in Cornwall were designed by him, whilst he was also responsible for the concentric feeder system for supplying energy to radio aerials and enabling extremely high-frequency currents to be transmitted along a line without loss. These feeders are used in the beam system and are essential to television transmission circuits.

Ninth International Ornithological Congress

THE ninth International Ornithological Congress, which will be attended by ornithologists from every part of the the world, will be held in Rouen on May 9–14. Later, the members of the Congress will proceed to Paris and the programme will terminate with a long excursion to the bird reserves in the Camargue. All questions concerning the preservation of birds will be dealt with at the meetings of the International Committee for Bird Preservation, which will be held immediately before the Congress. These meetings are confined to the official delegates of the national sections, which are operating in twenty-eight different countries, of the Committee. In connexion with the Congress an international exhibition of bird pictures is being held in Paris on May 14–29. British ornithological art will be represented by the works of Roland Green, G. E. Lodge, Peter Scott, Archibald Thorburn (lent by Messrs. W. F. Embleton) and A. W. Seaby (lent by Mr. A. W. Harvey Brown, Stevens and Brown Gallery).

Travelling Fellowships in Medicine

THE Medical Research Council invites applications for six Rockefeller Medical Fellowships for the academic year 1938–39. These are provided from a fund with which the Council has been entrusted by the Rockefeller Foundation of New York and are intended for British graduates who have had some training in research work in clinical medicine or surgery, or in some other branch of medical science, and are likely to profit by a period of work at a centre in the United States or elsewhere abroad, before taking up positions for higher teaching or research in the United Kingdom. The stipend will ordinarily be at the rate of £360 per annum for a single Fellow, and of £480 per annum for a married Fellow. Travelling expenses and some other allowances will be paid in addition. The Council also invites applications for four Dorothy Temple Cross Research Fellowships in tuberculosis, which are awarded from a special endowment of which the Council is the trustee. The object of these fellowships, as defined in the trust deed, is to give special opportunities for study or research to suitably qualified British subjects of either sex "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms". The stipend will ordinarily be at the rate of £360 per annum for a single Fellow, and of £480 per annum for a married Fellow, with an allowance for travelling and incidental expenses. Completed applications for fellowships of either type must be lodged with the Council not later than June 1. Further particulars and forms of application are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

Announcements

THE Council of the Royal Society of Edinburgh has awarded the Neill Prize for the period 1935–37, to Prof. William J. Hamilton, St. Bartholomew's Hospital Medical College, for his contributions to the embryology of the ferret and other work published in the *Transactions* of the Society.

THE first of the two annual soirées of the Royal Society will be held on May 18.

THE Frankfort Senckenburg Society of Natural Science has awarded Prof. W. H. Hoffmann, director of the Finlay Institute of Havana, the Great Iron Medal of Honour, which is the highest distinction conferred by the Society, in recognition of his researches on tropical medicine.

IN NATURE of April 23 (p. 745), two record-breaking flights in gliders were announced. A new distance record was made on April 30 by Mr. Philip Wills, who flew from Heston to St. Austell in Cornwall, a distance of about 206 miles.

THE Challenger Society will be making further grants in aid of research during the current year. The general committee is prepared to consider applications for some grants in aid of research in marine biology, the work preferably to be carried out at one of the recognized laboratories. Applications, accompanied by details of the proposed research, should reach the Honorary Secretary, Mr. J. R. Norman, British Museum (Natural History), S.W.7, before the middle of June.

FARMERS and all interested in agriculture in its practical, technical or educational aspects are cordially invited to visit the Rothamsted and Woburn Experimental Stations at any convenient time between the beginning of May and the end of October. Mr. H. V. Garner and Capt. E. H. Gregory will be in charge of the demonstrations, and there is ample material at either of the farms to occupy a full day. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden.

THE Royal Sanitary Institute is giving a further course of lectures and demonstrations on pasteurization for medical officers of health, sanitary inspectors and others interested on May 26 and 27. Further information may be obtained from the Secretary, Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1.

AN institute for the study of the causes and treatment of influenza has recently been established at Budapest.

THE Cuban Government has recently allotted a million dollars from its lottery funds for a campaign against tuberculosis. Clinics are to be established throughout the country for the examination of every citizen.

THE first French Congress of Good Bread will be held at Nice on May 14 and 15. Further information can be obtained from the General Secretary, M. Robert Septembre, 16 rue de l'Hotel des Postes, Nice.

THE International Red Cross Conference, which was to have met in Madrid this year, will be held in London on June 20–24. The opening and closing sessions will take place at St. James's Palace, and the other meetings at the British Medical Association House, Tavistock Square, where further information can be obtained.

THE third International Congress of Tropical Medicine, which was to have been held at Amsterdam, and the third International Malaria Congress, which was to have been held at Madrid in 1935, had both to be postponed, but a joint congress will be held at Amsterdam on September 24–October 1 under the presidency of Dr. G. Gryns. Further information can be obtained from the Secretary, Mauritskade 57, Amsterdam 0.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Notes on points in some of this week's letters appear on p. 836.

Correspondents are invited to attach similar summaries to their communications.

AN ETHICAL DECLARATION FOR THE TIMES

In the last few years several of the most enlightened communities of Europe have been dispersed, and the principles of justice and tolerance openly challenged. More than this, the conception of the objective truth which is the basis of science and of all human progress is being steadily undermined. European civilization has had profound failings, but we must either devote our energies to maintaining and developing what is good in it or accept a collapse into a barbarism of violence and intolerance. The greatest danger to-day lies in the complacent illusion — seen so often in history and now prevalent in the more fortunate countries—that civilized traditions are an inalienable legacy which can be enjoyed indefinitely by generations which are no longer ready to make sacrifices for them.

It is my belief that men in all countries who do not wish to betray the tradition they have inherited must now discard false modesty and announce clearly for what they stand. We do not deserve and we shall not long retain the fruits of a civilization to which we do not declare and prove our active loyalty. More than two thousand years ago the Hippocratic Oath was used to promote amongst practitioners of the art of medicine certain standards appropriate to their task. It is suggested that a Declaration such as that here reproduced should be offered to-day by cultural, educational, and technical institutions throughout the world to their members. The advance of intolerance and of the lie can only be reversed by awakening a militant loyalty to the principles of a world civilization, and this loyalty must be focused in special symbols and instruments.

DECLARATION

I AM the inheritor of the tradition of civilization which has proved more lasting than empires. Whenever I use the language or the products of science I unconsciously pay homage to the countless men for whom no sacrifice was too great in the struggle to develop the human mind and establish the truth. Toleration and freedom are the heart of this tradition; for individual thought and love of truth are the basis not only of science, but also of justice and of civilization.

I DECLARE my loyalty to this tradition, my belief in the freedom of the individual to develop his talents for the enrichment of the community, and my conviction that man's community is now the whole human race, within which each nation must play its characteristic part. The natural balance between personal freedom and the proper demands of society, which is the life and health of civilization, is to-day doubly threatened: in certain societies by the denial of freedom and in the democratic countries by the irresponsibility of individuals. In the face of this threat:

I PLEDGE myself to use every opportunity for action to uphold the great tradition of civilization, to protect all those who may suffer for its sake, and to pass it on to the coming generations. I recognize no loyalty greater than that to the task of preserving truth, toleration, and justice in the coming world order.

Though the Declaration is designed on the broadest human basis to appeal to all who understand what civilization means, it is appropriate that it should appear first in Nature. Science is to-day the only non-partisan and universal authority, and its principles are at stake. If the Declaration is timely it may either serve as the stimulus to a special declaration of scientific faith by the scientific organizations in all countries, or spread from this background to wider circles.

The Declaration is copyright-free for reproduction or translation. Arrangements have been made to have it printed on cards, and copies may be had from For Intellectual Liberty, 23 Haymarket, London, S.W.1. at cost price.

L. L. Whyte.

9 Stafford Mansions,
Stafford Place,
London, S.W.1.

Carriers of Foot-and-Mouth Disease

THE highly sporadic character of the occurrences of foot-and-mouth disease in Great Britain and its apparently repeated importation from the Continent have naturally caused much speculation about possible vectors, though the special difficulties of the case have prevented the direct demonstration of carriage.

Birds have often been incriminated, and Prof. A. C. Hardy, in his letter in NATURE of April 2, further suggests that insects may be carried far enough by air-currents even over the sea, to be considered also as possible carriers.

Neither birds nor insects can, however, be regarded as primary vectors, since neither group, so far as is known, can harbour the virus systemically, and viruses do not survive extra-cellularly for more than short periods. They can only be secondary carriers of the true agent of transmission. This might take the form of skin or hair particles or excreta of infected animals, adherent to the carrier, though the probability of birds, at any rate, becoming heavily contaminated in this way is not very great. It is not even necessary, in such circumstances, to assume the need for any vector, since the carrier material may equally well be disseminated by wind.

In this connexion it is perhaps worth while to direct attention to the work of L. A. Silber and his co-workers[1,2] and of Poppe and Busch[3] on the symbiosis of viruses and yeasts. The former have shown that smallpox and vaccinia viruses enter the yeast cells and form a close union with them, of an enduring character. The virus-yeast complex is passed intact from cell to cell during proliferation and the virulence may apparently be retained for an unlimited period. Variola virus has been propagated in this way through more than a hundred cell-generations. Poppe and Busch showed that the same is true of the foot-and-mouth virus, which also remains viable with the yeasts in serial sub-culture.

Yeasts of many kinds, *Torulopsis*, *Rhodotorula*, *Mycotorula*, *Candida*, *Sporobolomyces*, etc., abound in the soil and in the atmosphere, in which latter they sometimes outnumber the bacteria. In the air they seem to have a random distribution, considered as a population, but this is not the case for particular species, which are often to be found in local concentrations, strongly suggesting, as Trillat[4] claimed, that they can multiply in the air.

The possible importance of the aeroplankton yeasts as virus carriers is not, of course, limited to the case of foot-and-mouth disease, but it cannot be overlooked in any case. If it can be proved that yeasts carrying viruses of any type occur naturally in the free atmosphere, then the impossibility of precluding chance infection must be manifest and the importance of immunity in the subject is correspondingly enhanced.

The suggested role of yeasts as carriers is not limited to animal viruses. It may also provide the clue to the apparently vectorless outbreaks of tobacco necrosis recorded by Smith and Bald[5] and to Smith's observation of an air-filter contagion[6].

R. C. McLEAN.

Department of Botany,
University College,
Cardiff.
April 11.

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[1] Silber and Wostruchowa, *Z. Bakt.*, Abt. 1, Orig., **132**, 314 (1934).

[2] Silber and Timekow, *Z. Bakt.*, Abt. 1, Orig., **133**, 242 (1935).

[3] Poppe and Busch, *Z. Bakt.*, Abt. 1, Orig., **136**, 385 (1936).

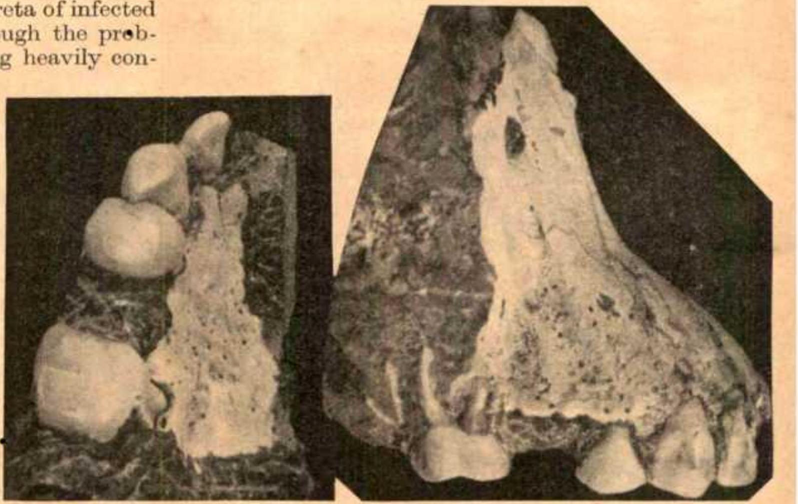
[4] Trillat, *Comptes rendus*, **170**, 1291 (1920).

[5] Smith and Bald, *Parasitology*, **27**, 1 (1935).

[6] Smith, NATURE, **139**, 370 (1937).

More Discoveries of *Australopithecus*

A FEW months ago I sent an account to NATURE[1] of the discoveries of a number of teeth of *Australopithecus*. The principal of those was a beautifully preserved third lower molar, but I also had found a new third upper molar and much of a first incisor.


(*a*) (*b*)

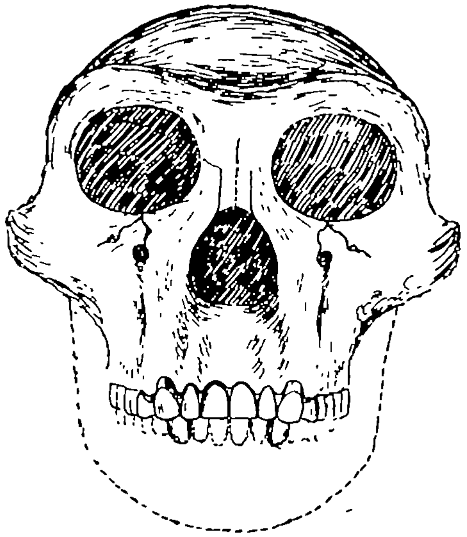
Australopithecus transvaalensis BROOM. (*a*) OCCLUSAL VIEW OF RIGHT UPPER TEETH AND PART OF PALATE; PART OF THE BACK OF THE CROWN OF THE FIRST MOLAR HAS BEEN DAMAGED BEFORE FOSSILIZATION. (*b*) SIDE VIEW OF RIGHT MAXILLA; NOTE THE REMARKABLY HUMAN-LIKE INCISOR AND CANINE. NATURAL SIZE.

Since then nothing more was found until two weeks ago, when a fairly well-preserved lower canine was discovered. This is so like a human canine that I hesitated to describe it in case it might prove to be human. The whole length of the tooth is about 32 mm., but as the tip of the crown is lost the exact length is uncertain. The crown cannot have been more than 10·5 mm. in height. The base of the crown measures 9 mm. by 6·3 mm. It is like the human lower canine, but the face of the crown is in *Australopithecus* directed more outwards than forwards. It bears no close resemblance to that of the chimpanzee either in size or shape.

Then last week I made a much more important discovery—a nearly complete right maxilla in good condition and with the second incisor, the canine, the first premolar and first molar in position. The premolar and the molar agree so closely with those of the type as to leave no doubt that the jaw is of the same species—*Australopithecus transvaalensis*.

me importance as it
much more enlarged
nd down to the same
d the second incisor ;
incisor, which is smaller
up to the canine.
eserved with part of the
ow know the width, and the
revealed that the molar teeth do
, as in the gorilla and chimpanzee, parallel
but rounded arches as in man.

The nostril measures about 23 mm. in width and the nose has probably been fairly similar to that in the chimpanzee. The infraorbital foramen is large and oval and lies 9 mm. from the orbital margin.



FACE OF *Australopithecus transvaalensis* BROOM, PARTLY RESTORED. × ½.

The face agrees fairly closely with that of the chimpanzee, except that the reduction in size of the incisors and canines makes the anterior part of the snout much narrower and shorter. One might describe *Australopithecus* as a chimpanzee with human teeth. Whether it is a descendant from a chimpanzee-like ancestor or near the common ancestor of man and the chimpanzee need not at present be more fully discussed. Most will agree that if it had large canines it would be near to the chimpanzees, and if it had a large brain it would be near to man. Possibly it is near to the human ancestor, and it may be that man arose from a form like *Australopithecus*, by a mutation resulting in a large brain. Whether such a mutation was an accident or the result of the work of some spiritual force, opinions will differ.

R. BROOM.

Transvaal Museum,
Pretoria.
April 19.

[1] NATURE, 140, 681 (Oct. 16, 1937)

Gilding of Copper among the Pre-Columbian Indians

I HAVE already given an account[1,2] of certain investigations regarding the metallurgical methods employed by the pre-Columbian Indians, especially their methods of procuring platinum in coherent form without fusing it, and I have demonstrated the metallurgical processes adopted by them in soldering by 'sweating', wire-drawing, the plating of gold with platinum, etc. Further investigations have now disclosed the fact that the Indians, at any rate those in the Esmeraldas district, gilded their copper objects in a fashion which appears to have been completely unknown hitherto, both to the ancient world and to us. It was previously supposed that such gilding must have been carried out in America with the help of mercury. Although it has been impossible to demonstrate traces of mercury in any of the gilded objects, no other explanation has been suggested.

After cleansing such objects to remove the products of corrosion and the remnants of gold still adhering to them, I have shown by chemical analysis that the copper contains varying quantities of gold in alloyed form—the largest amount on the surface and decreasing gradually towards the centre. Such unequal gold content might well be imagined to have arisen from the melted gold permeating the copper. Gilding must have been done by dipping the copper into a melted gold-copper eutectic (gold with about 20 per cent copper) the melting point of which is some 200° C. lower than that of copper ; or possibly, the gold-copper alloy was applied to the copper and kept at red heat on charcoal by means of a blowpipe. The alloy will then fuse and run over the copper without the use of flux being necessary, the reducing flame securing a glowing surface free of oxide. Investigations have shown that copper has a tendency to absorb the melted alloy in the same manner as melted tin permeates copper or a zinc rod absorbs mercury. The copper nucleus thus becomes a gold-copper alloy richest in gold at the surface, the amount of gold decreasing gradually. After the gilding process had thus been accomplished, the reddish tinge of the coating was improved by boiling out in pickle—in French, *mise en couleur*, in German, *Abochung*—a method with which, we know with certainty, the Indians were acquainted.

I have examined breastplates covered with gold, but only on one side, originating from Ecuador. These plates appear to have been beaten out from thicker plates which had already been gilded. This is quite feasible if care is taken that the gilding is not too thick. Gilding was used by the Esmeraldas Indians for other purposes than decoration. Of the thirty-five fish-hooks found, all were gilded, but not one single specimen of thirty-two sewing needles discovered. The gold which penetrates the copper fish-hooks makes the metal much harder, and hardness is the first consideration in a fish-hook.

Objects gilded in this manner are far more exposed to the attacks of corrosion than copper, and this probably has been a contributory factor to the difficulty which previous investigators have had in discovering the above facts.

Investigations have also shown that it is possible to silver copper in the same way.

A detailed statement will be made on the occasion of the Anthropological Congress which is to be held in Copenhagen this summer.

PAUL BERGSØE.

Copenhagen.
March 31.

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[1] NATURE, 137, 29 (Jan. 4, 1936).

[2] Bergsøe, Paul, "Metallurgy of Gold and Platinum among the Pre-Columbian Indians", *Ingeniørvidenskabelige Skrifter*, A., **44** (Copenhagen, 1937).

A Colorimetric Method for the Estimation of Nicotinic Acid in Foodstuffs

RECENT investigations[1,2,3,4] have shown that pellagra in human beings, black-tongue in dogs and pellagra-like symptoms in pigs, can be cured by the administration of nicotinic acid, and nicotinic acid is probably identical with, or a precursor of, the pellagra-preventive (P.-P.) factor. Hence the question of estimating the nicotinic acid content of foodstuffs is of immediate importance and interest.

A method has been developed based on the colour produced by the pyridine ring[5] when acted upon by cyanogen-bromide and aniline. A hot aqueous extract of the test foodstuff is freed from protein derivatives by lead acetate, the excess of lead being removed by sulphuric acid; the extract is brought to *p*H 10 and any colour present is removed by boiling with charcoal. The clear colourless extract is adjusted to *p*H 7·5 and made up to volume.

Aliquot portions of the extract and the standard nicotinic acid solution are each diluted with water to the same volume (20–30 ml.) in 100 ml. separating funnels; 4 ml. of freshly prepared aqueous cyanogen-bromide solution is then added to each and the mixture shaken and allowed to stand for half an hour. 4 ml. of a saturated aqueous aniline solution is then added and the mixture again shaken. The yellowish-green colour produced is then extracted three times with 10 ml., 5 ml. and 5 ml. portions of purified amyl alcohol[5] and the colours compared after standing for two hours.

The method is extremely sensitive—0·01 mgm. of nicotinic acid is easily detected—and the gradation of the colour produced is excellent for increments of 0·01 mgm. up to 0·1 mgm. of nicotinic acid. The whole procedure is simple.

The method has been applied to twelve foodstuffs. Further, known amounts of nicotinic acid were added to known amounts of yeast and raw milled rice and the recovery was good in both cases. The results are shown in Tables I and II.

TABLE I

Name of Foodstuff	Nicotinic acid (mgm. %)
Yeast, dried (brewer's) . .	62 50
Skimmed milk powder . .	10·53
Wheat, whole	5 33
Ragi (*Eleusine coracana*)	3·08
Rice, raw, milled . .	2 38
Rice, parboiled, home-pounded .. .	2·78
Cambu (*Pennisetum typhoideum*) ..	2 50
Cholam (*Sorghum vulgare*)	1·82
Maize, white	1 48
Soya bean .	4 85
Red gram (*Cajanus indicus*)	5·33
Bengal gram	4 74

TABLE II

Foodstuff + nicotinic acid	Total nicotinic acid present (mgm. %)	Total nicotinic acid found (mgm %)	Error %
Raw milled rice 10 gm + 1 mgm nicotinic acid	1 24	1·29	5
Dried yeast 10 gm +10 mgm nicotinic acid.	16 25	15 85	−4

The colour reaction is probably given by all compounds containing the pyridine ring, and the assumption is made that nicotinic acid and its derivatives form the major port [illegible] common foodstuffs. [illegible] taken to verify this [illegible]

The low value of ma [illegible] because of the associa [illegible] maize. While true pellag [illegible] like condition (stomatitis) [illegible] it is quite possible that defic [illegible] an important defect of Indian [illegible] or millet.

M. SWAMINATH [illegible]

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor,
March 7.

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[1] Fouts, Helmer, Lepkovsky and Jukes, *Proc. Soc. Exp. Biol Med.*, **37**, 405 (1937).

[2] Smith, Ruffin and Smith, *J. Amer. Med. Assoc.*, **109**, 2054 (1937).

[3] Elvehjem, Madden, Strong and Woolley, *J. Amer. Chem Soc.*, **59**, 1767 (1937).

[4] Chick, Macrae, Martin and Martin, *Biochem. J.*, **32**, 10 (1938).

[5] Stafford and Parry-Jones, *Analyst*, **58**, 380 (1933).

Selective Oxidation as a Fundamental Principle in Metallic Protection

IT is known that the oxidation or tarnishing of iron and copper can sometimes be diminished by alloying with small amounts of aluminium, beryllium, chromium and silicon, and that some oxide films confer protection or even passivity—especially when they are so thin as to be invisible. Little has been done, however, to obtain reliable protection by controlling the composition of the films. Miyake[1] has noted that, in the case of copper containing more than 3 per cent aluminium, the oxygen content of the atmosphere used for the first heating is an important factor. Sloman[2] has recommended the introduction of beryllium into silver to prevent tarnishing, but the efficacy of this addition has been questioned by Raub[3], whose work suggests to us that some factor other than the composition of the alloy determines its behaviour.

A new derivation[4] of Wagner's expression[5] $(n_1+n_2)n_3\kappa E/F$ for the velocity constant of tarnishing or oxidation reactions following the parabolic law (where κ is the electrical conductivity of the reaction product, n_1, n_2 and n_3 the transport numbers of cations, anions and electrons respectively in the film and E_0 the affinity of the reactants for each other) has suggested the necessity of producing on the metal to be protected *a film of very low conductivity*. Alumina or beryllia will possess the required properties if pure; but the analogous case of silver chloride containing traces of cadmium chloride[6] considered in connexion with the work on the conductivity of alumina[7], suggests that small traces of silver or copper oxides in the alumina or beryllia film would greatly increase the conductivity, and therefore the rate of tarnishing or oxidation.

By pre-treating alloys containing aluminium or beryllium in a controlled atmosphere—designed to permit the oxidation of the alloying constituent only and at temperatures suitable for the necessary diffusion of this constituent to the surface—protective films of pure alumina and beryllia have been obtained in these laboratories. Application of this principle of selective oxidation has led to materials almost immune from 'tarnishing' and 'scaling'. A specimen of copper containing 5 per cent aluminium heated in air at 800° C. for four hours gained 50 mgm./sq. dm., developing a loose black scale; the same alloy previously heated in a hydrogen atmosphere containing water vapour at a partial pressure 0·1 mm. (which still permits sufficient oxidation to develop a film of *copper-free* alumina), remained quite undarkened and gained only 4 mgm./sq. dm. when heated under the same conditions. Similarly, silver containing 1 per cent aluminium was found to tarnish rapidly when exposed to a polluted atmosphere, whereas the same alloy pre-heated in damp hydrogen at 400° C. so as to produce an invisible film of *silver-free* alumina, suffered no change in appearance within thirty times this period; pre-heating in air at atmospheric pressure did not reduce the tendency to tarnishing.

Several other examples could be given and full results will be published shortly. It is hoped that this principle of selective oxidation will play an important part in overcoming the deterioration of metals.

G. J. Thomas.
Laurence E. Price.
Goldsmiths' Metallurgy Laboratories,
University of Cambridge.
April 4.

[1] Miyake, S., *Sci. Papers Inst. Phys. Chem. Res.* (*Tokyo*), **31**, 161 (1937)

[2] Sloman, H. A., *J Inst Met.*, **49**, 365 (1932).

[3] Raub, E, *Mitt. Forschungs Edelmetalle*, **8**, 77 (1934).

[4] Hoar, T. P., and Price, L E., *Trans. Faraday Soc.*, 1938, Symposium on "Chemical Reactions involving Solids"

[5] Wagner, C., *Z phys. Chem*, B, **21**, 25 (1933).

[6] Koch, E, and Wagner, C, *Z phys Chem.*, B, **38**, 295 (1937)

[7] Jander, W, and Stamm, W., *Z. anorg. Chem*, **199**, 169 (1931).

Effect of Succinic Acid on the Respiration of Normal Human Muscle and Various Myopathies

Succinic acid has long been known to be oxidized rapidly by muscle and many other tissues. Experiments of Szent-Gyorgyi and co-workers[1] suggested that succinic acid and certain other dicarboxylic acids catalyse the aerobic respiration of muscle tissue. Conclusive proof for this catalysis in muscle tissue was given by Stare and Baumann[2], and its application to liver and kidney tissue was shown by Stare[3].

In current studies on the respiration of human muscle tissue, we have observed that in muscle taken from patients with myasthenia gravis and progressive muscular dystrophy, succinic acid fails to catalyse the aerobic respiration and is itself oxidized only to a very slight extent. Malonate was found to inhibit the respiration. With normal human muscle tissue we observed the expected catalytic result upon addition of succinic acid as well as malonate inhibition.

The experiments were done in Warburg manometers at a temperature of 38° C. and in a Ringer phosphate-glucose buffer at *p*H 7·4. The tissues were obtained by muscle biopsy and immediately ground in an ice-cold Latapie mincer. Succinate and malonate were added as the sodium salts in concentrations of 0·003 and 0·03 molar. The following table shows typical experiments:

Muscle	Condition	Q_{O_2}	Increase of Q_{O_2} with succinate (0 003 M)	(0 03 M.)	Decrease of Q_{O_2} with malonate (0 003 M)
Gastrocnemius	Myasthenic	3·9	+ 3 per cent	+ 8 per cent	– 47 per cent
Gluteal	Prog muscular dystrophy	3 7	+ 5 ,, ,,	+ 5 ,, ,,	– 38 ,, ,,
Abdominal rectus	Normal	3 4	+ 27 ,, ,,	+ 50 ,, ,,	– 60 ,, ,,

The percentage increase in U_{O_2} values with succinate calculated at 90 and 20 minutes were even more striking than the Q_{O_2} values presented.

These results are of particular interest since they suggest that certain disturbances in the intermediary metabolism of normal muscle may be associated with these myopathies. These experiments are being continued and will be reported in detail in a forthcoming communication.

F. J. Stare.
E. S. Gordon.
M. J. Musser.
University of Wisconsin,
School of Medicine,
Madison.
March 23.

[1] Szent-Györgyi, A, and co-workers, *Z. physiol. Chem.*, **236**, 1 (1935)

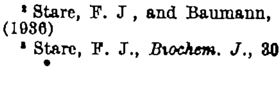
[2] Stare, F. J, and Baumann, C A., *Proc Roy. Soc*, B, **121**, 338 (1936)

[3] Stare, F. J., *Biochem. J.*, **30**, 2257 (1936).

Vitamin B$_1$ and Cocarboxylase

The appearance of a paper by Lipschitz *et al.*[1] in which the authors consider that tissue extracts induce a synthesis of cocarboxylase from vitamin B$_1$ and phosphate by alkaline washed yeast prompts the publication of the facts below; they form part of an investigation on the phosphorylation of the vitamin suggested to me by Prof. R. A. Peters.

Lohmann and Schuster[2] found cocarboxylase to be vitamin B$_1$ pyrophosphate, but the vitamin itself was inactive as cocarboxylase. While confirming the latter fact, I find that the action of pure cocarboxylase is strongly stimulated by the addition of synthetic vitamin B$_1$. The graph which follows shows the activating effect of the vitamin on 1 γ cocarboxylase* using alkaline washed yeast and pyruvic acid. The pyrimidine group of the vitamin seems to be the one responsible for this activation. Pyrimidine I* has



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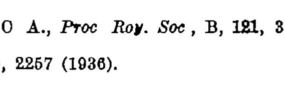

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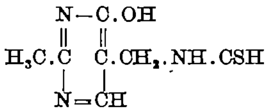

III

about 1/10, pyrimidine II 1/30 the activity of the vitamin. Pyrimidine III, without the NH_2 group, is inactive up to 90 γ. This may be of significance in view of Langenbeck's findings[3] on artificial carboxylases. Thiazole (up to 90 γ) is inactive, as also is vicine, cytidylic acid (commercial specimen) and nicotinamide (up to 100 γ). The stimulation by the vitamin of the action of boiled tissue extracts is due to the presence of cocarboxylase in the latter.

The activation of the carboxylase reaction by vitamin B$_1$ is being explored for the estimation of both cocarboxylase and free vitamin B$_1$ in biological material. These results will be reported elsewhere. In the meantime, it seems clear that the discovery of this particular activation makes necessary a revision not only of the conclusions quoted above[1], but also of other present evidence for the synthesis of cocarboxylase from vitamin B_1.

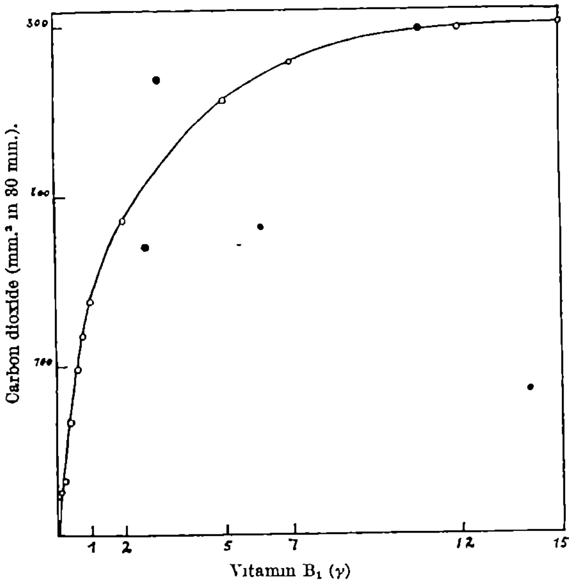

Fig. 1.

ACTIVATION OF COCARBOXYLASE ACTION BY VITAMIN B_1. ORDINATE, CARBON DIOXIDE EVOLVED IN PRESENCE OF VITAMIN AND 1 γ COCARBOXYLASE MINUS CARBON DIOXIDE EVOLVED BY 1 γ COCARBOXYLASE ALONE (1 γ COCARBOXYLASE = 163 $mm.^3$ CARBON DIOXIDE; BLANK = 25 $mm.^3$ CARBON DIOXIDE IN 30 MINUTES).

Thanks are due to the Rockefeller Foundation and the Nuffield Trust for financial help.

S. OCHOA.

Department of Biochemistry,
Oxford.
April 2.

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[*] Samples kindly supplied to Prof. Peters; cocarboxylase by Dr. Lohmann, pyrimidines and thiazole by Dr. Todd.

[1] Lipschitz, M. A., Potter, v. R., and Elvehjem, C. A., *Biochem. J.*, **32**, 474 (1938).

[2] Lohmann, K., and Schuster, Ph., *Naturwiss.*, **25**, 26 (1937) *Biochem. Z.*, **294**, 188 (1937).

[3] Langenbeck, W., *Ergeb. Enzymforsch.*, **2**, 314 (1933).

Magnitude of Nuclear Forces

IN a recent letter to NATURE[1] it has been shown that the degree of dissociation of a proton or neutron is very close to $q = \frac{1}{2}$.

It can be shown that the so-called method of second quantization leads to essentially the same behaviour of elementary particles as the elementary theory. The numerical value of the degree of dissociation, however, remains undetermined, since it is proportional to the square of the interaction constant between heavy particle and heavy electron field. Thus, combining both methods, it is possible to determine the numerical value of the interaction constant. We obtain in this way the potential energy of nuclear forces

$$V = \pm A^2 \frac{e^{-\varkappa r}}{r}$$

where $A = \sqrt{\frac{hc}{2\pi} \frac{2m}{M}}$.

The details of the theory will be published in the *Physical Review*.

GUIDO BECK.

Cité Universitaire,
45 Boulevard Jourdan,
Paris XIV. March 27.

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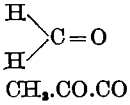
[1] NATURE, **141**, 609 (1938).

Mechanism of the Primary Photodissociation Processes of Organic Molecules

Two rules have been derived experimentally from investigations of the continuous absorption spectra of inorganic molecules[1]. First, the action of light may produce the splitting of a single bond, the two products of dissociation, namely, atoms or radicals, possessing free valencies. This process occurs as long as the central atom of the original molecule is in a lower state of valency, molecule formation being brought about by its p electrons only. The first long wave limit then agrees with the single bond energy concerned. The second mechanism refers to molecules the central atom of which is in its maximal state of valency, its s electrons being responsible for chemical linkage in addition to its p electrons. In this case, one of the dissociation products does not possess free valencies, but is a saturated molecule of lower valency state in a $^1\Sigma$ term. Here, the first long wave limit is not correlated to a single bond energy, but agrees with the energy difference of the total energy of formation of the original molecule and that of the produced molecule of lower valency. In other words, the action of light produces a transition to that repulsive electronic state, which is due to the repulsive character of the s^2 group of electrons and predicted by the pair bond theory of valency, originally advanced by Heitler and London.

In organic molecules the carbon atom is in its state of maximal valency and hence the above view should hold for organic molecules too. Indeed it has been verified already for simple tetrahalides of carbon. In addition to methan halides we have now studied aldehydes and ketones, acids and derivatives, ketonic acids and esters, a few examples being shown below. We have measured the continuous absorption spectra of some of them, while for others we used figures from literature, particularly the predissociation data as reported for aldehydes and ketones by Henri[2]. The results are in fair agreement with the theory, if we assume the following processes:

(1) $CI_4 \rightarrow CI_2(^1\Sigma) + 2I.$

(2) 
$H_2C{=}O \rightarrow 2H + CO(^1\Sigma).$

(3) $CH_3.CO.CO.CH_3 \rightarrow CO(^1\Sigma) + CH_3 + CH_3.CO.$

(4) $CH_3.CO.OC_2H_5 \rightarrow CO(^1\Sigma) + CH_3 + OC_2H_5.$

(5) $CH_3.CS.SH \rightarrow CS(^1\Sigma) + CH_3 + SH.$

Particular attention may be directed to the large shift of the predissociation point from the ultra-violet (λ 2750) in formaldehyde to the visible spectrum (λ 4395) in diacetyl, which is perfectly represented by the above theory. Also the long wave limits of further regions of selective continuous absorption in the far ultra-violet, measured for some such molecules, are capable of interpretation on these lines, comprising higher repulsive states of a similar character.

Substance	Process	Energy required calculated K.cal./mol.	observed λ (A)	K cal./mol.	Remarks	Author
Carbon tetra-iodide	(1)	70	3930	72	L. W. L	Samuel and Parti[1]
Formaldehyde	(2)	104 5	2750	103	Pr. D.	Henri and Schou[3]
Diacetyl	(3)	66	4395	64 5	Pr D.	Henri[2]
Ethylacetate	(4)	108	2630–2420	108–117	L. W L.	Present paper
Dithioacetic acid	(5)	84	3010	94	L. W L	,, ,,
			3360	84	Min. Sol.	,, ,,

L. W. L. = Beginning of continuous absorption (vapour) Pr. D = Predissociation of band spectrum. Min Sol. = Minimum of absorption curve of hexane solution.

In all such cases two bonds of the absorbing molecule appear to be broken simultaneously without involving two single bond energies, but by the direct transition from the ground state to a repulsive term, correlated to a saturated molecule of lower valency. A strict application of the pair bond theory seems, therefore, to offer an explanation of certain features of the spectra of organic molecules and, as we hope, of certain photochemical reactions and processes at the same time. This will be discussed at greater length in a forthcoming paper.

Daniel Sieff Research Institute, **Ernst Bergmann.**
Rehovoth.
Hebrew Technical Institute, **R. Samuel.**
Haifa.

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[1] Samuel, R., "Absorption Spectra and Chemical Linkage", Symposium Ind. Acad. Sci. (Bangalore, 1934). Asundi, R. K., and Samuel, R., *Proc. Phys. Soc*, 48, 28 (1936). Jan-Khan, M., and Samuel, R., *ibid*, 48, 626 (1936). Parti, Y. P., and Samuel, R., *ibid.*, 49, 568 (1937). Hussain, S. L, and Samuel R., *ibid.*, 49, 679 (1937). Samuel, R., *Proc. Ind. Acad. Sci. (Bangalore)*, 6, 257 (1937).

[2] Henri, V., "Structure des Molecules" (Paris, 1925)

[3] Henri, V. and Schou, S. A., *Z. Phys.*, 49, 774 (1928)

Band Spectrum of Silicon Monosulphide

In a recent paper[1] on the ultra-violet band system of GeO, a survey was made of the band systems of the monoxides and monosulphides of the Group IV (*b*) elements which appear to be analogous to the "Fourth Positive" system ($A^1\Pi \rightarrow X^1\Sigma$) of CO and the well-known ultra-violet systems of CS and SiO. For SiS, the only molecule of the sub-group for which no data were available, the character and approximate position of the corresponding band system were predicted graphically.

Using heavy-current (3–5 amp.) discharges through a mixture of SiS vapour and argon in a tube of the type recently described by Pearse and Gaydon[2] and also in an all-silica tube, we have observed in the region λ2576–λ3876 a system of some seventy to eighty bands degraded to the red. The heads are approximately represented by $\nu_{\text{head}} = 35028\cdot5 + (512\cdot9u' - 2\cdot88u'^2 - 0\cdot006u'^3) - (749\cdot6u'' + 2\cdot58u''^2)$ where u is written for $v + \frac{1}{2}$. The rotational structure of the stronger bands in high dispersion appears to be of the well-known three-branch type given by a $^1\Pi \rightarrow {}^1\Sigma$ transition. That the lower state is the ground state of SiS is proved by our further observation of a few of the bands (about eight strong bands with $v'' = 0$ and 1) in absorption by SiS vapour at about 1000° C.

In the SiS discharge also are some seventy to eighty bands extending from λ3491 to λ6169, which are similar in appearance and distribution to bands in the longer-λ sequences of the above system. They appear to form part of another system, the upper and lower states of which are different from, but have vibrational frequencies of the same order as those of the ultra-violet system. The emitter may be SiS, which is expected to have triplet as well as singlet states.

The ultra-violet system of SiS is well developed also in a heavy-current discharge through Al_2S_3 vapour in a silica tube. In this source, however, the well-known $^3\Sigma \rightarrow {}^3\Sigma$ system of S_2 (of which there is, fortunately, no trace in the SiS discharge) is prominent, and the second set of bands cannot be detected.

R. F. Barrow.
W. Jevons.

Imperial College,
London, S.W.7.
April 7.

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[1] Jevons, Bashford and Briscoe, *Proc. Phys. Soc.*, 49, 543 (1937).

[2] Pearse and Gaydon, *Proc Phys. Soc.*, 50, 201 (1938).

Fluctuation Noise in Thermionic Valves

In a recent paper[1], I put forward the theory that the noise generated by a thermionic valve is alternatively (*a*) of the shot noise type if the valve anode current is temperature-limited, *or* (*b*) of the thermal or 'Johnson noise' type if the current is fully space-charge limited. (Contrast Llewellyn's theory that the noise in the presence of space-charge is the *sum* of shot and thermal noise, with a smoothing factor applied to the shot noise.) In the paper quoted, however, there was no quantitative treatment of the practical case of a valve which is partially space-charge limited, that is, does not correspond exactly to either of the simple states of temperature or space-charge limitation.

It has now been found possible to treat this practical case with moderate accuracy by dividing the current into two parts. Assuming the law of the valve under investigation to be known for the fully space-charge limited condition (for example, $i_a = bV_a^{3/2}$ for a diode), the proportion of the observed anode current which is fully space-charge limited can be deduced by comparing the slope of the measured i_a/V_a characteristic with the calculated value for an equal current with full space-charge limitation; when the current so calculated has been subtracted from the total measured current, the residue is current which is temperature-limited. The total noise output of the valve is then the sum of (*a*) the thermal noise in the measured resistance (calculated in accordance with the methods given in the paper already quoted), and (*b*) simple shot noise arising from the residual current which is temperature-limited.

This method has been applied numerically to two diodes, and it is hoped to extend it to triodes before full details are published.

D. A. Bell.

Eastlea,
Great Baddow,
Chelmsford.
March 26.

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[1] "A Theory of Fluctuation Noise", paper read before the Wireless Section of the Institution of Electrical Engineers on Jan. 5, 1938.

Elastic Constituent of Rubber

IN a recent paper[1] K. C. ROBERTS has described the isolation from dried fresh *Hevea* latex of small quantities of a highly elastic substance which he has named caoutchol and to which he has ascribed the formula $C_{80}H_{130}(OH)_2$. This substance has been shown to possess the high degree of elasticity hitherto regarded as characteristic of rubber; the rubber hydrocarbon purified by its removal is comparatively non-elastic.

The X-ray photograph of freshly prepared caoutchol, unstretched, at room temperature (35° C.), shows certain sharply defined rings identical with those reported by W. H. Barnes[2] for 'frozen' rubber. Other rings, however, exhibit significant differences. At 700 per cent extension, caoutchol gives an X-ray photograph almost identical with that obtained from stretched, air-dried, fresh latex, the transition from the rings of the Debye-Scherrer diagram to the sharply defined spots of the fibre pattern being clearly visible.

The purified rubber hydrocarbon, to which Dr. Roberts has given the name caoutchene, does not show the sharply defined rings characteristic of caoutchol nor can it be extended sufficiently to give the fibre characteristic of stretched rubber. The X-ray evidence therefore supports the theory that the minor constituent caoutchol is the primary factor in the elasticity of rubber.

The detailed results of this work, together with further X-ray observations on derivatives of caoutchene and caoutchol, will be published elsewhere.

T. C. ROBERTS (née MARWICK).

Rubber Research Institute of Malaya,
Kuala Lumpur, F.M.S.
March 22.

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[1] Roberts, K. C., *J. Chem. Soc.* (Feb. 1938).

[2] Barnes, W. H., *Canadian J. Research*, B, 15, 156 (1937).

Food of the Partridge

JUST a quarter of a century ago I concluded an investigation on the food and feeding habits of the partridge, and my results were set forth in the *Journal of the Land Agents' Society* (June 1917), and in further detail in *Science Progress* (Oct. 1918). I found an examination of crop, intestine and stomach contents over a period of five years to "show that of the total bulk of food consumed 59·5 per cent. is vegetable matter and 40·5 per cent. animal matter. Of the former 53·5 per cent. consists of leaves, fruits, and seeds of weeds, 3·5 per cent. of grain, and 2·5 per cent. of miscellaneous vegetable matter. Of the animal matter, 23 per cent. consists of injurious insects, 3 per cent. of beneficial species, 4 per cent. of neutral species, 6·5 per cent. of earthworms, and 4 per cent. of slugs complete the summary." These facts were repeated in my work on "The Food of Some British Wild Birds" (1924–27).

In November last, Mr. A. D. Middleton and Miss H. Chitty published an interesting paper on this subject in the *Journal of Animal Ecology* (which I have only just seen), in which they state "Perhaps the most striking are the large quantities of green food eaten during the winter and spring months and the very low percentage of animal food. For some reason, partly due to the publications of Collinge, insects have for a long time been regarded as an important and even essential part of the food of partridges."

With all respect, as one who has devoted more than thirty years of his life to such investigations, I think I may say that Mr. Middleton and Miss Chitty have failed to realize one of the most important results of their work, namely, that since I carried out my investigation on the nature of the food of the partridge, in 1912 and 1913, this bird has changed its food habits, just as the rook and the starling have in that period. Like these authors, I chronicled exactly what I found in the stomach and intestines, they in the crops, and the two records show conclusively the change that has taken place. There can be little doubt that this change has not been beneficial to the partridge as a species, for, for some years past, the mortality due to strongylosis and coccidiosis and other causes have been enormous.

It is clear to me that here we have a very striking case of reduced vitality due to a change in diet, and it shows how important it is, as I have previously advocated, that from time to time all such investigations should be repeated, in order that the true economic status of any particular species of wild bird should be ascertained.

WALTER E. COLLINGE.

The Yorkshire Museum,
York.
April 25.

Cytology of Metamorphosis in the Culicinæ

A NUMBER of investigators[1] have distinguished two main types of larval insect tissue with respect to growth and metamorphosis. Many tissues grow by increase in cell size and undergo disintegration at metamorphosis, the corresponding adult tissue being formed from imaginal disks that were not functional parts of the larval tissue. The second class of tissues grow by cell division and multiplication, and are carried over, with or without modification, into the adult.

The epithelium of the larval ileum of *Culex pipiens* behaves in a manner intermediate to the two methods described above. Larval growth is accomplished solely by increase in cell size, and at metamorphosis the adult tissue is formed by the simultaneous division, reduction in size and increase in number of these same larval cells. In this case great increase in cell size is not accompanied by inability to divide or to undergo further differentiation.

These phenomena, first observed in *Culex pipiens*[2], have during the past year been found in the following other species collected in Maryland: *Culex apicalis* Adams, *C. territans* Walker, *Aedes canadensis* Theobald, *A. triseriatus* Say, *Orthopodomyia signifer* Coquillett, and *Anopheles punctipennis* Say. Metamorphosis of this type is probably present throughout the sub-family Culicinæ.

All seven species have a diploid number of six chromosomes. The following cytological peculiarities, first studied in *Culex pipiens*, have since been found in the other six species of mosquito: (*a*) increase in the chromosome number of larval cells, accompanying increase in size and apparently taking place within the resting nucleus; (*b*) multiple chromosome complexes of 192, 96, 48, 24 and 12 chromosomes appearing during the mitoses effecting metamorphosis, and showing a direct correlation between chromosome number and cell size; (*c*) prophase synapsis of high multiples of sister and homologous chromosomes with no formation of chiasmata.

Considerable indirect evidence favours the interpretation that these divisions are somatic reduction divisions. Decisive evidence is being sought by attempting to observe the process in the living organism.

CHARLES A. BERGER.

Johns Hopkins University,
and
Woodstock College,
Maryland.
March 10.

[1] cf. Trager, W., *J. Exp. Zool.*, 76, 467 (1937).

[2] Berger, C. A., *Anat. Rec.*, 67, *Supp.*, 1, 63 (1936); Berger, C. A., *Genetics*, 23, 140 (1938); Berger, C. A., *Carnegie Inst. of Wash*, *Contrib to Embryol*, 27 (in the Press).

Absorption of Growth-Promoting Substances by Cuttings

ABOUT two years ago a batch of leafless cuttings of *Bougainvillea* (var. Mrs. Louis Walthen) was received at these laboratories for propagation. They were planted in our usual propagators. The majority threw out small shoots but there was no callussing or root development. After eighteen months it was decided to try the effect of a proprietary root growth-promoting substance. The cuttings still alive were treated in the normal way, that is, by immersion of the basal ends in a dilute solution for eighteen hours. However, no callussing or rooting took place and it is assumed that this was due to lack of transpiration in the cuttings, which were leafless when treated.

Finally it was decided to try the effect of forcing the growth-promoting substance into the cuttings now almost exhausted of food reserves. The ends of the cuttings were cut off to expose fresh surfaces. The lower ends were submerged to a depth of one inch in the solution contained in a vacuum desiccator which was exhausted until a strong stream of bubbles emerged from the bottom end of each cutting. On breaking the vacuum the solution was forced into the submerged ends. Two or three months after replanting the cuttings, 90 per cent rooted and are now healthy plants.

The experiment was not planned as a test of the growth-promoting substance, but was made in a final attempt to save the last remaining cuttings of a variety new to Kenya. So striking have been the results that the suggestion is put forward that possibly failure to secure rooting with winter cuttings of deciduous plants after treatment with various growth-promoting substances has been due to non-absorption, or to the absorption of too little of the material by the leafless cuttings.

T. H. JACKSON.

Scott Agricultural Laboratories,
Department of Agriculture,
P.O. Box 323,
Nairobi, Kenya.
March 22.

Probable Fossil Hail Impressions in Natal Coal Measures (Middle Ecca Series)

DURING the course of a geological survey of the Verulum district, Natal[1], some peculiar little depressions were noticed on the upper surfaces of freshly exposed slabs of lower Middle Ecca (Permian) sandy shales occurring in a small road-metal quarry situated on the main road between Verulum and Tongaat, a little north of the Shortlands Hotel. The depressions appeared to be confined to a single horizon which, owing to the lack of exposures, could not be traced beyond the confines of the quarry.

The depressions, which are circular to slightly elliptical in outline, are bounded by slightly raised edges. In size they are remarkably uniform, averaging about 14 mm. in diameter and 5 mm. in depth, while in shape casts showed that they are slightly assymmetric, the steeper sides being usually similarly orientated.

Specimens cut perpendicularly to the bedding revealed that the laminæ immediately under the depressions were arched down as though the latter had been caused by blows. Their casts in the overlying horizon were found to be slightly coarser grained than the bounding layers and invariably plano-convex in shape.

It has been indicated by Twenhofel[2] that the maximum depth of rain-drop impressions appears to be 3 mm. and their maximum width 12 mm. It would seem, therefore, that some other natural origin should be postulated for these depressions. Their character seems to suggest that they were caused by the impact of hailstones, since their relatively great depths in proportion to their diameters eliminates the possibility of their being splash impressions.

Twenhofel[2] also figures artificial hail-impressions in mud which are characterized by very steep sides and relatively great depths. Preliminary observations made during actual hailstorms and experiments made by dropping ice spheres indicate, however, that even in highly plastic muds, a layer of water only a few millimetres in thickness over the surface of the mud suffices to modify the effects considerably—shallower and more regular plano-convex depressions resulting. Futhermore, if the hail falls on exposed sand or sandy mud, shallower depressions result, provided that other factors such as the size, shape and velocity of the stones remain constant. In the case of only slightly plastic moist sands, secondary minor depressions, either adjacent to or overlapping the major direct ones, are formed owing to the bouncing of the hailstones.

In the present area the unconsolidated material was a sandy mud which, as fossil rain-prints, etc., noted in other portions of the Verulum area indicate, was on occasion exposed to sub-aerial conditions. Incidentally, depressions identical in appearance with those on the sandy shales were produced by dropping small rounded hailstones from a height of 15 ft. into a sandy mud which was covered by a 2 mm. film of water.

With one exception[3], these would appear to be the first impressions tentatively attributed to the action of hail which have been recorded from the whole geological column. The re-examination of reported 'rain print' localities in the light of experimental evidence would, however, appear to be desirable.

LESLIE E. KENT.

Geological Survey,
Pretoria,
Union of South Africa.

[1] Kent, L. E., "The Geology of a Portion of Victoria County, Natal", *Trans Geol Soc. S Africa*, 41, 1-30 (1938).

[2] Twenhofel, W. H., "Treatise on Sedimentation" (2nd Edition. 1932), p. 680.

[3] Lyell, Sir Charles, "On Fossil Rain-marks of the Recent, Triassic, and Carboniferous Periods", *Quart J. Geol Soc Lond*, 7, 243 (1851).

Heavy Electrons in Cosmic Rays

A LETTER under this title appeared in NATURE of April 16. In the table on p. 685, the values of the momentum of the particles *a*, *b*, *c* and *d* (col. 4) should have been given as 69, 110, 95 and 73 respectively, instead of 65, 107, 86 and 67. The errors arose from an unnecessary alteration of the completed table, under the impression that some early preliminary data had been quoted. The masses in the last column correspond to the correct values of the momentum. We would also add that the results of Nishina and his collaborators, referred to in the above letter are in accord with ours for particulars *a*, *c* and *d* rather than *b*.

E. J. WILLIAMS.
E. PICKUP.

Illusion of Convergent Beams of Light

'CONVERGENT' beams similar to those reported by J. J. Hopfield[1] and A. C. Klebs and others[2] can be observed near lighthouses.

The effect was frequently observed by me in Scheveningen in Holland and corroborated by others, from a road running parallel to the shore between the lighthouse and the sea.

At evenings when in a slight haze the rotating beam of light from the lighthouse could be followed to the opposite horizon, the light beams seemed to converge towards the opposite horizon in such a way that a rotating beam of light appeared to be issuing from this horizon opposite the lighthouse, giving a strong impression that a second lighthouse, issuing a rotating beam of light, was out at sea beneath the opposite horizon.

The phenomenon is different from those observed with sunbeams in so far as the beams from the lighthouse are really diverging, practically from a nearby point, whilst the sunbeams are parallel. It is interesting that similar 'convergent' beams can be observed in both cases.

A. H. ROSENTHAL.

68 Ladbroke Grove,
London, W.11.

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[1] NATURE, 141, 333 (1938).

[2] NATURE, 141, 558 (1938).

Points from Foregoing Letters

THAT yeast cells, transported by wind, may be carriers of various viruses, including that responsible for foot-and-mouth disease, is suggested by Prof. R. C. McLean, who points out that methods of acquiring immune strains of animals might be the only way of preventing the disease.

The discovery of a complete right jaw-bone, with several teeth, attributed to *Australopithecus*, is reported by Dr. R. Broom. The reconstructed face agrees fairly closely with that of the chimpanzee but the teeth are human. The author suggests that man may have arisen from *Australopithecus* by a mutation resulting in a large brain.

A method of gilding copper by applying a melted gold-copper eutectic (80 per cent gold, 20 per cent copper) which was apparently used by the pre-Columbian Indians is described by P. Bergsøe. The alloying was used, apart from purposes of decoration, to increase the hardness of certain articles, such as fish-hooks.

A colorimetric method for the estimation of nicotinic acid—the probable pellagra preventive factor—has been developed by M. Swaminathan. The nicotinic acid content of twelve common foodstuffs, as determined by the method, is also given. Values ranged from 1·48 mgm. per cent for maize up to 62·50 mgm. per cent for dried brewer's yeast.

By heating alloys of copper or silver containing a small percentage of aluminium or beryllium in an atmosphere of hydrogen and water vapour, under controlled conditions which allow selective oxidation, G. J. Thomas and Laurence E. Price have obtained protective films of alumina and beryllia which render the metals almost immune from tarnishing and scaling. The authors explain how they were led to their experiments by theoretical considerations on the electrical conductivity of surface films.

Dr. F. J. Stare, E. S. Gordon and M. J. Musser have observed that succinic acid does not catalyse the aerobic respiration of skeletal muscle tissue obtained from patients with myasthenia gravis and progressive muscular dystrophy, and that it is oxidized only to a slight extent. The usual catalytic effect was observed with normal human muscle. The results are of interest as they suggest that disturbances in the succinic acid cycle may be associated with these muscular diseases.

A graph showing the activating effect of synthetic vitamin B_1 upon the production of carbon dioxide through the action of cocarboxylase is given by Dr. S. Ochoa. The pyrimidine group of the vitamin appears to be responsible for activation, and previous views on cocarboxylase action may have to be revised.

Dr. E. Bergmann and Prof. R. Samuel advance a theory of photodecomposition of organic molecules according to which two bonds are fissured simultaneously, not by the splitting of two single bonds, but by a transition of the molecule to a repulsive state, which is produced by the repulsive character of the s^2 group of electrons of the central atom.

R. F. Barrow and Dr. W. Jevons announce the observation and vibrational analysis of the predicted ultra-violet band system of SiS, which corresponds to the "Fourth Positive" system of CO.

D. A. Bell states that the total noise output of a radio valve can be considered as made up of (*a*) the thermal noise in the measured resistance and (*b*) simple shot noise arising from the residual current, which is temperature-limited. This view has been applied to the case of diode valves.

X-ray studies of rubber constituents show, according to Dr. T. C. Roberts, that the highly elastic caoutchol, when stretched, gives X-ray patterns similar to those of stretched raw rubber. The author considers that this minor constituent of rubber is responsible for its elastic properties, rather than the major constituent, caoutchene, which does not show such an X-ray pattern.

Prof. C. A. Berger reports a new method of insect metamorphosis found in seven species of mosquitos from four genera. Cytological peculiarities present throughout the group throw new light on chromosome pairing and the origin of polyploidy.

Research Items

Woman's Status in Manam, New Guinea

MISS CAMILLA H. WEDGWOOD opens a study of women in Manam, an island about ten miles off the north-east coast of New Guinea, with an examination of the status of the women in Manam society (*Oceania*, 7, 1937, 4: Sydney Univ. Reprints, ser. 12, 2, 15–18, 1937). The belief that women in the islands of the west Pacific have a very low status has some support; but it is not possible to make any statement which will be valid for the whole. In Manam the social differentiation between the sexes is marked in almost every department of daily life. The women have their distinctive dress and modes of doing their hair, their distinctive occupations, and even their way of sitting and carrying their loads. Any departure from these distinctions provokes comment or ridicule. At gatherings in which both men and women are present the sexes sit apart and carry on conversation within the separate groups. In the economic sphere the differences between men and women are very sharply emphasized; but there is no ritual prohibition against a man doing a woman's work, or *vice versa*. For a man to fill and carry the drinking vessels from the water-hole, however, or to boil food in a pot, would be considered somewhat degrading for him; and the women would be as ready as the men to laugh at him for doing this; but he breaks no taboo thereby. It is considered equally ridiculous and wrong for a woman to ape a man; but there is nothing reprehensible for a woman to be skilled in some of the crafts which are usually known only to men. On the contrary, such a woman is often respected for her skill. The men generally assume that they are superior to the women, who are debarred from taking part in the sacred rites of the men, a privation justified by their inferior worth. Their interests, conversation and quarrels are trivial, when compared with the 'important' matters men discuss. To a great extent, the women echo the opinions of the men concerning their sex.

The Mammals of Ireland

SINCE William Thompson's description of the mammals of Ireland was published in 1856, no comprehensive account of the group has appeared. In the twenty-second report from the Fauna and Flora Committee, C. B. Moffat has brought the subject up to date by gathering together the scattered information which has accumulated in three quarters of a century, and commenting upon the present status of the 55 representatives of the Irish mammalian fauna (*Proc. Irish Acad.*, 44, B, 61; 1938). The greatest change occurs in the Cetacea, where 10 species are recorded as new to the fauna. Of land mammals Ireland possesses only 33, in contrast to the 54 which are present in Great Britain. The most noticeable blanks occur amongst the rodents, where voles are unrepresented; the insectivores, which include only the hedgehog and the lesser shrew; and the bats. Additions to the fauna include the Egyptian mouse (*Mus musculus orientalis*), the tree rat (*Rattus rattus frugivorus*), and the deliberately introduced grey squirrel, which is well established in Co. Longford. The Irish stoat and mountain hare are now regarded as specifically distinct from the British forms. The author notes that since the European War marked changes have occurred in the numbers of some members of the fauna: rabbits and mountain hares have increased, as well as some of the beasts of prey such as the fox and badger, while others, like the hedgehog and the red squirrel, appear to be declining. The latter, although once a native of Ireland, is now represented only by descendants of introduced individuals.

Nest-building of the Bush-tit

IN an account of the behaviour of the Californian bush-tit (*Psaltriparus m. minimus*) Alice Baldwin Addicott gives some interesting details about nest-building (*Condor*, 40, 49; 1938). The completed nest is a delicate suspended structure with a hood, very like that of the European penduline tit. The first step in the construction of the nest is the weaving of a horizontal rim, held together by spider's web and attached between a forked branch or two adjacent twigs. From the rim a loose bag is generally suspended, built by the birds as they perch upon the rim and work, head downwards, at the inside surface, to which strengthening materials are added. The last process is the construction of the hood and of the final side entrance which supersedes the first rim opening. The nest is made of mosses, lichens, oak leaves and spider's web, so blended that externally the structure is inconspicuous in its surroundings; the inside is lined with spider's web, down or feathers. The time taken in building varied from 13 to 51 days, the average being just over 33 days, but it was noticeable that nests built later in the season were more rapidly completed than early nests, and the opinion may be hazarded that, since many pairs nest a second time, the increased speed of construction was due to practice.

Marine Plankton Animals as Indicators of Water Movements

THE belief that certain plankton animals may serve as indicators of water movements has long been held by some marine biologists; but it was not until the publication of a paper by F. S. Russell in 1935 (*J. Mar. Biol. Assoc.*, 20, 309–331) that their value for this purpose in British waters was clearly demonstrated. At the western entrance to the English Channel—the area studied by Russell—the most useful indicator animals were found to be certain members of the chætognath genus *Sagitta*, three species of which occur in that locality. Following upon Russell's researches, J. H. Fraser studied the occurrence and distribution of chætognaths in Scottish waters in 1936 (*J. Conseil Perm. Intern. pour l'Explor. de la Mer*, 12, No. 3, 311–320; 1937). Six species or sub-species of *Sagitta* and one species of *Eukrohnia* were collected, all of which revealed well-marked correlations with different water masses. *S. setosa* was distributed over the whole of the North Sea and extended as far as 61° N. except where there was some oceanic influence; *S. elegans* was found to belong to mixed oceanic and coastal waters (cf. Russell's 'western water'); *S. serratodentata* was more truly oceanic; *S. maxima* belongs to the deeper oceanic waters (below 600 metres) and is brought into shallow water by upwelling along the edge of the continental shelf; *S. hexaptera* is typical of the epiplankton of tropical and sub-tropical regions, but a few individuals were taken in the Faroe-Shetland Channel, probably indicating an influx of some warm Atlantic water. Both this species and *S. maxima* quickly die on reaching Scottish waters. *E. hamata*, like *S. serratodentata*, is an oceanic form of more general distribution but belongs to a slightly deeper habitat. This work on Scottish chætognaths, although only a preliminary survey, is a useful contribution to our knowledge of plankton animals as indicators of water movements. Analyses of additional collections made over a number of years in the same region are contemplated and should furnish further information of great interest and value.

History of the Peach

THE community of gardeners has to thank Mr. E. A. Bunyard for many scholarly dissertations upon the histories of various cultivated plants. Peaches and nectarines have lately claimed his attention (*J. Roy. Hort. Soc.*, 63, Parts 3 and 4, March and April 1938). The first mention of the peach in literature is, according to Bretschneider, contained in a Chinese manuscript of 551 B.C., and there can be little doubt that China was the original home of this fruit. The Romans probably obtained peaches through Persia, and peach stones of present-day size were excavated from Pompeii. Representations upon frescoes in that city's ruins also show fruits equal in dimensions to those of modern times. The peach was known in England during Anglo-Saxon times, and became somewhat notorious in 1216, when King John died "from a surfeit of peaches and ale". Thomas Rivers of Sawbridgeworth, his son and grandson, together introduced more than twenty-seven new varieties of peaches and nectarines, whilst a particularly early fruiting type was developed in America. Mr. Bunyard also deals in detail with the cultivation of the peach and nectarine.

Artificial Doubling of Chromosomes

A. F. Blakeslee and A. G. Avery have used the alkaloid colchicine to bring about doubling of the chromosomes of certain plants. A short paper in the *Gardeners' Chronicle* of April 16 outlines the process, and cites further papers where greater detail is published (for example, *J. Hered.*, 28, 392–411; 1937; or U.S. Dept. Agric. Year Book, separate No. 1605, 1–35; 1938). Solutions of the amorphous product in strengths varying from 0·0004 per cent to 0·4 per cent have been used. Seed of *Datura*, for example, was soaked in a 0·2–0·4 per cent solution for 4–10 days before planting. Plants grown from treated seed are often at first stunted and malformed, and it is only in the succeeding generation that individuals with doubled chromosomes may be expected. The discoverers of this treatment have shown considerable restraint in their interpretation of the experimental results, but great possibilities may be envisaged when more detail is made available.

New Zealand Earthquake of 1934

THE Pahiatua earthquake of March 5, 1934, is described by Mr. R. C. Hayes in *Bulletin* No. 122 of the Wellington Dominion Observatory. The region most severely shaken lay along the east coast of the North Island, about fifty miles south of Hawke's Bay, and the shock was felt at Dunedin, 460 miles from the epicentre, or to about the same distance as the great earthquakes of 1929 and 1931 were felt. So far as can be judged from the records of the seismographs that were not dismantled by the shock, the epicentre was submarine, in lat. 40° 57′ S., long. 176° 48′ E., or about thirty miles east of Castlepoint. The focal depth is uncertain, but probably lay between 20 km. and 40 km.

New Radioactive Silver Isotope

RECENT investigations on the artificial production of radioactive silver isotopes have led to the discovery of four more isotopes, in addition to those with half-life periods of 2·3 min. and 23 sec., respectively, discovered by Fermi and his co-workers. ^{106}Ag occurs in two isomeric forms, one of which emits positrons, and has a half-life period of 24·5 min., whilst the other gives electrons, and has a half-life of 8·2 days. Both are obtained, with others, by bombarding silver with rapid neutrons, the process being ^{107}Ag $(n, 2n)$ ^{106}Ag. ^{108}Ag has a half-life of 2·3 min., ^{110}Ag one of 23 sec., ^{111}Ag one of 7·5 days, and ^{112}Ag one of 3·2 hours. ^{107}Ag and ^{109}Ag are stable isotopes. Further experiments by H. Reddemann and F. Strassmann (*Naturwiss.*, 26, 187; 1938) on the bombardment of silver foils in paraffin with slow neutrons for long periods (2 months), have indicated the existence of a new active isotope, with a half-life as long as 190 ± 40 days. That the activity was indeed due to silver was confirmed by chemical separation. It is probable that the isotope is produced by a (n, γ) process, and may be an isomeric nucleus of atomic weight 108 or 110.

Field Due to Two Nuclei

IN wave mechanics one often meets the problem of an electron acted on by two centres of force. This is the fundamental problem of molecular forces or of chemical valency, and also arises in the study of the spectra of atoms such as helium. A summary of the present state of the problem and a new contribution to the subject are given by E. A. Hylleraas (*Ann. de L'Institut Henri Poincaré*, 7, 121; 1937). The usual approximate treatment replaces a non-central and non-statical field by the central statical field which is the average of the true field. This works fairly well for some purposes, but is unsatisfactory for the calculation of the polarization produced by an external electron. For molecules, there are two methods often employed. Heitler and London form the characteristic functions for a molecule from those of isolated atoms, while the other method uses the functions for an electron due to two nuclei. The first method works best for large atomic distances, the second for small. For moderate distances both are unsatisfactory unless certain corrections are made. Dr. Hylleraas treats in detail the simplest case, where the two centres have equal charges, as in the hydrogen molecule-ion. The wave equation separates into two, the interior and the exterior equation. A new method of treating these is suggested, which should lead to a complete solution in the exterior case, but further calculations are required before its value in the interior case can be estimated.

Chemical Reactions Involving Solids*

PHYSICAL BASIS

INTRODUCTORY papers by Profs. N. F. Mott (Bristol) and J. C. Slater (Cambridge, Mass.) dealt with the motion of electrons in polar salts. Electrons can be set free by the absorption of light or by the heat motion of the atoms of a crystal; however, the absorption of light will not necessarily free an electron; an atom of the crystal may be raised merely into an excited state, without the electron being free to move far away from its original position. An excited atom in a crystal has been termed an 'exciton'; an exciton can move a certain distance through the crystal by transferring its energy from atom to atom, before the energy is all dissipated. The various types of lattice imperfection at which an electron can be trapped were also discussed.

Papers by Prof. J. D. Bernal (London), Prof. G. Hevesy (Copenhagen), H. A. C. McKay (London), Prof. C. Wagner (Darmstadt), Prof. W. Jost (Hanover), Dr. T. P. Hoar and Dr. L. E. Price (Cambridge), and Dr. J. A. A. Ketelaar (Leyden), dealt mainly with the transport of atoms and ions through solids. Experiments on self-diffusion in metals were described, using natural and artificial radioactive materials as indicators. A hypothesis was advanced to account for the small values of the coefficients of self-diffusion, compared with the coefficients of diffusion of one metal into another. Ionic conductivity and diffusion in solid polar salts were discussed in the light of the theory that there exist in a polar salt in thermodynamical equilibrium a certain number of vacant lattice points and a number of ions in interstitial positions. Experimental and theoretical methods of estimating the activation energies necessary for the formation of these configurations were described. Finally an account was given of the behaviour of salts of very high conductivity, for example, α-Ag_2HgI_4.

PHOTOCHEMICAL PROCESSES

A number of papers dealt with photochemical reaction in solids. Dr. R. Hilsch and Prof. R. W. Pohl (Göttingen) demonstrated a beautiful experiment in which a transparent crystal of potassium bromide containing KH in solid solution is coloured blue on exposure to ultra-violet light, the well-known *Farbzentren* being formed. The efficiency of the photochemical reaction falls rapidly, however, as the temperature is lowered. Prof. J. Eggert and M. Biltz (Leipzig) described experiments on the sensitivity of the silver bromide photographic layers; they considered that *Störungstellen* in the halide grains have two functions: to serve as nuclei for the formation of the latent image, and, for wave-lengths greater than 500 mμ, to make possible the absorption of light.

Papers by Dr. C. F. Goodeve and J. A. Kitchener (London) dealt with photosensitization by solids, and by Prof. W. Reinders and Dr. M. C. F. Benkers (Delft) with the physical development of the latent image. Dr. Lüppo-Cramer (Jena) contributed a paper on photographic sensitivity, and Prof. F. Weigert (Glasgow) on a new time phenomenon in photographic emulsions.

THERMAL DECOMPOSITION AND THE DETONATION OF SOLIDS

Prof. S. Roginski (Leningrad), in a classification of the reactions involving solids, showed that sometimes the chemical and sometimes the crystallization steps determine the course of the reaction. Near equilibrium and when $Q + E$ is small or negative, the processes are governed by crystallographic factors, the rate of reaction in such cases being proportional to the surface area of the grains. The decomposition of hydrates and mercuric oxide (HgO) are good examples of this type. On the other hand, when $Q + E$ is large and the processes are irreversible, the chemical reaction may take control and the reaction penetrate the lattice in an irregular fashion, giving rise to chain reactions. F. R. Meldrum (Bristol) gave an account of the decomposition of nitrogen iodide, which may be of this latter type.

The conditions under which nuclei form and grow on the surface of crystalline solids were dealt with by Prof. W. E. Garner (Bristol), and a distinction was drawn between endothermic and exothermic changes. There is lattice penetration in certain explosives, for example, mercury fulminate, and it is found generally that in the exothermic class, $dp/dt = kp^n$, where $n = 0{\cdot}8$–1, is obeyed instead of the 2/3 power law. This indicates that these reactions are chain reactions, it being maintained by some investigators that the chains are structural in character and by others that they are analogous to the chain reactions occurring in the combustion of hydrocarbons (Semenoff).

A number of phenomena arise when the rates of formation of the new solid phases are slow. Prof. J. Zawadski and Dr. S. Bretsznajder (Warsaw) showed that spurious equilibria (sorption equilibria) are found in the case of zinc and cadmium carbonates which are due to the slow rate of crystallization of the oxides and carbonates. In the case of hydrates, two factors are involved: (1) the retardation of the rate of reaction by water vapour is greater when the new solid phase is amorphous than when it is crystalline; and (2) water vapour catalyses the crystallization of the new phase (Volmer). Dr. J. Colvin and J. Hume (Leeds) discussed the application of these principles to the appearance of metastable hydrates during dehydration, and showed that the tri-hydrate of copper sulphate is produced when conditions are favourable to the crystallization of this phase. They also gave an account of the Topley-Smith effect with $Mn(COO)_2 2H_2O$, where a minimum in the rate of dehydration occurs at a water vapour pressure of 0·1 mm. In the course of the discussion, it was agreed that the explanation of this effect given by Volmer, which was based on the above principles, is substantially correct.

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* Report of a General Discussion, arranged by the Faraday Society, held in the University of Bristol on April 11–13.

The thermal decomposition of solids of the explosive class passes into a linear propagation of the reaction or deflagration under certain conditions, and the cause of this transition was ascribed to the simultaneous decomposition of a small number of adjacent molecules (Prof. W. E. Garner and Dr. H. Muraour (Paris)). It was pointed out that the linear propagation can arise under conditions where there is a negligible self-heating of the crystals and therefore that the deflagration must be due to some localized event. Dr. W. Taylor and A. Weale (Stevenston), who have studied the initiation of detonation by mechanical shock, put forward a tribo chemical theory of the origin of the detonation wave, ascribing to the action of friction the activation of a number of adjacent molecules which serves as the centre from which detonation can be initiated.

As Muraour pointed out, although the thermal decomposition can pass into deflagration, it is not possible in all cases for deflagration to pass into detonation, and Taylor and Weale ascribed this to the necessity for a critical stress which must be set up before detonation can occur. This critical stress varies in magnitude from case to case, being very small for explosions of the initiating class but possessing a high value in the case of typical high explosives. This stress cannot arise in all cases from the thermal decomposition but can be brought about by initiation with a more sensitive explosive. The view was expressed in the discussion, in which M. Polanyi, W. Jost, W. Payman and J. D. Bernal took part, that under the high pressures in the detonation wave, 350 tons/in.^{2} and more, the molecular compression would be sufficiently high to cause chemical reaction, the effect of the stress being such as to cause the disappearance of the energy barrier separating the reactants from their products. No general conclusion was reached on this matter, it being considered that other factors such as temperature may play some part in the propagation of the wave. Dr. T. Carlton Sutton (London) brought forward evidence in the case of tetryl that the heat of detonation increases step-wise with increasing density of loading.

LAYER LATTICES IN SOLID CARBON

The unique electronic structure of the carbon atom which is responsible for its extensive organic chemistry also confers upon solid carbon peculiar properties of considerable interest and fundamental importance. The advent of X-ray methods of studying the solid state has made possible a much deeper insight into the chemical nature and reactivity of black carbon, and the papers discussed in the section of the discussion dealing with this aspect suggested that the near future will witness a rapid development of this solid phase chemistry, which originated with Fredenhagen's discovery of the alkali-graphites some ten years ago.

Already the list of inter-layer lattice compounds is of considerable length, and although the nature of some of the compounds is still somewhat obscure, their further study is likely to give results of considerable importance. Prof. U. Hofmann (Rostock) described the formation of salts of graphite and strong acids. The peculiar step-wise manner in which these salts decompose (similar to the manner in which C_8K passes into $C_{16}K$) suggests that there is a fundamental electronic connexion between the layer planes of the graphite crystal lattice. Prof. O. Ruff (Breslau) put forward certain suggestions concerning the structure of 'amorphous' carbon and discussed the reactions of carbon with oxygen, fluorine, carbon dioxide and with metals. He also exhibited specimens of graphite monofluoride prepared by himself and Bretschneider and demonstrated the decomposition of the substance on warming. The reaction (*Verpuffen*) was very reminiscent of the decomposition of graphitic oxide. Prof. H. L. Riley (Newcastle-upon-Tyne) directed attention to the abrupt changes which occur in the properties of the products of carbonizing various organic substances at temperatures in the neighbourhood of 700° C. He discussed particularly the susceptibility of various carbons to oxidation to chromic-phosphoric acid and the changes which occur in the strength of coke during carbonization. Dr. H. Thiele (Kiel) discussed the oxidation of black carbon in various electrolytes at room temperature, and demonstrated the swelling of a graphite electrode when anodically polarized in concentrated sulphuric acid, and also the peculiar crackling which occurs when a hard carbon electrode is treated in a similar manner. He referred to the various stages in the oxidation: (1) primary oxide, (2) swollen oxide, (3) blue graphitic oxide and graphitic acid and also humic acid.

The problems connected with the kinetics of carbon combustion are likely to become less obscure as our knowledge of the chemical nature of black carbon increases. In spite of extensive experimental work, the exact mechanism of carbon oxidation is still obscure. Prof. V. Sihvonen (Helsingfors) discussed the influence of keto- and ketene groups and of adsorbed molecules and ions and the mechanism of carbon oxidation. Basing his views on extensive experimental work on the reduction of carbon dioxide, adsorption of oxygen, combustion in oxygen, effect of water vapour and the anodic oxidation of carbon both in electrolytes and in the gas phase, he advanced comprehensive theories as to the mechanism of the breakdown of the carbon lattice. Dr. Lothar Meyer (Höllriegelskreuth, near Munich) described some of his ingenious experiments on carbon combustion at low pressures. The technique employed, following the static experiments of Langmuir, consists in streaming the oxidizing gas at a pressure of a few thousandths of a millimetre of mercury, at a high velocity, over a carbon filament heated electrically, so reducing considerably the chances of secondary reactions occurring. The results obtained with oxygen, carbon dioxide, and water vapour were described. The part played by surface oxides in the oxidation of carbon was discussed by Dr. R. F. Strickland-Constable (Oxford). Although the exact nature of the oxide is still uncertain, there appears to be little doubt that some form of solid oxide plays an important intermediate part in carbon combustion. The views of Rhead and Wheeler put forward twenty-five years ago, and the recent views of Eucken on the mechanism of carbon combustion, support this idea. Strickland-Constable also described experiments on the oxidation of carbon in nitrous oxide. J. D. Lambert (Oxford) discussed briefly the effect of certain metals on the oxidation process.

The paper by Prof. E. Berl (Pittsburgh) on the formation and properties of activated carbon was taken as read. Only a very limited time remained for discussion.

Dominion Tributes to Lord Rutherford

TRIBUTES to Lord Rutherford continue to appear, written in many cases subsequent to the numerous appreciations in NATURE. Prof. T. H. Laby, professor of natural philosophy in the University of Melbourne, has published an article in the January number of the *Australian National Review*. Dr. C. M. Focken, lecturer in physics at the University of Otago, N.Z., has given a good summary (19 pp.) of Rutherford's life and work (Otago: N.Z. University. London: Whitcombe and Tombs, Ltd.). Dr. E. Marsden, now Director of the New Zealand Department of Scientific and Industrial Research, has written an interesting account of Rutherford's origin and youth in the *New Zealand Railways Magazine* for January and February, 1938.

The chief feature of these contributions is the insistence on the great benefits to the Dominions of Rutherford's visits and influence. Prof. A. Norman Shaw, of McGill University, has already pointed out that physics acquired a new status in Canada dating from that period when Rutherford 'set the St. Lawrence on fire' at the beginning of the century. During the visit of the British Association to South Africa, Rutherford spoke at several of the colleges, and the gratitude conveyed to him always expressed fresh interest and stimulation. In Australia and New Zealand his lecture tours were semi-regal, and Rutherford endeavoured in vain to curb the enthusiasm which would manifest itself in functions, students dragging his car, and even mayors and brass bands. The fact is that wherever he went—Europe, America or the Antipodes—he was one of Great Britain's best ambassadors.

Rutherford was aware, from personal experience, of the difficulties which most physicists have to face in working in the Dominions, sometimes rather isolated, with a shortage of co-workers to discuss developments, and with delay in acquiring information and delay in publication of results.

As Prof. Laby writes: "Although he left New Zealand as a young graduate, Rutherford never forgot his native land, and he rendered it many scientific services. This attitude was expressed, too, in the numerous connexions which he maintained with physicists in the Dominions: the many helpful letters which he wrote to them must have been no small tax on his energies. His experience in Canada, his visits to Australia, New Zealand and South Africa, gave him a quite rare perception of the difficulties of scientific work in the Dominions. He went to great pains to accept in his laboratory research students from the Dominions, and few were so quick to recognize in them real ability, if they possessed it, than he. . . . It is conventional to speak of the loss which a man's death creates, but it is no mere tribute of that kind to say Rutherford's death is a very real loss to physics in the Dominions."

So, too, Dr. Focken: "Although he was essentially modest and unassuming, his dominating presence commanded success. In view of his tremendous energy and blazing intellectual fire, it is not at all surprising that he got things done. . . . It is related that his students after a period of fear, learned to love and respect him. His enthusiasm infected them. Once a day he walked round the whole laboratory to talk to each student and discuss difficulties which had arisen and possible lines of advance in the student's research. He spoke of his forty or fifty students as his family, to whom he acted as 'father, grandfather and mother'. He was always pleased to take into his laboratory any young men from the Dominions who had had proper training, provided he had the accommodation. At one time he had so many of these students that he could not accept any from foreign countries. I recall his generosity in offering to allow me to work in his laboratory for a brief period at a time when he had many other applications from students willing to stay longer. Just as generations of overseas students at Oxford took delight in the open house kept on Sunday afternoons by Sir Charles and Lady Sherrington, so at Cambridge, students who attended the Cavendish Laboratory recall with great pleasure the informal tea parties in the Rutherford home."

Dr. Focken also mentions several interesting facts relating to Rutherford's early life which are not well known in Great Britain. His father, James Rutherford, was born a century ago in Perth, Scotland, and was taken by his parents to New Zealand while still a child. He became a wheelwright like his father and in 1866 married Martha Thomas. Ernest Rutherford was the fourth child of twelve and was born at Nelson on August 30, 1871. The family afterwards moved to Havelock, twenty-five miles east of Nelson and worked "an outback farm". From the age of eleven to sixteen, Ernest attended the Havelock school under Mr. Jacob Reynolds and won a provincial scholarship tenable for two years at Nelson College. Here he won many prizes, became dux of the College and gained a Junior University scholarship at Canterbury College, Christchurch. In 1893 he took his M.A. degree with first-class honours in mathematics and physics and next year was awarded an 1851 Exhibition Science scholarship with which he entered Cambridge in 1905. At Christchurch under Prof. Bickerton he constructed a magnetic detector of wireless waves, took a prominent part in debate and as a forward in the football team. According to a fellow pupil at Nelson and Christchurch, Mr. F. Milner, who contributes a foreword to the pamphlet, "whatever Rutherford did as a student he did thoroughly".

Dr. E. Marsden was one of the distinguished band of research students working at Manchester with Rutherford: "Geiger and Marsden made the very striking observation that some of the particles incident on a sheet of matter have their direction changed to such an extent that they emerge again on the side of incidence." ("Radiations from Radioactive Substances", p. 191.) This result started Rutherford on his successful voyage to the nucleus!

Marsden accompanied Rutherford on his last tour in New Zealand and made all arrangements for travel, meetings and lectures. He has written a good account of Rutherford's youth and given an appreciation of the enormous influence his life and work, his visits and lectures have had on the people of New Zealand.

Mr. R. M. Laing has contributed a brief article to *To-morrow*, a New Zealand independent fortnightly (Nov. 10, 1937).

The *Nelsonian*, the magazine of Rutherford's school, Nelson College, has collected notices and published a photograph of the old Rutherford home since demolished. One of the Houses at Nelson College is now known as Rutherford House.

Dr. C. M. Focker is also preparing a full bibliography of the publications of Lord Rutherford to be given in the *Transactions of the Royal Society of New Zealand*. The list is still incomplete, but the present number of books, letters and articles has already reached a total of some two hundred and sixty. It will be a valuable index of Lord Rutherford's activities.

The Assessment of Nutrition

IT is not often that a single problem is, at one time, and without deliberate co-ordination, studied by medical men, scientific workers and sociologists. This is the case with the 'assessment of nutrition'. Everyone who is interested should read a contribution* which both shows how urgent the problem is and (by implication, since the author tactfully understates his case) indicates possible modes of solution. Everyone should also read the discussion which follows the paper.

Mr. Huws Jones defines the problem : To discover undernourished children that they may be fed. There is reason to believe the methods in use are not discovering them all. Three possible improvements are suggested ; more frequent detailed medical examination, frequent rapid survey to select cases for detailed examination, or the use of a physical yardstick to select cases for detailed examination. Since questions of finance exclude the first suggestion (yearly examination of all children would mean trebling the number of school medical officers), and the second is not considered likely to be useful, attention is concentrated on the third.

The object of the inquiry was to show whether any system of physical measurements can be used to avoid unnecessary extension of medical examination, to select probable cases for the decision of the medical officer. School children were therefore medically examined and carefully measured. Children from the same school were examined by the same doctor on two occasions ; the same children were examined by different doctors ; the doctors "were urged to take as much time as they wanted over the assessment of each boy". Finally, the grading of the children by physical measurement and by medical opinion was compared.

The comparison showed that the percentage of children graded by medical examination as subnormal increased steadily from good to poor schools ; that height and weight, at each age, improved with social class ; that of children graded medically in the same nutrition class those in better schools were taller and heavier than those in poorer schools, and that height and weight in all classes of school improved with nutrition class. Nutrition grades, as determined by medical examination, "are distinguished best by weight, then by chest, and finally by height". But no combination of measurements could be found which could be used to pick out exactly the same children as the medical officers would select as a result of their examination.

The discussion is illuminating. Dr. Magee ignored the economic reason for seeking a time-saving substitute for clinical examination and wished to combine anthropometric with clinical examination and even add on physiological tests. Dr. Glover, of the Board of Education, cheerfully delivered himself into the hands of his critic on two counts, first that the discrepancies between the assessments of the different medical men could be explained as due to borderline cases, and second that the judgment of "teachers, school nurses, school attendance officers and others in regular contact with the children . . . could go far towards filling any gaps left by clinical assessment".

From the former of these suggestions, Mr. Huws Jones deduced that, in some areas, more than half the children examined were on the borderline between satisfactory and unsatisfactory nutrition, which makes the published reports of the Board seem "Too rosy". In view of the second, he wondered what need there is to employ medical men at all for this purpose if teachers appear to be so successful in picking out children who escape the doctors' scrutiny.

Dr. Daley suggested that the important thing was, not the anthropometric measurements at a given moment, but periodic measurements to show rate of growth.

Apart from the general conclusion that physical measurements give an index "at least as satisfactory as a careful and complete clinical examination", the issue is left in doubt. Indeed, Mr. Jones himself questions whether the best index he found (Tuxford's) can be regarded "as a satisfactory measure of nutrition". But, if the problem be accepted as originally enunciated, namely, to discover undernourished (that is, underfed) children in want of more food, then, on analogy with animal husbandry, physical measurements are the simplest and only reliable criteria. If, on the other hand, as appears from several parts of the discussion, something more difficult and subtle must be read into the problem, which becomes a complicated mixture of questions of disease and *mal*nutrition, as well as underfeeding, then the role of the doctor appears to be to select from amongst those shown by physical measurement to be below an accepted standard : (*a*) those whose condition is referable to any detectable disease condition not nutritional in origin ; and (*b*) those suffering not from gross lack of food, but from some particular deficiency. The first would receive appropriate treatment and all the others would be fed ; unless, of course, as Mr. Jones rationally suggests—and his study has given a general indication in favour of this solution—all the children from poor families are fed.

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* Jones, R. H., "Physical Indices and Clinical Assessments of the Nutrition of Schoolchildren" (with Discussion), *J. Roy. Statist. Soc.*, 101, 1-52 (1938).

Science News a Century Ago

Thomas Andrew Knight, F.R.S., 1759-1838

On May 11, 1838, Thomas Andrew Knight, the plant physiologist and horticulturalist, died in London at the age of seventy-nine years. Born at Wormsley Grange near Hereford on August 12, 1759, he entered Balliol College, Oxford, in 1778, and being in possession of ample means was free to follow his own inclinations. His physiological investigations began with inquiries as to the circulation of sap, on which it has been said he "did much that was not only instructive for the time", but "was destined to remain with little modification among the fundamental facts of science". His most important work related to the growth of plants and their environment. In his study of the germination of seeds he used a revolving water-mill wheel on the edge of which he placed the seeds. He found that the shoots, no matter how they were pointed at first, gradually turned their points outwards from the circumference of the wheel, while the radicles grew inwards. In 1795 he read a paper to the Royal Society on the inheritance of disease of fruit trees and the propagation of debility by grafting. This paper was succeeded by accounts of experimental researches into vegetable fecundation, the ascent and descent of sap in plants, the phenomena of germination, the influence of light upon leaves, and a great variety of similar subjects. Knight was an original member of the Horticultural Society founded in 1804. In 1805 he was elected a fellow of the Royal Society and in the following year was awarded the Copley Medal. In 1811 he succeeded Sir Joseph Banks as president of the Horticultural Society, founded in 1804, and held office until his death. The Knightian Medal was founded in his honour. He was "a man of great patience and great perseverance, and seems to have had a charming personality, warm-hearted and generous, a little hasty at times, but of great kindness". His "Physiological and Horticultural Papers" were published in 1841, with his Life prefixed. In addition to numerous papers in the transactions of the Horticultural and Linnean Societies he was the author of "A Treatise on the Culture of the Apple and the Pear", "The Manufacture of Cider and Perry" (1797) and "Pomona Herefordiensis" (1811).

National Standards of Length and Weight

In his autobiographical notes for 1838, Airy wrote: "The National Standards of Length and Weight had been destroyed in the fire of the Houses of Parliament (Oct. 16, 1834). On May 11th I received a letter from Mr. Spring Rice, requesting me to act (as chairman) with a committee consisting of F. Baily, J. E. Drinkwater Bethune, Davies Gilbert, J. G. S. Lefevre, J. W. Lubbock, G. Peacock, and R. Sheepshanks, to report on the steps now to be taken. I accepted the charge, and the first meeting was held at the Observatory on May 22nd; all subsequent meetings in London, usually in the apartments of the Royal Astronomical Society, I acted both as chairman and as working secretary. Our enquiries went into a very wide field, and I had much correspondence."

This was the beginning of the long and laborious investigations and experiments which led to the construction of the new standards. Most of the work was done by Baily, who died in 1844, and Sheepshanks, who died in 1855, the day before the Royal Assent was given to "an act for legalising and preserving the last standards of weights and measures". This act provided that "The straight Line or Distance between the Centres of the two Gold Plugs in the Bronze Bar deposited in the Office of the Exchequer as aforesaid shall be the genuine standard of that Measure of Length called a Yard and the said straight Line or Distance between the Centres of the said Gold Plugs or Pins in the said Bronze Bar (the Bronze being at a temperature of Sixty-two Degrees by Fahrenheit's Thermometer) shall and be deemed to be the Imperial Standard Yard".

On June 18, 1857, Airy read to the Royal Society an "Account of the Construction of the New National Standard of Length, and of its Principal Copies."

The history and development of standards of measurement formed the subject of Sir R. T. Glazebrook's Guthrie Lecture to the Physical Society of London on May 15, 1931 (see NATURE, **128**, 17, July 4, 1931).

The London and Southampton Railway

Under the date May 12, 1838, the *Gentleman's Magazine* recorded, "The works upon The London and Southampton Railway having been so far completed as to permit its being opened to Woking-common, a distance of twenty-three miles from London, the first experimental trip was made, when the Directors, accompanied by their chief engineer Mr. Locke, by several noblemen and by many Members of Parliament, paid a flying visit to the admiring rustics who had congregated in thousands at Woking. The party assembled at the handsome and convenient terminus at Nine Elms, near Vauxhall Bridge. Rolling onwards at an equal but rapid rate Wandsworth and Wimbledon were soon passed; Merton was seen on the left; and in a few minutes Kingston with all its lovely scenery showed itself in the distance. . . . Byfleet and the long and beautiful range of hills which bound the neighbourhood of Leatherhead and Dorking" could be seen, "and a few minutes afterwards the station of Woking-common was gained. The whole distance was accomplished in 45 minutes."

University Events

Birmingham.—The Huxley Lecture is to be given by Prof. Ernest de Selincourt on May 19 at 5.30 p.m.; he will take as his subject "Literature and Science".

Cambridge.—The following have been appointed University demonstrators in anatomy: E. W. O. Adkins, of St. John's College; G. D. Channell and F. Wemyss Smith.

It is proposed to confer the degree of Doctor of Science, *honoris causa*, upon F. P. Rous, of the Rockefeller Institute for Medical Research in New York.

Oxford.—In Convocation on April 26 it was agreed that the honorary degree of D.Sc. should be conferred on July 16 on Dr. Harvey Cushing, emeritus professor of surgery at Harvard University.

St. Andrews.—The Court has appointed Dr. W. F. K. Wynne-Jones, of the University of Reading, to the chair of chemistry in University College, Dundee, which will become vacant on September 30 by the retirement of Prof. Alexander McKenzie. Mr. J. Norman Davidson has been appointed to the vacant lectureship in bio-chemistry in University College, Dundee.

Societies and Academies

Dublin

Royal Dublin Society, March 22, 1938.

Paul A. Murphy: A study of the seasonal development of the potato plant in relation to blight attack and spraying. The rate of growth of foliage and tubers was studied on potatoes on which *Phytophthora infestans* was perfectly controlled, commercially controlled, and uncontrolled. The first effect of spraying was generally to check the production of foliage and tubers, and reduce blossoming, but during the drought of 1933 the foliage was increased, as has been found under similar conditions in the United States.

H. H. Dixon: Subaqueous transpiration. This note deals with the criticism of Smith, Dustman, and Sheill, of a paper published by the author in 1898 on transpiration into a saturated atmosphere. The critics repeated the author's experiments with material from several species, always with negative results. They concluded, not realizing the precautions that had been taken, that the early results were due to water-deficit in the experimental material. In the present work, positive results were obtained with branches and leaves which had been kept twenty-four hours submerged and freely supplied with water. The material used by the critics was similarly treated for only one or two hours. Hence the objection of water-deficit cannot be raised. Probably some difference in technique, or in the physiological state of the material, was responsible for the discrepancy.

Paris

Academy of Sciences, March 7 (*C.R.*, 206, 705–792).

Léon Lecornu: Cutting a solid body.

Pierre Lejay and Chang Hung Chi: Measurements of gravity in the south of China. The measurements given were made with the Holweck-Lejay pendulum. In order to avoid the large temperature corrections necessary with this instrument, a field thermostat was devised capable of maintaining a constant temperature for several hours.

Wolfgang Dœblin: Study of the ensemble of powers of a law of probability.

Robert Fortet: The resolution of a system of equations of Schrodinger.

Henri Eyraud: Certain decompositions in imaginary chances.

Max Zorn: The lemma of Schwarz.

Ernest Vessiot: The equations $F(x,y,z,p,q,r,s,t)=0$ integrable by the method of Darboux.

Szolem Mandelbrojt: The applications of a theorem on the arguments of singularities.

Ayzyk Gorny: Functions indefinitely derivable on the whole of the real axis.

Georges Valiron: The directions of Borel of meromorph algebroid functions of infinite order.

Arnaud Denjoy: The singularities of an analytical function defined by an element.

Raymond Tremblot: The multiple spectroscopic stars 52 and 58 Perseus.

Théodore Kahan: Shock between a high-energy neutron and a proton treated by the method of approximation of Born.

Manuel Valadares and Francisco Mendes: Study of the $L\alpha$ satellites for the element 82 (Pb).

Guy Emschwiller: The photochemical oxidation of methylene iodide: the production of iodic anhydride. Methylene iodide with oxygen in a closed vessel exposed to ultra-violet light gives iodine, formaldehyde, formic acid, carbon monoxide and iodine pentoxide, the last in appreciable quantity.

René Audubert: The ultra-violet emission spectrum and slow thermal dissociation of sodium hydrazoate.

Frédéric Joliot and Ignace Zlotowski: The energy of the groups of protons emitted during the transmutation of boron by the α-rays.

Mlle. Marie Théodoresco: The Raman spectrum of some molybdates in aqueous solution.

Victor Auger and Mlle. Nina Ivanoff: Ammonium magnesium arsenate and alkaline earth arsenates.

Charles Dufraisse and Jean Houpillart: Syntheses in the naphthacene series: naphthacene-diaquinone.

Bernard Gèze: The genesis of the Quercy phosphorites.

Otto Munerati: The use of rhizogene compounds for favouring the formation of roots and of flower bearing stems on the collars of the beetroot.

Robert Douin: The photo-geotropic sensibility of the sporogone of the Hepaticæ.

André Mirimanoff: Vitamin C and chlorophyll. Determinations of ascorbic acid in various organs of plants by Meunier's method leads to the conclusion that the antiscorbutic value of a plant does not depend on the presence of chlorophyll.

René Souèges: The embryogeny of the Portulaceæ. The development of the embryo in *Portulaca oleracea*.

René Moricard, Mlle. Simone Gothié and Basile Tsatsaris: The realization of a culture medium deprived of animal matter and allowing the maturation of the ovules of mammals.

Jean Jacques Bounhiol: The possible role of the frontal ganglion in the metamorphosis of *Bombyx mori*.

Mlle. Yvette Neefs: Remarks on the sexual cycle of the sea-urchin, *Strongylocentrotus lividus*, in the Roscoff region.

Eugène Aubel, Wastroslaw S. Reich and F. Michel Lang: The state of the glycogen in the liver.

Maurice Lecamp: The regeneration of the limbs in *Carausius morosus*.

Edgar Lederer and Franz H. Rathmann: The vitamins A_1 and A_2.

Robert Paulais: The colorimetric estimation of iron. Application to the analysis of biological substances.

Henri Bierry, Marcel Andrac and Bernard Gouzon: The globulines and reagines of syphilitic sera.

Maurice Doladilhe: The antibody property of hæmolysin is exercised by a substance isolable from hæmolytic serum.

Cracow

Polish Academy of Science and Letters, February 7.

T. Banachiewicz: Rotations in space of four dimensions and the two aspects of the equations of spherical polygonometry.

J. Pniewski : Studies on the diffusion of light in the edges of the Rayleigh line in carbon disulphide. The distribution of the intensities of this line observed in carbon disulphide cannot be explained by the Raman theory of diffusion due to the rotation of the molecules

Mlle. B. Twarowska : The absorption spectra of biacene and fluorocyclene.

D. Doborzynski : Measurements of the dielectric constant of solids by means of ponderomotive forces.

F. Kepinski : The movement of the periodic comet of Kopff (1906 c).

W. Opalski : Microphotometric measurements of SU Draconis in 1935–1936 and their comparison with preceding measurements.

M. Centnerszwer and Mlle. H. Ladzinska : The lowering of the boiling point of a ternary system by non-volatile substances. (2) Mode of behaviour of cobalt chloride and sodium nitrate in water.

M. Centnerszwer and Mlle. K. Zolatkowska : The lowering of the boiling point of a ternary system by non-volatile substances. (3) Aqueous solutions of calcium nitrate.

M. Centnerszwer : The lowering of the boiling point of a ternary system by non-volatile substances. (4) Certain properties of isozeonic solutions.

St. Kreutz : The amphibolites of the Tatra.

F. Weiler : Mode of behaviour of roots under the action of growth substances contained in the germs of oats and maize.

Geneva

Society of Physics and Natural History, February 3.

Paul Rossier : Accuracy of measurements with the Thomson bridge. The influence of a difference between the resistances which ought to be equal in the bridge is reduced to a minimum if the connection resistances are made as small as possible, in this way resembling the Wheatstone's bridge.

Paul Rossier : The determination of the coefficients of leak of electrical machines. The addition of supplementary coils, the use of known resistances one of which can be altered, and of an ordinary or differential galvanometer allows a simple determination of this coefficient.

Emile Guyenot and Kitty Ponse : Antihormonal immunization and specificity. The immunization obtained by a prolonged treatment with prepituitary extracts of the ox, protects the animals against the action of the thyroetrope and crinogen hormones arising from the ox or sheep, animals belonging to the same group, whilst it is without action towards the same hormones of the pig, horse and man. Hence the reaction is specific. Moreover, the immunization appears to be set up not towards common albumens, but with respect to the protein molecules which constitute the hormones themselves.

Emile Cherbuliez and Anna Herzenstein : The differential estimation of the reducing acids of sulphur. The differential estimation of various reducing sulphur acids in sulphurous waters may be carried out, even at very low concentrations, in the following manner. (1) Determination of the total reducing power by iodine. (2) Determination of hydrogen sulphide or of the sulphides by precipitation with cadmium carbonate or acetate and titration of the precipitated sulphide by iodine. (3) Determination of the thiosulphuric acid or of its salts by iodine, after eliminating sulphuretted hydrogen and an unknown reducing agent by means of potassium iodate in neutral solution. This last reaction is new. The authors have applied the method to Pistany (Czechoslovakia) waters which contain the following reducing sulphur acids : hydrogen sulphide, thiosulphuric acid and an unknown reducing agent which is perhaps hydrosulphurous acid ($H_2S_2O_4$.)

Fernand Chodat and Paul Brunschwig : New researches on cresol blue (tyrosinase, paracresol, amino acids). The authors have measured the quantity of oxygen fixed in the course of the first phase of the synthesis of cresol blue, and have arrived at the following results. The amino acid has nothing to do with the quantity of oxygen fixed, the latter depending only on the concentration of the oxidizable phenols. Each molecule of paracresol fixes a little less than three atoms of oxygen. The oxidation of the phenol, catalysed by the tyrosinase, is much more rapid in the presence of the amino acid (glycocol).

Moscow

Academy of Sciences (*C.R.*, 18, No. 1, 1938).

Loo-Keng Hua : Some results in the additive theory of numbers.

I. I. Privalov : (1) Applications of the idea of harmonic measure to certain problems of the theory of functions. (2) Limit problems of the theory of harmonic and subharmonic functions in the space.

S. A. Tchounikhin : Groups with predetermined subgroups.

I. A. Čarnyi : Theory of unidimensional non-stationary movement of fluid in tubes.

L. Sedov : Hydrodynamic theory of grid.

P. Kapitza : Viscosity of liquid helium below the λ-point.

S. N. Rshevkin : Possibility of obtaining high coefficients of sound absorption by using systems of resonators.

A. A. Geršun : Photometric invariant.

P. A. Bobrov, L. I. Kolotova and V. A. Zamyatina : Investigation of decomposition products of lignin.

D. I. Rjabtschikow : Thiosulphate compounds of the bivalent platinum. (1).

D. J. Vakulin : The problem of the responsiveness of *Lallemantia iberica* F × M to vernalization.

N. S. Petinov and G. A. Zak : The problem of the hardening of plants by soil dryness under conditions of irrigation. (1) The effect of hardening on growth and formative processes.

N. S. Petinov : The problem of the hardening of plants by soil dryness under conditions of irrigation. (2). The effect of hardening on photosynthesis and yield.

A. A. Richter and O. K. Elpidina : The practice of aerial fertilization with carbon dioxide.

D. A. Komissarov : Application of growth substances to increase the rooting capacity in cuttings of woody plants and shrubs.

N. S. Petinov : The effect of continuous and discontinuous water supply on the photosynthetic process and the yield of summer wheat.

Forthcoming Events

[Meeting marked with an asterisk is open to the public.]

Monday, May 9

Royal Geographical Society, at 8.30.—Capt H. C. Smith: "On the Frontier of British Guiana and Brazil".

Tuesday, May 10

Gresham College, Basinghall Street, London, E.C.2, at 6.—A. R. Hinks, F.R.S.: "Astronomy for Surveyors and Navigators". (Gresham Lectures on Astronomy.) (Succeeding lectures on May 11, 12 and 13.)*

Institution of Civil Engineers, at 6.—Annual General Meeting.

Wednesday, May 11

Society for the Study of Alchemy and Early Chemistry (at the British Academy, Burlington Gardens, W.1), at 8.—Prof. J. Read, F.R.S.: "Alchemy under James IV of Scotland".

Thursday, May 12

Royal Society, at 4.30.—Discussion on Plastic Flow in Metals, to be opened by Prof. W. L. Bragg, F.R.S.

Institution of Electrical Engineers, at 6.—Annual General Meeting.

Dr. A. P. M. Fleming: "The Evolution of Electrical Power" (Faraday Lecture).

Friday, May 13

Royal Astronomical Association, at 5.—Prof. Charles Fabry. "Interstellar Space" (George Darwin Lecture).

Royal Institution, at 9.—J. M. Wordie: "An Expedition to North-West Greenland and the Canadian Arctic".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Lecturer in Physics in the University of Sheffield—The Registrar (May 9).

Scientific Officer (Explosives) and Junior Scientific Officer (Metallurgy) in the Research Department, Woolwich, S.E 18—The Chief Superintendent (May 10)

Lecturer in Mechanical Engineering in the Dudley and Staffordshire Technical College—The Principal (May 12).

Technical Officer and Assistant (II) for Radio Research, War Department—The Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, N.W.1 (May 18).

Principal Technical Officer (Ref. No. 32 B) and Technical Officers (Ref. 33 B) in the Aerodynamics Department, Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (May 13 and May 14 respectively).

Agricultural Bacteriologist in the Punjab Agricultural Service (Class I)—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2, by postcard (May 18).

Assistant Lecturer in Mathematics, with qualifications in applied mathematics, in the University of Manchester—The Registrar (May 14).

Assistant (grade II) for aircraft instrument work at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent, quoting Ref. No. 37 B (May 14)

A Technical Officer (Ref. 20 B), an Assistant (grade I; Ref. 21 B), an Assistant (grade II; Ref. 22 B), an Assistant (grade III; Ref. 23 B) for electrical equipment work at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (May 14).

Lecturer in Bacteriology in the University of Birmingham—The Secretary (May 14).

Assistant Field Supervisor at the Norfolk Agricultural Station—The Director (May 14)

Assistant Lecturer in Chemistry in the Technical College, Bradford—Director of Education, Town Hall, Bradford (May 14).

Assistant Lecturer in Chemistry in the Technical College, Bradford—The Principal (May 14)

Lecturer in Psychology in the Victoria University College, Wellington, New Zealand—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1.

Examiner in the Petroleum Laboratory and Women Examiners in the Non-Metallic Section of the A.I.D. Test House, Kidbrooke, London, S E.3—The Secretary, Air Ministry, Kingsway, London, W C.2 (quote I G 10 and I.G 11 respectively).

Assistants (grade III, male) in the Meteorological Office, Air Ministry—The Secretary (S.2A), Air Ministry, Adastral House, Kingsway, W.C.2.

Assistant Civil Engineers in the Civil Engineer-in-Chief's Department, Admiralty—Civil Engineer-in-Chief, marked "A C.E. April".

Assistant Civil Engineers in the Air Ministry—The Secretary (W 9), enclosing addressed envelope.

Assistant in the Intelligence Section of the Mineral Resources Department, Imperial Institute—The Establishment Officer

Junior Scientific Officer at the Low Temperature Research Station, Cambridge—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, London, S.W 1 (postcard quoting J.38/4).

Lecturer in the Mathematics Department of Heriot-Watt College, Edinburgh—The Principal

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Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

World Power Conference. Annual Report 1937 Pp 15. (London. World Power Conference.) [204

British Museum (Natural History) Instructions for Collectors, No. 13 Alcohol and Alcoholometers. Second edition. Pp. 13. (London. British Museum (Natural History).) *3d.* [224

Scientific Proceedings of the Royal Dublin Society Vol 21 (N.S.), No 59. The pH of Conifer Leaves in relation to Systematy. By O. Roberts and Dr. J. Doyle. Pp. 655–674 (Dublin Hodges, Figgis and Co, London. Williams and Norgate, Ltd.) *2s.* [224

Iron and Steel Institute. Special Report No. 20. The Application of Time Study to Rolling Mills By the Rolling Committee of the Iron and Steel Industrial Research Council. (Rolling Mill Committee Report No. 2.) Pp. viii+130 (London: Iron and Steel Institute.) [234

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences No. 774, Vol. 237: On the Forces acting between Atoms and Ions and the Physical Properties of Matter in Bulk By J. A Wasastjerna Pp. 105–134. *4s.* No. 775, Vol. 237. Investigations on Magne-crystallic Action. 5: Paramagnetic Salts of the Rare Earth and the Iron Groups. By Prof. K. S Krishnan and A. Mookherji Pp. 135–159. *3s 6d* (London. Cambridge University Press.) [234

Statutory Rules and Order, 1938, No. 299. Public Health, England. Aircraft Regulations, 1938 Pp 17 (London. H.M Stationery Office.) *5d* net [254

Other Countries

The Rockefeller Foundation. A Review for 1937. By Raymond B. Fosdick. Pp. 62. (New York: Rockefeller Foundation.) [194

U S Department of the Interior: Office of Education. Leaflet No. 32 Personnel and Financial Statistics of School Organizations serving Rural Children, 1933–34. Prepared by Lester B. Herlihy. Revised by Emery M. Foster and Katherine M. Cook. Pp. 15. (Washington, D.C.: Government Printing Office.) 5 cents. [194

Expedition Antarctique Belge. Résultats du Voyage de la *Belgica* en 1897–99 Rapports Scientifiques. Zoologie. Siphonophores et Cténophores. Par Eugène Leloup. Pp 12+1 plate. (Anvers: J.-E. Buschmann.) [204

Bureau of Education, India. Education in India in 1935–36. Pp. vii+139. (Delhi: Manager of Publications.) [214

Jamaica. Annual Report of the Department of Science and Agriculture for the Year ended 31st December 1936. Pp. ii+92+11+1 plate. (Kingston, Jamaica. Government Printing Office.) [214

Miscellaneous Publications of the Royal Alfred Observatory. No. 17. The Cyclone Season 1934–35 at Mauritius. By M Herchenroder. Pp 6+41 plates (Port Louis Government Printer) [214

Advisory Committee on Education. Report of the Committee, February 1938 Pp. xi+243. (Washington, D C.: Government Printing Office.) 35 cents. [224

University of Denver. Department of Anthropology. The Archæological Survey of the High Western Plains. Tenth Report: The Black's Fork Culture of Southwest Wyoming By E. B. Renaud. Pp. 54+12 plates. (Denver, Col The University) [254

U.S Department of Agriculture. Miscellaneous Publication No. 273. Insect Enemies of Western Forests. Compiled by F. P. Keen. Pp. 210. (Washington, D C. Government Printing Office.) 25 cents. [254

Occasional Papers of Bernice P. Bishop Museum. Vol. 13, No 10: A Check List of the Syrphidæ of Oceania By Frank M. Hull. Pp. 79–87. Vol 13, No. 15. A New Species of Hawaiian Portulaca. By Frank E. Egler. Pp. 167–170. Vol. 13, No 16. A New Species of Trisetum and a New Variety of *Panicum imbricatum* from the Hawaiian Islands. By Leo D. Whitney. Pp. 171–174. Vol 13, No. 17: Ecological and Floristic Studies in Kipapa Gulch, Oahu. By Edward Y. Hosaka. Pp. 175–232. Vol 13, No. 18: Liliaceæ of South-eastern Polynesia. By Carl Skottsberg. Pp. 233–244. Vol. 13, No 19. Some Rubiaceæ of Southeastern Polynesia By F. Raymond Fosberg. Pp. 245–298. Vol 14, No 1 An Open Bog on Oahu; Descriptions of two new varieties of Styphelia and Lobelia. By F. R. Fosberg and E. Y Hosaka. Pp. 6. (Honolulu. Bernice P Bishop Museum.) [254

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol 43, Part 1: Studies on the Agaricaceæ of Hokkaido, 1. By Sanshi Imai. Pp 178+3 plates. (Sapporo Hokkaido Imperial University, Tokyo: Maruzen Co, Ltd.) [254

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Physical Fitness at Universities

THOSE Englishmen—unfortunately still very few—who are acquainted with the universities of Canada and the United States, have long had cause for astonishment, indeed for shame, at the way in which the universities of Great Britain have lagged behind those of America in their care for the health and fitness of their students. In those countries at any rate, it cannot be suggested that the desire to produce a healthy population is a sign of latent militarism or of any peculiar brand of politics. To an American or Canadian student—or professor—visiting Great Britain, it seems incredible that in most of our universities there is no medical examination whatever, either at entry or later on, no organized system (voluntary or compulsory) of physical exercise, little provision (except in a few privileged places) for healthy recreation 'in the spare half-hour', no arrangement to provide medical or surgical advice or treatment when required.

A wider knowledge of our deficiencies in this respect, and perhaps a stimulus to make them good, is given by a very timely pamphlet, "Student Health", recently issued by the National Union of Students.* In this pamphlet the need of student health services and of greater facilities for healthy exercise and recreation is discussed, the services and facilities existing in the United States, in Canada, in Germany and in Sweden are described, an account of what is already being done, or is contemplated, in the universities of Great Britain is set out, and a 'minimum policy' for the future is proposed.

The causes of this neglect are various and to some degree, at least, a matter for speculation: the medieval view, based upon a false antithesis of mind and body, that the universities exist solely for the training of the intellect; a superstitious horror of anything which might savour of organization, discipline or compulsion in personal affairs; a belief in the magic of *laissez-faire*; the dominant position in public life of Oxford and Cambridge, where the colleges exert a parental influence, where most of the students are not so poor, and where games and recreations are much easier to get; indifference; and a fear that students themselves might not co-operate. The last cause at least is removed by the publication of this pamphlet on behalf of the students themselves. It is peculiarly timely because, unknown to its writers, a new movement was already under way and that movement will be given greater confidence and strength by the knowledge that the National Union of Students is openly and emphatically sympathetic. The committee of the Union which discussed the matter "was struck with the fantastic lack of attention there had been in this country to scientific methods of physical education". "It became more and more impressed with the importance of preventive as well as curative methods". The systems in other countries, it found, "indicate a very general acceptance by the universities of a great measure of responsibility for the physical as well as the intellectual well-being of their students, a responsibility which is still to a large extent shirked by the universities of Great Britain".

In the autumn of 1937, the National Fitness Councils for England and Wales and for Scotland invited the University Grants Committee to advise on the distribution of a capital sum of £230,000 to aid the universities of Great Britain in providing urgently needed facilities for healthy recreation and for physical exercise. The sum itself is small—

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* Student Health: the Report of an Enquiry into University Health Services by the National Union of Students. Pp. 104. (London: National Union of Students, 1938.)

only about one tenth of the annual Treasury grant, for all purposes, to the universities—and it can do no more (it was not intended to do more) than catalyse the interest of the universities themselves and perhaps of their potential benefactors. That, however, it is beginning to do, and although the £230,000 itself cannot be spent otherwise than on facilities for healthy recreation—on gymnasia, swimming baths, squash courts and the like—it has set the universities thinking and planning, and ultimately very much more may result. In most of them—indeed if not all—voluntary medical examinations are to be instituted, lectures will doubtless be given on matters relating to health, the status of members of the staff dealing with physical training is to be raised, the co-operation of scientific and medical departments is to be sought, committees are to be formed to consider the place of student health as a proper function of a university; and probably, under the guidance of the Medical Research Council, in certain special centres, a scientific examination of the problem is to be instituted. An attempt is to be made, in fact, to give to the subject of bodily and mental health and fitness its proper university status. Those, however, who take a longer view will realize that it is not merely 'student health' as such which is to be aimed at, but—through the universities—the intelligent and conscious application of a new biological outlook on human beings, an outlook intended ultimately to affect the entire community

Health is a positive thing, namely, living up to the best powers of the individual. It is not merely absence of obvious diagnosable disease. As a matter of fact, however, even among students, disease is common enough. A professor in a medical school writes:

"Recently there have come within my notice four students with mild or severe mental trouble, three cases of early tuberculosis, and a host of minor ailments, such as trouble with hearing, vision and teeth, tonsils, colds, influenza, muscular pains, skin diseases, lassitude, anæmia, and not so very infrequently fears about health."

What is true of medical students is just as true—though not perhaps so easily realized—of others. To recognize disease, or minor ailments, or chronic under-nutrition, or mental trouble, or anything lowering the level of happiness, fitness and usefulness in university students, and to provide means of improvement, are important enough. Even more important, however, in the long run, is to send out steadily into the community a stream of intelligent and keen young people who have learned, even in a minor way, what a health service can do for them and their friends, and how necessary it is to the happiness and well-being of the people.

Medicine at present consists too largely of the diagnosis and treatment of obvious disease, often when it is too late for complete health ever to be restored. Hospitals are crowded and only urgent cases can be considered. Human biology must take a much wider view than this of its duties and opportunities. Adequate nutrition, in quantity and quality, exercise suited to the needs and powers of the individual, healthy recreation, a sane outlook on bodily functions—not disregarding sex and reproduction—guidance and help in mental and emotional difficulty, the profitable use of holidays and leisure, all these require an educated public opinion. How better may that educated opinion be built up than by giving to those who pass through the universities some personal appreciation and understanding of the part which an adequate health service, taking account of all such factors and employing all the resources of science, can play in promoting the well-being of those whom it reaches?

Protection of Ancient Monuments in Britain*

THE recently issued list of monuments in England, Wales and Scotland now protected under the Ancient Monuments Acts contains the names of more than five thousand monuments. These are of all kinds from prehistoric camps, stone circles, and barrows to the remains of abbeys, castles, bridges and even relatively modern buildings. Three hundred and twenty-five monuments were added to the list in 1937. Especially noteworthy among the additions are Bewcastle Roman fort, St. Alban's Gatehouse, with its archway and turrets, Reigate old town hall, which it had been proposed to demolish, the remains of the palace of Archbishop Roger at York, dating from the twelfth century, and the remains of the monastic settlement on Faroe Island.

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* Ancient Monuments of Great Britain List of Monuments to December 31, 1937, prepared by the Commissioners of Works. Pp. 101. (London. H.M Stationery Office, 1938.) 1s 6d. net.

Although the list is known not to be exhaustive, as is pointed out by Sir Patrick Duff in his introductory note, it serves to indicate the wealth of Great Britain in remains of historic and æsthetic interest, as well as the multifarious activities of the Ancient Monuments Branch of the Office of Works. Between 1921 and 1931 the Commissioners published lists which indicated from time to time the monuments to which State protection had been granted under the Act of 1913; but since 1931, when the new Act was passed, the list, which it is incumbent on the Commissioners to publish under the law, has been made more comprehensive by the inclusion of those monuments appearing in previous lists, as well as certain classes of monuments for which the Commissioners are responsible in various ways by deed of gift, guardianship, or purchase, or as Crown property, or as situated on Crown property, though not under custody. There also appear the buildings of historic or architectural interest, some wholly or partially in occupation, for the maintenance of which the Office of Works is responsible. Among those in this last category are the Banqueting Hall, Whitehall, the Jewel Tower, Westminster, Holyroodhouse, Edinburgh, Glasgow Cathedral and Dunblane Cathedral.

The interest of the list to the general public, and even its value to the expert, might be considerably enhanced by some such additions as a brief statistical statement in the nature of a progress report, an indication of the latest inclusions, and the date of protection of each monument. Although the introductory note records recognition by the Commissioners of the assistance of local archæologists in compiling the lists, archæologists on their side would acknowledge that the organization and personnel of the Ancient Monuments branch of the Office of Works, as at present constituted, provide a combination of scientific knowledge and practical training and experience best calculated to secure the co-operation of Government department and public, represented by the local expert, which it is the aim of successful administration in a democratic community to secure.

The departmental inertia in matters affecting our antiquities, which caused General Pitt-Rivers to refuse for many years to draw his salary as inspector of ancient monuments, has long been a thing of the past; and Sir Frederic Kenyon in his presidential address to the Society of Antiquaries on April 28 was fully justified in referring to the work of the Commissioners through the ancient monuments inspectorate as the most striking advance in the official recognition of archæology in our time. When, however, Sir Patrick Duff says that "the present enlarged list cannot be regarded as covering in a systematic way the whole of the more important Ancient Monuments of Great Britain", and Sir Charles Peers can tell the Oxford Branch of the Council for the Preservation of Rural England, at the meeting at Oxford on April 30, that the work already done in the protection of ancient monuments is no more than a beginning, it is evident that no means should be neglected to enlist the interest of the public, if the State, as many would like to see, is to take a greater and more responsible share in the systematic advancement of archæological knowledge. The more widely it is known how much is already accomplished by the Office of Works in the course of the year, the more readily will it be possible to win public support for an extension of its activities.

Ideals and Conflicts of Civilization

Ends and Means:

an Enquiry into the Nature of Ideals and into the Methods employed for their Realization. By Aldous Huxley. Pp. v + 336. (London: Chatto and Windus, 1938.) 8*s*. 6*d*. net.

SIX years ago Mr. Huxley presented to the world the picture of a "Brave New World". The days of that scientific Utopia, so cleverly constructed with satire and malice out of Mr. Huxley's rich imagination, are gone. The brave new world is changed to the Utopia of an evangelist, a Utopia seen through the haze of an infinitely troubled world. "Ends and Means" deals with the critical state of present world conditions and with the ideal individual. It considers the problems of domestic and international politics, of education, of religion and ethics, and in it Mr. Huxley tries to suggest a way out of the conflicts which now threaten the destruction of civilization.

Mr. Huxley has applied himself to his task with a faith that cannot fail to command respect, and with a certainty which belongs far more to the mystical world of religious reformers than to the world of reality in which the book was written. The gloomy picture which he paints of the state of the world is also so familiar that at first one fails to realize that it is charged with a brilliant analysis of the conditions that have led to it, and with an equally brilliant statement of the only possible outcome if existing social trends remain as they are. But Mr. Huxley differs from most other social reformers in what he thinks necessary to transform our present social environment into a better one. He does not share the common belief that the way to alter the structure of society is through large-scale political and economic reforms. On the contrary, he holds that transformation brought about by such means would not be accompanied by that necessary change of heart, by that free renunciation of personal ambitions which in his opinion alone can transform human society into an association of peoples in which the first consideration is the common good. National planning he finds inconsistent with international peace, and he argues convincingly that the defence of democracy against fascism inevitably entails the transformation of democracy into fascism. After considering many possible principles of social change, he concludes that the only certain political road to social security is non-violence and decentralization. To achieve these ends he asks that all people should become "non-attached"—non-attached to power, to possessions, to bodily sensations, to fame, non-attached even to science, art and philanthropy. It is plain that to enter Mr. Huxley's kingdom of man, man must completely stop being the mammal we know him to be. Unfortunately, the educational policies, and the mental and physical exercises which he suggests will bring about this transformation, are scarcely practical enough for our immediate needs.

In the few months that have passed since Mr. Huxley's book appeared, society has become even more insecure than it was when the book was written. Mr. Huxley's views have correspondingly receded further from any realm of practical politics. Retreat to mysticism is a poor prescription for the millions who already, through the turn of political fortune, have to face violent death. To suggest that ruthless dictatorships can be opposed by masses determined not to use violence seems equally unreal—for in the absence of opposition there seems no reason why ruthlessness should not continue for ever. Mr. Huxley's argument almost leads to the conclusion which he is anxious to avoid, to the view that violent dictatorships can only be opposed by violence. But irrespective of any such considerations, one has to remember that most of those who make up the world's population are completely unaware of their "attachments", and especially of those particular attachments the interplay of which, in the form of national politics, are most responsible for the present critical condition of society. Politics, it may be true, becomes more and more a game whose counters are *a priori* concepts that are devoid of meaning, counters whose moves completely obscure the simple wishes of simple people. It is, however, no use supposing that one set of *a priori* concepts are any more valid than any other. To use "spiritual exercises" to get "spiritual insight" into "ultimate reality", to form "a mystical union of the soul with the integrating principle of all being", concepts which Mr. Huxley advances, means no more to the vast majority, perhaps even less, than to use "national honour" to defend the "vital interests" of "society", concepts which Mr. Huxley may rightly regard as empty of real meaning and as propaganda to further the exploitation of the many for the benefit of the few. One cannot help wishing that Mr. Huxley, in discussing the vital issues which make up his book, had himself abided by his desire for terms of "concrete contemporary reality".

The most vital of all these issues is the fact that now, almost more than at any other time in human history, there is a premium on human aggressive tendencies, and the most vital of all the problems considered by Mr. Huxley is that of finding means for restraining these tendencies. Mr. Huxley admits that reforms can transfer the undesirable tendencies of individuals from one channel to another channel, but because transference does not abolish what he regards as a fundamental evil, he detracts somewhat from the value of reforms which bring it about. So fundamental an evil as aggressiveness, which observations suggest is a biological heritage, can scarcely be dissipated at its source in the way Mr. Huxley suggests, and it is plain that our only immediate hope of securing the future is to divert, through scientific planning, expressions of dominance from more undesirable to less undesirable fields of social activity. Science cannot be treated, as Mr. Huxley often treats it, as though it were some human epiphenomenon. "Technological progress," he writes, "has reduced the number of physical contacts, impoverished the spiritual relations between members of a community." Whatever these particular relations may be, it is even more true that science has also immeasurably enriched other and more immediate relations between human beings. Technological progress may have provided us "with more efficient means of going backwards". It has no less provided us with more efficient means of progressing. If the civilization of to-day fails to take advantage of these possibilities, it will not be because of the introduction of scientific method into social affairs—for it is certain that success will be achieved only when that which is rational becomes enthroned. Mr. Huxley's present mysticism will not clear the darkness which at present prevents the application of reason in social affairs.

In spite of the shortcomings of the plans it advocates, Mr. Huxley's book is a magnificent achievement, and it is impossible not to be deeply impressed by the wide sweep of his imagination and knowledge. His method of saving the world may not be effective. He has, however, more than helped to outline the problems by which we are faced, and in doing so he has written a book which, in carving its own territory, has cut across all accepted lines of politics and belief.

Climatology of the British Isles

The Climate of the British Isles: being an Introductory Study of the Official Records, for Students and General Readers. By E. G. Bilham. Pp. xix + 347. (London: Macmillan and Co., Ltd., 1938.) 21*s*. net.

In this book Mr. Bilham, superintendent of the British Climatology Division of the Meteorological Office, sets out to compile a reasonably complete summary of the main climatic features of the British Isles within the compass of a book of reasonable size. The book runs to 339 pages, and achieves in a marked degree the avowed intention of the author, and so meets a very long-felt want of meteorologists and geographers. It contains a wealth of information of a statistical character concerning the climatic elements of importance, all discussed and compared in a clear and interesting manner. Much of the information contained in the book has not hitherto been available in printed form, while still more was only available in the rather arid form of such publications as the "Book of Normals".

The book begins with a discussion of the nature of the observations to be treated. Here we find mention of a point all too frequently ignored, that the meteorologist's fog, meaning visibility of less than 1,000 yards, is not of necessity fog to the ordinary man. The motorist, for example, thinks of a fog as a condition which seriously interferes with driving, which corresponds with visibility less than 100 yards.

Mr. Bilham describes the evaluation of the standard deviation and probable error of rainfall statistics, pointing out that the use of these parameters involves the assumption that the data fulfil the normal law of error, which, he says, is not likely to be strictly true. This is obviously so of rainfall, since rainfall is of necessity a positive quantity, while amounts of double the mean are by no means rare. It would therefore have been of interest to know how wide of the truth the assumption of a normal distribution really is. The author has treated the type of distribution of pressure, in accordance with Gold's classification, as a climatic element, the frequency distribution of which at different times of the year is given. This is a new departure in a text-book of climatology, and a welcome one.

Without going into the details of the contents of the book, we may say that the data for wind, rainfall, evaporation and run-off, temperature, sunshine and cloud, humidity, ground frosts, snow, hail, thunderstorms, and visibility, are given as fully as can be expected in any text-book. The mass of data concentrated into these pages bears testimony to the skill of the author, as well as to his mastery of the subject. Although the book is perhaps to be judged as a collection and discussion of the facts of observation rather than as an introduction to general climatology, it is readable and interesting. It will prove not only useful as a text-book for the meteorologist and geographer, but will also be extremely useful to the research worker who desires to know at what point to take up the climatology of any special region.

So much being given, it may appear ungrateful to ask for more. In discussing wind data, Mr. Bilham gives on p. 59 a table of the frequencies of winds of different velocities for January, July and the whole year. The reader who is likely to make real use of the data for January and July is also likely to want similar data for the other months of the year, and it would be possible to suggest a number of uses for such tables for each month of the year, for a number of places distributed over the British Isles.

The occasions of very high wind, of very heavy rain, of abnormally high or low temperature, are shown in convenient tables, and these tables should enable the weather correspondents of the daily newspapers to check up their frequent comparisons with record occasions. In passing, the author stays to scoff at the dew-pond, pointing out that the main factor in the maintenance of the high level in the pond is the fact that it collects rain from a much greater area than the surface area of the water exposed to evaporation. This fact is probably enough to account for the observed phenomena, but it might also be pointed out that any comparison of the dew-pond with the actual formation of dew on grass should be restricted to the dew which *falls*, since over the pond there is no phenomenon corresponding to the dew which is formed by condensation from the air rising from the soil.

The final chapter of the book is devoted to the special types of climate, such as those of coastal areas, inland areas, valleys and towns; and an appendix gives for thirty-nine stations a synopsis of monthly data of cloud, visibility, temperature, rainfall and sunshine. This table, giving as it does the most recent determinations of the normal values of these factors, is one of the most valuable features of the book.

Mr. Bilham's book is one of the most useful additions to the meteorologist's library which has appeared in recent years. Although it is to be judged as a summary of the climatological data for a restricted area rather than as a discussion of the physical principles of climatology, the author's keen sense of the relative importance of the various factors of climate has led to the interpolation of remarks which are of the utmost importance to the clear understanding of the data. The attention directed to the importance of gust-level as compared with mean wind in determining the damage caused by wind, might be cited as an example of such happy interpolations. For a first edition the book is remarkably complete, particularly in view of the fact that it is the first serious attempt to produce a climatology of the British Isles.

D. BRUNT.

Popular Science

(1) The Advancing Front of Science

By George W. Gray. Pp. xiii + 364. (New York and London: McGraw-Hill Book Co., Inc., 1937). 12*s*. 6*d*.

(2) Frontiers of Science

By Carl Trueblood Chase. Pp. xv + 340 + 19 plates. (London: English Universities Press, Ltd., 1937.) 12*s*. 6*d*. net.

(3) The Universe Surveyed: Physics, Chemistry, Astronomy, Geology

By Harold Richards. Pp. xvii + 722. (London: Kegan Paul and Co., Ltd., 1938.) 12*s*. 6*d*. net.

TO those who would like to see not only scientific knowledge but also scientific action play its part in developing civilization, popular science literature is a painful subject. So much of it is either inaccurate or unscientific. Admittedly technical writing on any technical subject is easier than accurate non-technical writing on the same subject.

The bulk of the science literature for the general reader happens to be prepared by two quite different classes of writer, the journalist and a few very distinguished men of science. The journalist has a very difficult task in that he may be unable to read the original research papers and economic pressure may prevent his taking too much time in understanding their subject-matter. The distinction between observable facts and interpretations of facts is likely to be completely lost. Moreover, he is apt to seek only those parts of scientific research which have news value.

On the other hand, the expert scientific workers, with one or two notable exceptions, have so far chosen to present to the general reader a very little that is science with much that is philosophy or mysticism. Even a little theology may be introduced. Both classes of writer use freely, without definition, such highly technical philosophical terms as *truth*, *existence*, *reality*, and *values*, where equally technical but more easily definable scientific terms are carefully avoided. It is not, therefore, surprising that outside the research laboratory there is little or no idea of what is typically scientific action and what is not.

(1). The first of these three volumes, "The Advancing Front of Science", by G. W. Gray, is specially welcome. Although written by a journalist, it is outstanding for its clear and generally accurate account of recent researches. Attention is directed to current work in representative fields of science, the earlier parts of the researches having been dealt with in the author's preceding book. From the nature of the writing, and from the three-page list of acknowledgments, it is clear that the information has been sought in the laboratories in America where the researches were carried out. Mr. Gray has been fortunate, not only in his opportunities of consulting many of the leading workers in America but also in his powers of grasping and conveying to the reader the results of his contacts. The choice of topics ranges from cosmic and atomic physics to recent developments in acoustics, chemistry and biology.

Sometimes the personal element is introduced, as in the chapter dealing with Langmuir's work on thin films, where biographical details are also given. There are occasional slips. For example, when referring to man's inability to survive for long a small change in his body temperature, the phrase "a 1 per cent change" in temperature is used

(p. 20). Then again, on p. 179, "These two separated hydrogen atoms, with their natural affinities now loose and unsatisfied, were eager for any kind of union". It is surely difficult for any scientific investigator to tell whether or no atoms are 'eager'. There is also the customary carelessness in using technical philosophical terms. In spite of these slight blemishes, the volume can be very strongly recommended.

(2) The scope of the second volume, "Frontiers of Science" by C. T. Chase, is very similar. Yet in spite of its excellent illustrations, the account is much less vivid. To the reviewer it savours more of the atmosphere of the science library than of the research laboratory itself. If popular science writers insist on using animistic explanations in physics, would it not help to push the method to its logical conclusion ? Mr. Gray's atoms can be 'eager' ; Mr. Chase's electrons can 'make decisions'. "What happens when an electron decides to break away from an atomic nucleus ?" (p. 249).

(3) Instead of bringing animistic explanations up to date by giving atoms and electrons instincts or Œdipus complexes and the like, Prof. Richards in "The Universe Surveyed" seems, on p. 5, to go back to the early appeal to what is 'natural', giving, incidentally, vectorial qualities to hydrostatic pressure. "It is natural for water to run down hill. This is a consequence of the tendency of water to flow in the direction of the greater pressure." The writing is so 'bright' that it is sometimes difficult to tell which passages are offered as explanations and which as rhetorical devices planned to ridicule.

'Why' questions are frequently asked. "Why do we fall when the foot-bridge breaks under us ? . . . the answer itself, when finally discovered, was found to link us with the stars" (p. 17). Such a passage is apt to give the impression that the scientific investigator can answer 'Why' questions and moreover that the finality of a scientific explanation can be determined. The most noteworthy features of the book are its many excellent illustrations and the inclusion of a section on geology. The title is much too comprehensive in that the universe surveyed is chiefly the non-biological part of the universe. Even vitamins and hormones are treated chiefly from the chemical point of view and psychology is barely mentioned.

The outstanding excellence of Mr. Gray's book overshadows all except the illustrations of the other two volumes. W. H. GEORGE.

Human Ecology

Life as a Whole
By Dr. J. W. Bews. Pp. ix + 347. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1937.) 15s net.

PROF. BEWS' book is very difficult to review and, but for the evidence of the accomplished fact, might have been thought impossible to write. It is intended to supplement his previous work "Human Ecology", which was a study of man in relation to his environment—material, social and cultural. The present work is an attempt at a more complete synthesis. It is written explicitly from the point of view of General Smuts's theory of 'Holism'. The development of mankind is considered as the construction or creation of new 'wholes', whether these are mechanical inventions, social institutions, scientific and philosophical theories, or works of art. The author's general conclusion is that all human constructions are imperfect and may have to be pulled down and reconstructed. The pulling down may necessitate temporary reversion to more primitive and simpler conditions.

Perhaps the least satisfactory parts of the book are the chapters dealing respectively with social life and institutions, history and philosophy, art, architecture, music, literature. Twenty pages or so are devoted to describing the endeavours of the whole human race in each of these directions. The reader who knows about the subject is likely to be exasperated and the reader who does not bewildered. At almost any point he will be likely to ask : Why is this put in and why is that left out ?

One does not know whether to praise Prof. Bews for his courage or condemn him for his rashness. Yet it is hard to see what else he could do. If the chapters had been expanded to two hundred pages or contracted to two, it would probably have been worse. That is one of the reasons why a book of this kind seems impossible to write.

The earlier chapters, the subject-matter of which may be roughly indicated by the term social psychology, are more satisfactory. Occasionally Prof. Bews may have chosen to follow opinions of doubtful reliability, but as he quotes his authorities this cannot do much harm. In any event we should be grateful to one who brings to his survey of mankind moderation, reason and sanity, at a time when these virtues are being extinguished in many quarters. A. D. R.

Sex and Personality:

Studies in Masculinity and Femininity. By Lewis M. Terman and Catherine Cox Miles, assisted by Jack W. Dunlap, Harold K. Edgerton, E. Lowell Kelly, Albert D. Kurtz, E. Alice McAnulty, Quinn McNemar, Maud A. Merrill, Floyd L. Ruch, Horace G. Wyatt. (McGraw-Hill Publications in Psychology.) Pp. xii+600. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 25*s*.

THE purpose of this work, which the authors regard as a pioneer attempt, is the accomplishment in the field of masculinity and femininity of something similar to Binet's early achievement in the field of intelligence, inasmuch as they have endeavoured to apply psychometric methods in the form of a test to the study of sex temperaments. The test was originally devised by the senior author, Lewis M. Terman, in 1922 in the investigation of intellectually superior children, and has since been applied in the examination of a great variety of groups, including college students, office workers, athletes, delinquents, homosexuals and prostitutes, the ages ranging from early adolescence to extreme old age.

The test is made up in two equivalent forms, *A* and *B*, and is composed of 910 items of the *questionnaire* variety, 456 in form *A* and 454 in form *B*. Although the test does not differ radically from previous methods in the study of sex differences, it represents a more systematic attempt to sample sex differences in a large variety of circumstances. The authors maintain that the types of investigation in which the test should be helpful include the relationship of masculinity and femininity of temperaments to body build, metabolic rate and other physiological factors, excess or deficiency of gonadal and other hormone stimulation, and homosexual behaviour, and to such environmental influences as parent-child attachments, number and sex of siblings, sex of teachers, type of education, marital compatibility and choice of friends or of occupations.

Philip's Biology Wall Charts

Designed and Drawn by the Rev. R. A. Ellis and A. E. Ellis. A. 1: Flower Colour. A. 2: Plumage Colour. A. 3: Shell Colour. A. 4: Comb Characters. B. 5: Skull of Dog. B. 6: Skull of Dog. B. 7: Skeleton of Rabbit. B. 8: Skull of Rabbit. B. 9: Rabbit: Ribs, Sternum, etc. B. 10: Rabbit: Limb Bones. C. 11: Protozoa. C. 12: Earthworm: General Anatomy. C. 13: Earthworm: Transverse Section, etc. C. 14: Frog. D. 15: Green Algæ. D. 16: Leaf. (London: G. Philip and Son, Ltd.) Double Charts, 11*s*. 6*d*. Single Chart, 6*s*. 3*d*.

THE difficulty of finding English diagrams suitable for the teaching of biology in schools is a byword amongst teachers of the subject. Philip's series will do something to remove the complaint. They are diagrammatically accurate, bold in design and colouring (although a little crude), well lettered, and of a size (24 in. × 38 in.) suitable for all except large laboratories and class-rooms. The series of sixteen charts contains four illustrating Mendelian inheritance, although unfortunately none shows a simple case of dominant and recessive characters, six are of skeletons or parts of skeletons, four illustrate common zoological types, and two are botanical. In making a selection for this limited series the designers wisely chose subjects which do not readily lend themselves to blackboard illustration. The charts are mounted on cloth and may be obtained at the same prices dissected to fold in four, or varnished with a roller; varnished diagrams, however, are useless in many laboratories because of light reflections from the glazed surface.

Schicksalsstunde Europas:

Erkenntnisse und Bekenntnisse, Wirklichkeiten und Möglichkeiten. Von Karl Anton Prinz Rohan. Pp. 432. (Graz, Wien und Leipzig: Leykam Verlag, 1937.) 7 gold marks.

PRINCE ROHAN is not content to live on the reputation of a historic name: he has won himself a prominent place as a writer on political philosophy. At the beginning of his philosophical career, Prince Rohan stood for free international co-operation. But the drift of events during recent years has modified his attitude to the extent of subordinating everything to a fight against communism. In the present work, which deserves to be translated into English, Prince Rohan begins with Europe's inescapable burden laid on it by centuries of tradition. Delving into the heart of mankind, he traces its hesitations between atheism and the search for God. From all this emerges his picture of twentieth-century man—a being torn between a dozen conflicting tendencies, between Christianity, socialism, liberalism, fascism, nazism and communism. To him the threat of communism is so great that only a vigorous antidote will counter. Hence his justification of nazism and the importance of the idea of 'race' which permeates it. Though everyone will not agree with Prince Rohan's views, his exposition is worth attention, and few would fail to benefit from the reading of "Europe's Hour of Destiny".

The Clear Mirror:

a Pattern of Life in Goa and in Indian Tibet. By G. Evelyn Hutchinson. Pp. xi+171+13 plates. (Cambridge: At the University Press, 1936.) 8*s*. 6*d*. net.

IN the three essays which make up this volume, the author, a member in 1932 of the Yale North India Expedition under the leadership of Dr. H. de Terra, records some of his impressions of travel. Of these the first, "Spain at Sea", deals, as its title may suggest, with the voyage to India and the life of Goa, with its former colonial splendours; the second, "Paintings on a Fan", the fan being the plain country of the north Indian foothills, describes Ladakh and the temples, with their paintings and ritual dances of Leh; and the third, "Lakes in the Desert", is concerned with the more picturesque and imaginative aspect of physiographic conditions in the upper regions of the Indus Valley. The author has a keenly observant eye for form and colour, and within the limits he has imposed, his essays are vivid pieces of description.

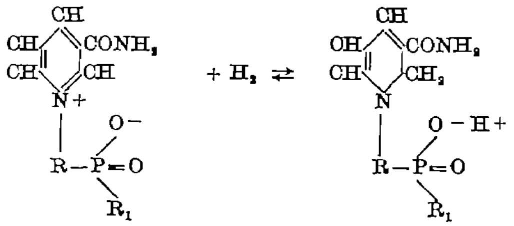
The Intermediary Reactions of Fermentation[*]

By Prof. Otto Meyerhof, For. Mem. R. S., Physiology Department, Kaiser Wilhelm Institute for Medical Research, Heidelberg

IN what way and by what mechanism is the sugar molecule transformed in the cell under anærobic conditions into its biological end-products, alcohol and carbon dioxide in the case of yeast, or lactic acid in the case of muscle? The different kinds of anærobic breakdown of carbohydrate are so closely related, the anærobic formation of lactic acid especially offers so many analogies to alcoholic fermentation, that the discussion of one will throw much light on the other.

Just as a cell-free yeast extract could be made according to the prescriptions of Buchner and Lebedew, so a glycolysing extract of muscle could be obtained and both systems could be divided further. The co-enzyme systems could be removed by dialysis and the protein residues could be fractionated in various ways. In addition to such fractionation, it is possible to suppress certain enzyme reactions by specific poisons, leaving others undamaged, and by other means to remove from further reaction certain intermediate products. At the end, one arrives at certain elementary or primary reactions by which, step by step, substances structurally adjacent are converted one into the other.

In these intermediary reactions, four different types are obvious. The most familiar type is oxidation-reduction. This oxidation-reduction is confined to three distinct reactions, which are connected by the cozymase of Harden and Euler. The chemical constitution and the function of this cozymase have been revealed by Otto Warburg during the past year. The cozymase was identified as diphosphopyridine-nucleotide, where the H_2-carrying group is nicotinic acid amide (scheme 1).



Cozymase. Cozymase—H_2.

R=Ribosephosphor. ac. R_1=Adenosine.

(1)

The reduction process consists of the conversion of acetaldehyde, which arises in fermentation, to alcohol. The oxidation has been achieved by O. Warburg with hexosemonophosphate; but in fermentation this monophosphate is not the molecule which reacts directly with cozymase but a more remote primary product. The oxidation process, which reduces the cozymase, consists of the conversion of triosephosphate (more exactly glyceraldehydephosphate) into phosphoglyceric acid. The oxidation-reduction consists of the *reduction* of aldehyde to alcohol, and the *oxidation* of phosphorylated aldehyde to phosphorylated carboxy acid. This is the oxidation-reduction in the stationary state of fermentation where acetaldehyde is already present as split product of pyruvic acid. In the beginning, during the so-called induction period, the phosphoglyceric acid arises by the dismutation of triosephosphoric acid alone, while simultaneously α-glycerophosphoric acid is formed as reduction product. This dismutation also is brought about by cozymase.

The yeast dialysate, designated originally as coenzyme of fermentation by Harden, does not contain only the cozymase, but several other constituents as well. One of these is a second coenzyme which also can be regarded as the dissociable active group of an enzyme, namely the phosphorylating coenzyme. This coenzyme is the so-called adenylic system. It consists of three parts: (*a*) adenylic acid (adenosinmonophosphate), (*b*) adenosindiphosphate, and (*c*) adenosintriphosphate.

The last two substances were discovered by K. Lohmann in our Institute. The transfer of phosphate is brought about by adenylic acid or adenosindiphosphate taking up phosphate, and adenosintriphosphate giving it off. The substance which accepts phosphate from adenosintriphosphate is hexose. It first becomes hexosemonophosphate and then hexosediphosphate, the well-known ester of Harden and Young. On the other hand, only one substance gives off phosphate. This is the precursor of pyruvic acid, phosphopyruvic acid. In splitting phosphopyruvic acid, the phosphate group is transferred to a sugar or hexosemonophosphate molecule, according to the following scheme (2).

A. 2 phosphopyruvic acid + adenylic acid = 2 pyruvic acid + adenosintriphosphoric acid

B. 2 glucose + adenosintriphosphoric acid = 2 hexosemonophosphoric acid + adenylic acid

$C = \frac{A+B}{2}$ phosphopyruvic acid + glucose = pyruvic acid + hexosemonophosphoric acid

D. phosphopyruvic acid + hexosemonophosphoric acid = pyruvic acid + hexosediphosphoric acid

(2)

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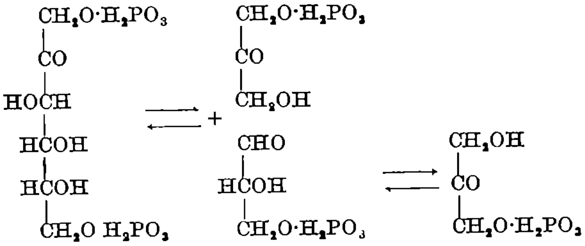
[*] Extracted from a lecture given at the staff meeting of the Rockefeller Institute for Medical Research, New York, on October 15, 1937.

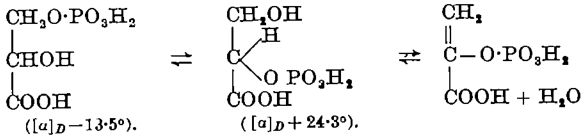
This chain of reactions goes very much faster than the direct splitting into pyruvic acid and inorganic phosphate, and is a typical example of transfer of phosphate.

The oxidation-reduction and the phosphorylations are the most important links of the reaction chain from the energetic point of view, but with these two types of reactions the series is not yet complete. If one removes all coenzymes by dialysis, such an extract is inactive towards hexose, also towards hexosemonophosphate, but not towards hexosediphosphate. In 1934, I found, together with K. Lohmann, that hexosediphosphate enters a very fast reversible reaction, namely hexosediphosphate ⇌ 2-dihydroxyacetonephosphate. Here the 6-C chain is split reversibly into 3-C chains. The closer investigation of this remarkable reaction revealed the fact that it must be separated into the two reactions given in scheme 3.



(3)

In the first reaction, one half of the molecule is converted into 3-glyceraldehyde-phosphate, synthesized by H. Fischer two years earlier. This 3-glyceraldehyde-phosphate is then largely converted into dihydroxyacetone-phosphate. In the opposite direction the two trioses react by enzymatic aldol condensation to form hexosediphosphate. The other reversible reactions described below are also independent of a coenzyme. In 1933 Embden discovered shortly before his death that phosphoglyceric acid is converted enzymatically into pyruvic acid and phosphate. The closer investigation of this Embden reaction taught us that here also a reaction chain occurs which must be formulated as in scheme 4.

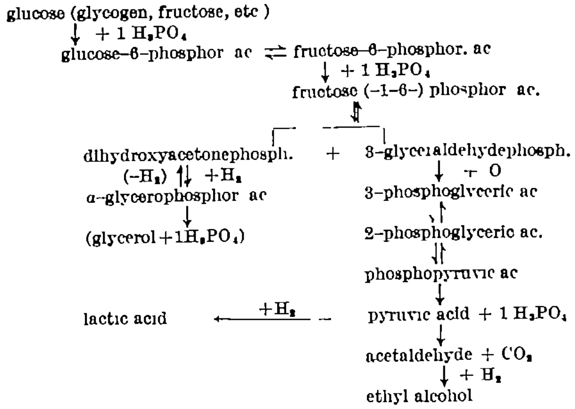


(4)

Between 3-phosphoglyceric acid, 2-phosphoglyceric acid and phosphopyruvic acid a reversible equilibrium exists. The conversion of the last into pyruvic acid is an irreversible dephosphorylation, as I have already stated.

In pursuing the further fate of the pyruvic acid we meet the fourth type of fermentation reaction, the breakdown of pyruvic acid into acetaldehyde and carbon dioxide by the well-known carboxylase of Neuberg. This carboxylase also has a dissociable group which was identified by K. Lohmann a short time ago as the pyrophosphate of aneurin (vitamin B_1).

I have put down all these intermediary products in scheme 5, where the chemically adjacent substances follow each other directly. Every substance is distinguished from the preceding one either by one phosphate group, one carboxyl group, one water group, an oxidative stage, or the neighbouring position of phosphate. Any other stable intermediates are, therefore, highly improbable.



(5)

Does this scheme also indicate the pathway by which in the stationary state the breakdown really proceeds? I can answer the question in the affirmative Some investigators claimed the hexosemonophosphate to be the reactive form of sugar, because it ferments more rapidly than does the Harden–Young ester. Some time ago I myself was also in favour of this opinion. On the other hand, the ester of Harden–Young was not popular in this respect, for the reason that it ferments very slowly and does not decrease during the rapid period of fermentation, but even accumulates, which seems strange for an intermediary product. Only in the past year have we succeeded in solving this paradox by the closer study of the so-called 'fermentation test' of Warburg and Christian.

These investigators have obtained from maceration juice of yeast two different fractions of protein partially purified, so-called *A*- and *B*-proteins which, together with the total system of coenzymes are able to decompose hexosemonophosphate in the presence of acetaldehyde into phosphoglyceric acid and pyruvic acid. (The carboxylase is removed by this fractionation.) Glucose alone and also hexosediphosphate alone remain practically unattacked in this fermentation test. It appeared as though hexosemonophosphate by the interaction of acetaldehyde would split into two oxidized halves, namely, pyruvic acid and phosphoglyceric acid. This finding contradicted all our experience, according to which the whole of pyruvic acid is derived from phosphopyruvic acid. The study of this fermentation test had an unexpected result: it could be proved with convincing evidence that the structural chemical sequence of substances is identical with the pathway of breakdown. Why, I should like to ask, can hexosemonophosphate be metabolized only with both protein fractions *A* and *B* together? This follows, as our experiments show, from the fact that the so-called *A* protein contains that enzyme which in co-operation with the adenylic system enables the phosphate transfer in equation *F* of scheme 6.

E. 1 hexosediphosphoric acid
$\upharpoonleft\downharpoonright$
2 triosephosphoric acid + 2 acetaldehyde + 2 glucose + 2 H_3PO_4
= 2 phosphoglyceric acid + 2 alcohol + 2 hexosemonophosphoric acid
F. 2 hexosemonophosphoric acid + 2 phosphoglyceric acid
= 2 hexosediphosphoric acid + 2 pyruvic acid

G = *E* + *F* 1 hexosediphosphoric acid + 2 acetaldehyde + 2 glucose + 2 H_3PO_4
= 2 pyruvic acid + 2 alcohol + 2 hexosediphosphoric acid
H = *G* + carboxylase 1 hexosediphosphoric acid + 2 glucose + 2 H_3PO_4
= 2 CO_2 + 2 alcohol + 2 hexosediphosphoric acid

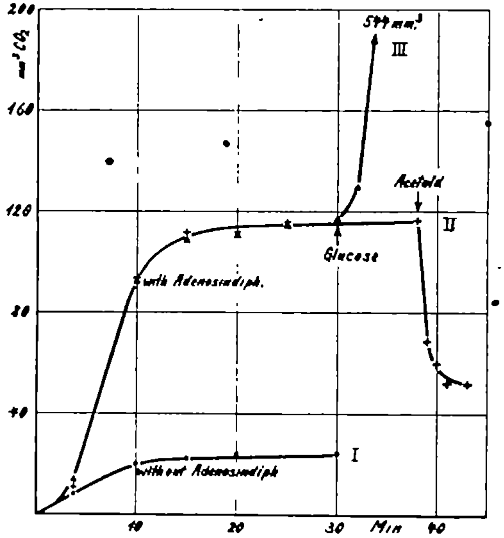
(6)

If no hexosediphosphate can originate, no fermentation takes place because hexosediphosphate is the only source of triosephosphate. Accordingly, a fermentation comes about with *B*-protein alone, if one starts with a mixture of glucose and hexosediphosphate, since now the hexosediphosphate can be decomposed into triosephosphate (*E* of scheme 6). Two molecules of triosephosphate, which originate from the rapid breakdown of one molecule of hexosediphosphate, are oxidized by acetaldehyde to phosphoglyceric acid; the acetaldehyde is reduced to alcohol, while simultaneously two molecules of glucose are esterified to hexosemonophosphate. On subsequent addition of the phosphorylating enzyme, that is, the *A* protein, the above-mentioned reaction *F* will be obtained. Hexosemonophosphate takes up phosphate from phosphopyruvic acid which originates from phosphoglyceric acid. When we sum up equations *E* and *F* and consider that two molecules of triosephosphate are equal to one molecule of hexosediphosphate, we obtain the balance equation *G* of scheme 6. In this balance, hexosemonophosphate and phosphoglyceric acid are cancelled as intermediates, since they appear on both sides. Now, for the turnover of two molecules of glucose we get one molecule of hexosediphosphate in addition; but while equation *E* indicates a stoichiometrical reaction, this is no longer the case with equation *G*. Hexosediphosphate increases autocatalytically and always reacts anew by way of triosephosphate according to equation *E*, until another component, for example glucose or inorganic phosphate, is completely consumed.

Equation *G* is nothing but the fundamental reaction on which the Harden–Young equation is based. In our case the carboxylase was removed by fractionating the proteins. When we add this carboxylase, by which the pyruvic acid is split into acetaldehyde and carbon dioxide, we arrive at the total balance *H* of scheme 6. Now the acetaldehyde also is cancelled in the balance and we obtain the Harden–Young equation itself by merely removing one molecule of hexosediphosphate from each side. It is, however, advisable to leave this hexosediphosphate as it is in equation *H*, because this emphasizes that really hexosediphosphate is converted into alcohol and carbon dioxide, while glucose represents the acceptor of phosphate. In the balance, according to the Harden–Young reaction, free sugar disappears and hexosediphosphate accumulates. However, according to the mechanism it is in fact entirely different, for the hexosediphosphate is the mother substance of the triosephosphate which reacts directly with cozymase, while glucose is being converted into diphosphate by way of hexosemonophosphate, according to equations *E* and *F*. I remind you of a finding obtained twenty years ago, that maceration juice free from autofermentation does not decompose sugar, without a trace of hexosediphosphate having been added in the beginning. This is the hexosediphosphate on the left side of equation *H*.

In respect to the fermentation of hexosemonophosphate studied by Warburg, it can also be shown that the mechanism is the same. The hexosemonophosphate is at first converted into hexosediphosphate by taking up phosphate, and equations quite analogous to those demonstrated are valid. As a matter of fact, the pyruvic acid which appears in this fermentation of hexosemonophosphate has derived from phosphopyruvic acid by the transfer mechanism of phosphate, as shown in equation *F* of scheme 6.

It is always the triosephosphoric acid which reacts directly with cozymase. But this reaction proceeds slowly by itself, and is rapid only in the presence of a substrate functioning as acceptor of phosphate. A most convincing demonstration can be given by substituting creatine for glucose in the fermentation system of hexosediphosphate. Creatine, as is well known, is not present in yeast, but it is of fundamental importance in the lactic acid formation of muscle as acceptor of phosphate. If one adds to the *B* protein of Warburg, in addition to the different coenzymes, hexosediphosphate and creatine and a little of the specific enzyme which enables the phosphate transfer from adenylpyrophosphate to creatine, hexosediphosphate will now be decomposed into pyruvic acid as rapidly as in the presence of glucose.



Manometric determination of reduction of cozymase by triosephosphoric acid in presence of *B*-protein. Carbon dioxide liberation from sodium bicarbonate by H+ of reduced cozymase and H+ of phosphoglyceric acid.

The specific relation between the oxidation-reduction and the uptake of inorganic phosphate, which has also impressed other investigators, can be traced to a coupling of the reduction of cozymase and the phosphorylation of adenylic acid or adenosindiphosphate to adenosintriphosphate. When we omit acetaldehyde from our system and employ triosephosphate and cozymase in equivalent amounts, only a very slow reaction takes place; but this reaction is accelerated enormously as soon as either a larger quantity of adenosindiphosphate or an excess of glucose with a trace of an adenylic compound is added. In the accompanying diagram the course of this conversion is demonstrated.

The measurements were made with manometric technique. The second curve is with a large amount of adenosindiphosphate. The steep upward branch of the curve shows the effect of adding glucose as indicated. This interacts with the adenosintriphosphate formed by phosphate transfer to adenosindiphosphate. The curve sloping downward shows the effect of adding acetaldehyde, by which the reduced cozymase is reoxidized. In addition to this manometric method, the hydrogenation of cozymase can be measured spectrographically. As discovered by O. Warburg, the reduced cozymase has a broad absorption band at 340 mμ, which is lacking in the oxidized form. From the breadth of the band the amount of reduced cozymase can be calculated. Thus, by different methods one arrives at the equations in scheme 7.

J. 1 triosephosphate + 1 Cz + 1 adenosindiphosphate + H_3PO_4
= 1 phosphoglyceric acid + 1 CzH_2 + 1 adenosintriphosphate
K. 1 adenosintriphosphate + 1 glucose
= 1 adenosindiphosphate + 1 hexosemonophosphate

L. = *J* + *K.* 1 triosephosphate + 1 Cz + 1 Glucose + 1 H_3PO_4
= 1 phosphoglyceric acid + 1 CzH_2 + 1 hexosemonophosphate

(7)

Always we obtain an equivalence between esterified phosphate, reduction of cozymase, and formation of phosphoglyceric acid. The profound cause for this coupling between the adenylic system and the reduction of cozymase (equation *G*) remains to be explained.

Basin Cultivation in the United States

By Lois Olson, Soil Conservation Service, United States Department of Agriculture

IN an article entitled "Soil Conservation in Tropical Africa" (NATURE, 141, 268–270; Feb. 12, 1938), Dr. L. Dudley Stamp described a basin type of cultivation that is in practice in Northern Nigeria. In conclusion he states, "If America could invent a plough which will imitate the Nigerian system by replacing the long furrow by a series of isolated elongated basins, one at least of her major problems in the dry lands of the Middle West might be solved". Actually, the principle of basin cultivation described by Dr. Dudley Stamp has been the subject of experimentation in the United States for the last ten years, and to-day several basin cultivators are on the market and in use by farmers in various parts of the country.

So early as 1927, Mr. C. T. Peacock, a Colorado ranch owner, developed a basin lister* which proved satisfactory on his land. The damming attachment consisted of a drag which followed the cutting blade. At intervals the drag was lifted,

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* A double mould board plough.

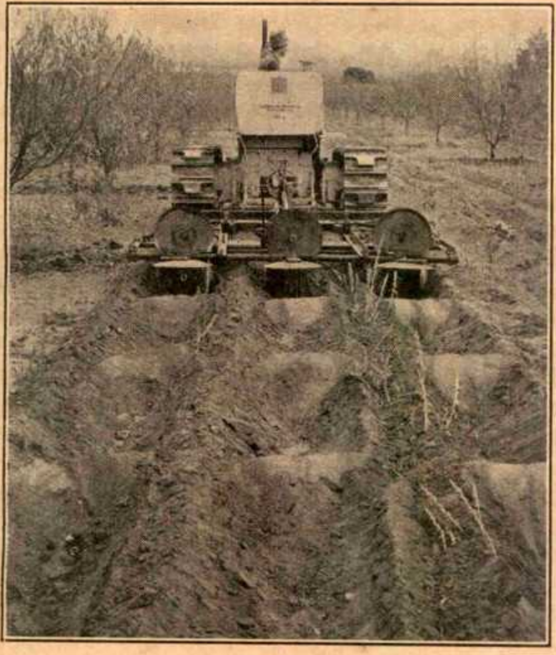

Fig. 1.
THE BASIN LISTER IN OPERATION IN A CALIFORNIA ORCHARD.

leaving dams across the furrows. A patent was obtained in 1931. In the spring of this same year, Mr. R. H. Davis began work on a hole-digging cultivator at Hays, Kansas, and by the autumn of the year an improved model of the implement was sent to the Soil Erosion Experiment Station, Pullman, Washington, for testing. Although the machines were operated on entirely different principles, they served much the same purpose in the semi-arid sections of the country. The cultivator, which dug holes of about ten-gallon capacity, was designed primarily to retain moisture and check erosion on fallow land but later proved effective in orchards, particularly in California. Because of the pockmarked appearance of the fields, it was commonly known as the 'waffle' cultivator, and during 1931 it received considerable attention in the Press. Almost simultaneously, but completely independently, a machine which accomplished the same ends was designed in Hawaii.

In 1934 experimentation was begun on another type of basin lister at Ames, Iowa, by the Bureau of Agricultural Engineering, in co-operation with the State Experiment Station. This work was performed under the direction of J. B. Davidson, C. K. Shedd and E. V. Collins. A rotary, paddle-like attachment was used for constructing the dams.

The basin lister has several advantages over the hole-digging cultivator. The furrows, being larger than the holes, retain a larger amount of water and fill with sediment less readily. Most farmers in the Great Plains area already own listers, and the damming unit may be purchased separately and attached to an ordinary lister. Plans and specifications for the construction of a home-made damming attachment are also being distributed by the Fort Hays branch of the Kansas Agricultural Station.

The use of the basin lister raises several practical problems. If it is used for corn, the water retained in the furrow may cause the soil to form a crust on the top. If so, the young shoots may not be able to break through and an imperfect stand results. After the corn has started growth, the subsequent cultivations tend to break down the ridges between the furrows, and during the last cultivation the ridges are practically destroyed. After harvesting the corn, the land is consequently left unprotected until it is again cultivated in the spring. This means that the soil has no protection during three fourths of the year. In other circumstances dams that have been left standing present obstacles to subsequent cultivation, but several simple types of 'dam busters' have already been devised.

The space occupied by the dams reduces the water-holding capacity of the furrows, the reduction being in proportion to the space occupied by the dams. The spacing of the dams would necessarily vary with the amount of rainfall and

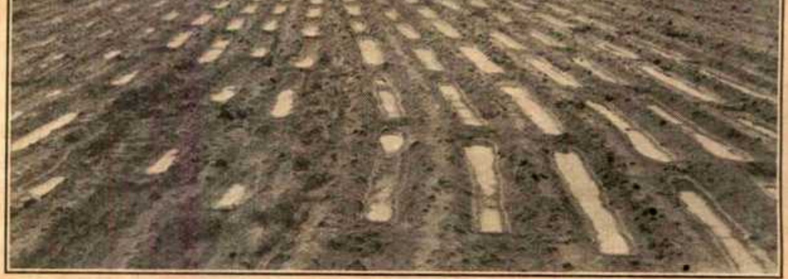

Fig. 2.
BASIN LISTING NEAR HAYS, KANSAS.

with the position of the furrows. The closer they approach to the contours the longer the furrows may be and the greater will be their storage capacity.

As yet the basin cultivator has not been adapted to grains such as wheat, since there is no seeding device capable of planting the seeds at the different depths that would be required on a field prepared by a basin cultivator. The objections advanced, however, are not serious enough to prevent the use of the basin lister for other crops or to discourage further experimentation.

Science and Industry at the Empire Exhibition, Glasgow

THE exhibits in three of the large exhibition halls in the United Kingdom Government Pavilion at the Empire Exhibition, Glasgow, opened by H.M. the King on May 3, have been arranged by the Department of Scientific and Industrial Research in close collaboration with industry. The aim of the halls is to show the relationship now existing between science and industry, and the part which science has played in the development of British industry. The theme is illustrated by the three great national industries of coal, iron and steel, and shipbuilding—one of the exhibition halls being devoted to each of these industries. The subjects of the halls were chosen on the advice of a committee which included some of the greatest industrial leaders in the country.

In telling the story of the place which science is taking in modern industry, practically every device of modern display has been employed to make the exhibits attractive and interesting. In this work the Department has had the help of a distinguished display expert.

Everywhere the visitor finds colour and movement. Complicated processes are simplified and traced out for him by moving lines of light. Where possible, working models are used, and elsewhere essential points are explained by short cinema films introduced into the various sections of the exhibit. The meaning underlying the halls is made plain by large murals. Many of the exhibits are demonstrated by members of the staff of the Royal Technical College, Glasgow. A novel feature of the halls is, that in the sections where a demonstrator is not provided, the various exhibits are explained in conversational tones by loudspeakers radiating the story of the section and directing attention to the various points. For this purpose a new system of sound recording employing a narrow strip of film is being used.

The first of the three industrial research halls is devoted to coal. The most prominent single exhibit in the hall is a large working model of a coal mine more than 200 square feet in area and fifteen feet in height. This has been provided for the Pavilion by the Mining Association of Great Britain, and is probably the finest model of its kind in the world. Both underground and surface workings are illustrated in detail. The latest methods of winning coal are demonstrated and near by are exhibits illustrating the work of the Safety-in-Mines Research Board and the Miners' Welfare Committee. There are also sections dealing with the preparation of coal for the market, which show that coal as supplied to the consumer to-day has ceased to be a crude raw material and has become more and more a semi-manufactured article. Entering the hall, there is a section dealing with the origin of coal. Here there is a large representation of what a coal forest looked like some two hundred million years before the appearance of man. A short cinema film shows how the debris of such a forest was converted into coal seams. The immense varieties of British coal are illustrated by a number of pillars cut from various coal seams. In the next section of the hall the work of the National Coal Survey is illustrated, and the way in which the immense amount of knowledge now available concerning the properties of coal is being used for its better utilization. The next section deals with the great advances which have been made in the use of coal for steam generation both in large power stations and in smaller industrial plants. Here, for example, it is shown that the amount of electricity which can be obtained from a ton of coal has increased by more than 60 per cent in the last twelve years and that, in addition, improvements in electric lamps and other appliances enable electricity to be used more economically. An interesting display shows the products of combustion in super-power station practice, in good and bad industrial practice, and in domestic heating. Something of the latest researches in domestic heating which are now being carried out is also illustrated.

The other side of the hall is devoted entirely to an exhibit prepared by the British Gas Federation dealing with the carbonization of coal in gasworks, coke ovens and low-temperature carbonization plants. The whole process of the treatment of coal and also many of the by-products produced are shown. The essential parts of the various plants are represented, and the course taken by the coal into these is traced by moving light. Light of a different colour shows the passage of the gas through the various stages and the methods by which impurities are extracted from it and converted into valuable products. In front of these diagrams are scenes showing the industries in which these by-products of coal are used, and below these again are fascinating models showing the finished articles which coal has helped to make. The centre of the hall is taken up by a large section illustrating the modern use of coal as a raw chemical material. Various processes for obtaining oil from coal are illustrated here, and it is shown how the gases produced by passing steam over red-hot coke or coal can be synthesized into motor spirit, industrial alcohol and other products. The use of coal as a raw material in the carbide industry, in the production of active carbon and in the making of electrodes is also illustrated.

In the Iron and Steel Hall the visitor will find a huge model of a blast furnace more than thirty feet in height. The furnace itself is made in glass and reveals the red-hot charge within and the molten iron apparently running into the pig beds. The right-hand side of the hall is devoted to the production of iron and steel from the ore to the finished product. To enable the layman to appreciate some of the research problems involved, an attempt has been made to show something of what goes on inside the steel furnace. This has been done by the use of moving coloured models partly made in glass. They indicate, for example, the importance of the heat resistance of the brick linings of the furnace. Industry spends £3,000,000 a year in the replacement of these, which represents 5*s.* of the cost of every ton of steel made. Here is obviously a problem of research, in which, by the way, great progress is being made. The importance of controlling the various processes by scientific instruments is brought out and the ways in which science is helping towards improvements in efficiency and reduction of waste in every form.

Two sections of the hall deal with the microscope and X-rays. The use of the microscope to reveal the inner structure of metals is demonstrated, together with the way in which such knowledge is being used to produce stronger but lighter steels, besides steels possessing special properties. In the X-ray section a powerful equipment for X-ray analysis is shown working, and the visitor learns how, by this means, the physicist can deduce the actual arrangement of the atoms from which the crystals seen in the microscope are built up. Both the use of the microscope and the X-ray apparatus is demonstrated by the staff of the Royal Technical College, Glasgow.

Finally, the way in which steel is used for various engineering purposes is illustrated and an attempt is made to show the visitor how an engineer would select a steel for a particular job and the kind of forces the steel would have to withstand. Progress in constructional steels, for example, is illustrated by a series of model bridges of increasing span constructed of cast iron, mild steel and alloy steel. The load on the bridges consists of a model train. The visitor is reminded of the immense savings, amounting to many millions of pounds a year, resulting from the use of improved steels produced by scientific research, and of the way in which these steels are enabling what were once the luxuries of the few to be brought within the reach of millions. Just before the visitor leaves the hall, an interesting small section directs his attention to the increase in value of iron resulting from research and craftsmanship, which shows that iron in the form of iron ore is worth about 34*s.* a ton, while in the watch-spring, for example, it is worth perhaps £4,000,000 a ton.

In the Shipbuilding Hall the subject has been treated in three parts—the hull, the engines and navigation. Improvements in the lines of the hull have come about as the result of 'tank' research. There is a working model of the famous Yarrow Tank and the workshops associated with it at the National Physical Laboratory. While such a model brings out the length of the modern tank, it can convey very little idea of the actual type of the model hull used in the work or of the instruments employed. Accordingly a 16 ft. wax model of a hull fitted with the necessary recording instruments is also shown. Recent research on the phenomenon of cavitation is illustrated by a propeller-tunnel in which a propeller is shown running under conditions which produce cavitation.

Turning to the marine engine, working models of three of the latest types of turbine, reciprocating engine, and oil engine are shown. In another exhibit the development is traced of the steam engine and its efficiency from the time of Watt to the present day.

The results of research in shipbuilding are summed up in one section of the hall. Here it is shown that the fuel consumption of an ordinary cargo vessel of, say, 9,000 tons steaming at 10 knots, has been reduced by nearly half in the last fifteen years as the result of research. How this remarkable result has been brought about is shown by a representation of a cargo vessel of fifteen years ago, which fades before the eyes of the onlooker to the same type of ship as would be built to-day.

One of the most popular exhibits in the hall is a very realistic ship's bridge carrying the wheelhouse and chartroom of a cargo liner. Practically all the navigating instruments found on such a vessel, including the gyro-compass, the echo depth-sounder and the wireless direction-finder are arranged so far as possible to simulate working conditions. The visitor is able to handle these instruments and to have their principles explained to him by the 'captain', the 'chief officer' or the 'quartermaster'. Elsewhere in the hall the principles underlying some of these instruments are demonstrated in other ways. In this section also there is a fascinating display illustrating a cathode ray direction-finder which gives the bearings of a distant station instantaneously. Another exhibit which is proving very popular is the wireless office of a British destroyer manned by naval ratings.

The large mural, 1,500 ft. square, over the exit of the hall is a striking example of the industrial co-operation which has made the exhibits possible. On this mural are displayed silhouettes of every vessel of more than 100 tons gross launched from British yards last year; they include liners, tanker vessels and smaller craft, besides warships of every description. Some four hundred ships, of capital value £46,000,000, are represented according to the town in which they were built. Every ship-building firm in the country has contributed to this remarkable feature by supplying silhouettes of the ships built in its yards.

Obituary Notices

Colonel Marcuswell Maxwell

COLONEL MARCUSWELL MAXWELL, who died suddenly in a Nairobi nursing home on April 21, was one of the most successful photographers of wild life in East Africa, his photographs of lions, elephants, giraffes, rhinoceroses and other big game being some of the best ever taken, while his photographic studies of the eastern gorilla have never been surpassed. He shared with his namesake, Marius Maxwell, the distinction of being not only a photographer but also a photographic artist in that nearly every exposure he made was a picture.

Maxwell's photographs of East African big game have from time to time appeared in the pages of *The Times* and were published in book form, in two volumes, by *The Times* in 1930. One of these volumes, entitled "Elephants and Other Big Game Studies", contains eleven magnificent photographs of the African elephant, the majority of which were taken at close quarters. These are followed by photographs of black rhinoceros, waterbuck, hunting dogs, hyaenas, impala, eland, zebra, giraffe, wildebeest and vultures. The other volume, entitled "Big Game Photographs", commences with a series of photographs of the well-known Serengeti lions, among them some of the most amazing close-ups of these large carnivora that have ever been secured. There is also an interesting study of a lion climbing a tree, showing that these animals do occasionally exhibit arboreal habits. In this volume, there are also photographs of a rhinoceros accompanied by tick-birds, giraffes in the open, a wonderful study of buffaloes in cover, two wart-hogs at home and a general view of waterbuck at a water-hole.

It is a sad coincidence that death should have overtaken both Marcuswell and Marius Maxwell, two of our most prominent animals photographers. They were not related, but their names and photographic work being so similar frequently led to confusion between the two. This was accentuated by the fact that, in addition to both photographing wild life in Kenya Colony, they both visited the Birunga range of volcanoes in the eastern Belgian Congo in the hopes of photographing the eastern gorilla. Here Marcuswell was more successful than Marius, the latter encountering abnormally bad climatic conditions even for these equatorial forests. Some of Marcuswell Maxwell's photographs of gorillas will never be bettered; he had the good fortune to come up close to an old male gorilla and his family, and without very much interference from the ground vegetation was able to take some excellent pictures.

Zoological science, naturalists and sportsmen have lost a very ardent worker in the death of Marcuswell Maxwell, and he leaves a blank which will be very difficult to fill.

GUY DOLLMAN.

Prof. J. E. Johansson

PROF. J. E. JOHANSSON, of Stockholm, died on March 31, at seventy-six years of age. Johansson was professor of physiology at the Caroline Institute in Stockholm from 1901 until 1927. His first degree was in physics and mathematics. He then studied physiology with Holmgren in Uppsala, and in 1889 he worked with Ludwig in Leipzig. In 1890 he was awarded his M.D. degree for a thesis on the splanchnic nerves and was appointed reader in Tigerstedt's laboratory at Stockholm. From 1890 until 1908, he carried out his well-known researches on metabolism, particularly in connexion with muscular exercise. From 1908 onwards, however, his spare time was chiefly occupied with various activities on behalf of the Swedish Government. He was chairman also (until 1926) of the Medical Nobel Committee, and the high standard which he maintained gave him an enormous amount of work in studying the claims of persons proposed for the Nobel Prize in physiology and medicine.

Johansson's works on social medicine are numerous. He revised and reformed the medical statistics of Sweden. As a member of a Government committee he worked very hard for the abolition of regulated prostitution in Stockholm and published a book on the subject "Sur la réglementation à Stockholm" 1912. The majority did not take his view and he had to fight alone, which he did with great vigour. In 1920 the Swedish Parliament passed a law which abolished it.

For many years, Johansson was a member, and later president, of the board for the Royal Gymnastic Central Institute, where he worked hard for the reorganization of the old institute and for the erection of a laboratory for the physiology of muscular exercise. It is hoped that the Swedish Government will provide for this shortly. He was chief adviser to the Board of Nutrition during the Great War.

Johansson was greatly beloved by his students and colleagues, and was a popular and well-known figure at international gatherings. He was president of the International Congress of Physiology at Stockholm in 1926 and chairman for many years of the Permanent International Committee of the Congresses. He attended the Harvey celebrations in London in 1928. He was an honorary member of the Physiological Society. For many years until his death he was chairman of "Idun", the well-known society of men of science, letters and art in Stockholm. He was an honorary member of the Medical Society of Sweden, honorary senator of the Polytechnical High-school of Dresden, and a commander of the order of the Belgian Crown. He received the degree of LL.D. from the University of Edinburgh in 1923.

Johansson's brothers were gifted men. The eldest is a mining engineer, the second became the youngest judge in Sweden, the third was a clergyman and the fourth, Harold, a well-known geologist. His sister was the wife of the famous Swedish chemist Arrhenius. Johansson never went to school, but was educated by his elder brothers and entered the University at the age of fourteen. Although a bachelor, his home was always full of young people, nieces and nephews, who nearly all of them spent years there when studying in Stockholm.

Johansson's scientific papers are published in various physiological journals, particularly the *Skandinavisches Archiv für Physiologie*, and in the text-books of Abderhalden, Zuntz and Loewy, and Hammarsten.

A. V. H.

Dr. Hermann Augener

DR. HERMANN AUGENER, of the Hamburg Museum, died on April 5 in his sixty-sixth year. The son of a merchant, he was born in Hamburg on October 2, 1872, and after doing his schooling in his native city went to Gottingen and afterwards to Munich to continue his scientific studies. Of independent means, he might have done anything he chose, but he decided to devote his life to marine zoology. He spent some time at the Zoological Station at Naples, and from there went as an assistant to the Zoological Institute of the University of Gottingen, where he remained for several years. His next and final move was back to his native Hamburg, where he became an unpaid, voluntary worker at the Hamburg Museum.

Augener was a specialist on the marine annelids or Polychæta and became a leading authority on the group. Most of his work was of a faunistic nature, and he did much not only to extend our knowledge of the group, but also to impose order upon its classification. He had great learning and an extraordinary capacity for accurate detail. He published about forty papers, many of great length, and among these the more notable are his work on the West Indian Polychætes, his volume on the Polychæta in the "Meeresfauna West-Afrikas", his contributions to Michaelsen and Hartmeyer's "Fauna Sudwest-Australiens" and his papers on the Polychæta of New Zealand. At the time of his death, he was engaged on the Polychæta of the Dutch *Siboga* Expedition.

After the Great War, Augener had a severe struggle against poverty and ill-health. Married and with a family, he was left almost destitute by the collapse of the mark, but happily the Hamburg Museum came to his rescue with a small grant which enabled him and his family to live. In middle life he developed grave defects of hearing and eyesight. In fact, for about the last twenty years he was more than half-blind, and how, his eyesight being what it was, he carried on with his fine microscopic work, was known only to himself. That he did so may justly be described as heroic. He ploughed a narrow furrow to the end, and was without the reward of any public appreciation of his work, which was recognized only by his co-specialists.

Augener's is a gallant story. C. C. A. M.

WE regret to announce the following deaths:

Prof. Max Neissen, professor of bacteriology and hygiene in the University of Frankfort-on-Main from 1914 until 1933.

Prof. P. A. Ross, professor of physics in Stanford University, who carried out work on X-ray spectroscopy, on March 20, aged fifty-four years.

Prof. L. W. Stern, professor of psychology in Duke University, formerly director of the Psychological Institute in the University of Hamburg, known for his contributions to child psychology, on March 27, aged sixty-six years.

Prof. W. T. Taggart, emeritus professor of chemistry in the University of Pennsylvania, on April 11, aged sixty-six years.

Prof. J. Thienemann, founder of the well-known ornithological station at Rossitten, who inaugurated the system of bird ringing, aged seventy-four years.

Prof. R. Verneau, honorary professor in the Muséum d'Histoire naturelle, professor of prehistoric anthropology in the Institut de Paléontologie humaine, on January 7, aged eighty-six years.

News and Views

Sir Leonard Rogers, K.C.S.I., C.I.E., F.R.S.

THE award by the Royal Society of Tropical Medicine of the Manson Medal to Sir Leonard Rogers will be felt by all to be a fitting recognition of outstanding contributions not only to tropical medicine in general, but particularly and almost uniquely to the practical application of therapeutic measures in the treatment of some of the most important major tropical diseases. As a result of his studies of biochemical and other changes in cholera, that most dread and dramatically fatal of all tropical diseases, Sir Leonard Rogers introduced the use of hypertonic saline injections at a time when such forms of treatment were little used. Further, to his untiring energy in directing attention to the necessity of taking active steps to combat the critical stage of the disease by this and other methods, many advances in the treatment of cholera owe their origin. The introduction by Rogers of antimony treatment of kala-azar in India, and his early efforts to improve the form of administration of the drug as well as to extend its application, was very largely responsible for later great advances in the treatment of this disease by organic antimonial preparations and for the remarkable developments which were later introduced for combating kala-azar on a large scale in India. By his insistence on the value of emetin in amœbic dysentery and by his introduction of the soluble salts of emetin, he very greatly stimulated the use of this valuable drug in the treatment of amœbic dysentery in all parts of the tropics. It was also his unflagging interest and insistence on the treatment of leprosy that led to so much attention being directed to the gynocardates, now widely used. Among contributions of a more academic type may be mentioned the discovery of the flagellate stage of the parasite of kala-azar, early researches on malaria and studies on the epidemiology of cholera. To the energy and initiative of Sir Leonard Rogers must also be ascribed the establishment of the Calcutta School of Tropical Medicine, the first large institution of the kind in the tropics.

Prof. A. Smithells and Salters' Institute Fellows

IN appreciation of advice and assistance rendered by Prof. Arthur Smithells while director of the Salters' Institute of Industrial Chemistry from 1922 until his retirement last year, a group of fellows of the Institute has made a presentation to him of a set of silver beakers suitably inscribed. Subscribers to this token of gratitude and affection were, with one or two exceptions, limited to those who held fellowships during Prof. Smithells' term of office as director. The Institute is maintained by the Salters' Company and has two main activities: training of selected graduates in applied chemistry, by means of fellowships, in Great Britain or abroad, and assistance by means of grants for fees and books to young men employed in chemical works who are attending evening classes. To the selection of the fellows, Prof. Smithells gave much thought and attention, and already many of them are filling important posts in chemical industry, this being the object for which the Company maintains the fellowships. He devoted also a very sympathetic consideration to those who were awarded grants, having regard to all the circumstances of the applicants, who are analogous to the apprentices of former days in whom the City companies took a living interest. About fifty of the former fellows who were selected during Prof. Smithells' time, as mentioned above, have now testified to their regard for the former director, and for the help he gave them in the important stage between the university and entrance into industry, by the recent presentation to him.

Disorderly Molecules and Refrigerating Engineering

SIR FRANK SMITH in his James Forrest Lecture to the Institution of Civil Engineers on May 3 pointed out that in recent years very low temperatures (that is, great reductions of molecular motion) have been attained, and the properties of materials at very low temperatures have been studied. The corresponding advance in engineering technique has resulted in the development of refrigerating engineering. The Joule-Thomson effect, whereby the work done in separating the molecules of a gas allowed to expand from a high pressure results in the gas being lowered in temperature, is used in many commercial processes for cooling gases, and in some cases for liquefying them. In order to obtain pure gases from air, the process of rectification is employed. The process depends on the fact that when equilibrium exists between a mixture of two liquids and the vapour it gives off, the composition of the vapour is always different from the composition of the liquid if the two liquids in the mixture have different boiling-points. For example, oxygen boils at 90° K. and nitrogen at 77° K., and when equilibrium exists between liquid air and the vapour above, the vapour contains about 7 per cent of oxygen and 93 per cent of nitrogen. The separation of oxygen and nitrogen by rectification is therefore carried out by allowing liquid air to drop slowly into liquid oxygen; the vapour given off by the latter condenses as it comes into contact with the drops, while part of the nitrogen in the drops simultaneously evaporates, and if the drops are sufficiently small and fall very slowly, all the nitrogen evaporates before the drops reach the vessel containing liquid oxygen. The process is continued, with the result that the gas becomes steadily richer in nitrogen. Other gases can also be extracted from the air by low-temperature separation.

Westinghouse Research Fellowships

THE Westinghouse Electric and Manufacturing Co., of Pittsburgh, Pennsylvania, has established ten 'post-doctorate' fellowships for research in physics, including chemical physics and physical metallurgy, to enable investigators to carry on their work at the Westinghouse Research Laboratories in East Pittsburgh. Five fellows have been appointed for 1938–39, and five more will be appointed in each succeeding year. The objects of the Company in establishing the fellowships are: "(1) To make a worth-while contribution to the development of the fundamental sciences on which modern industry is based. The Company feels that all research leading to a better understanding of the nature of matter and energy will ultimately prove valuable to technology even though its immediate field of application is not apparent. (2) To enable a group of able investigators to become familiar with the scientific problems confronting the electrical industry. It is felt that this contact will be of great value whether the men turn to industrial research or to academic work after completion of their fellowship period." Fellows will devote their entire time to work on their research projects, and will be under the general supervision of Dr. E. U. Condon, associate director for the programme of fundamental research. It is expected that they will also participate actively in the seminars and colloquia held at the Laboratories and in the neighbouring institutions of higher education. Appointments are made for a period of one year and a fellow is eligible for one reappointment for a like period. The salary is 2,400 dollars a year.

THE names of the first five Westinghouse Research Fellows, chosen from fifty applicants, are: Robert O. Haxby, University of Minnesota. Mr. Haxby has been a graduate student in physics for the last four years, and has participated actively in the nuclear physics research in the University of Minnesota. He will join the group which will carry on research in nuclear physics using the large high-voltage generator now being built in East Pittsburgh. John A. Hipple, Princeton University. Mr. Hipple has been a graduate student in physics at Princeton during the past four years, where he has worked with Prof. Walker Bleakney. He will design a large mass-spectrograph of high resolving power for studies in molecular structure in the Westinghouse Laboratories. Sidney Siegel, Columbia University. Dr. Siegel has carried out researches on elastic and magnetic properties of metals under the direction of Prof. S. L. Quimby. He hopes to develop methods of growing single crystals of pure metals and of alloys which show order-disorder transitions to study how the elastic properties of alloys depend on the arrangement of the atoms in the crystal lattice. W. E. Shoupp, University of Illinois. Dr. Shoupp is at present an instructor in physics at the University of Illinois, where he is actively engaged in studies on nuclear physics with the Illinois cyclotron. In addition to his work in nuclear physics, he has made several contributions to extreme ultra-violet spectroscopy as a collaborator of Prof. P. G. Kruger. At the Westinghouse Laboratories, he will continue studies in nuclear physics, working with Dr. W. H. Wells on the high-voltage generator. W. E. Stephens, California Institute of Technology. Mr. Stephens has done work in nuclear physics in the Kellogg Radiation Laboratory in Pasadena, where he studied the production of neutrons by bombarding boron and nitrogen with high-energy deuterons. He has also worked on the development of a new type of high-voltage discharge tube. In East Pittsburgh he will continue his researches on nuclear physics with the large generator at the Westinghouse Laboratories.

Bronze Age Hoard from Bognor

A bronze founder's hoard, which is dated at the early part of the first millennium B.C., has been brought to light at Flansham, near Bognor Regis. The find was made at a depth of about four feet at a point in Hoe Lane, a deep and ancient track now a lane, where it was joined by a new drive in course of construction. The objects discovered were distributed among several owners, but have been brought together again to be described by Mr. S. E. Winbolt in *The Times* of May 9. With six bronze implements were twenty-two lumps of copper, weighing 14 lb. Some round pieces of copper indicate a diameter of six inches for the complete cake, which would appear to have been cast in a crucible with a slightly concave bottom. This hoard is evidently the stock-in-trade of a bronze founder, such as has been discovered not infrequently in Britain. Mr. Winbolt recalls that a similar hoard was found in the course of road construction at Bognor some twelve years ago. The implements found with the copper are two socketed and looped celts, with square-mouthed socket openings, cast with a core, two socketed gouges, the top of a V-type sword with rivet holes, and the side of the top of a carp's tongue sword with a very sharp edge, which is compared with those of the Addington (Kent) and Beachy Head deposits. All may be dated at about 1000–750 B.C., and are probably a native product, though showing the influence of Spain and north-west France. It is to be noted that, as usual, there are no traces of tin with the copper. It is suggested that this, as well as the other and slightly earlier Bognor hoard, may have been abandoned or temporarily hidden, on account of the difficulties of a journey arising from the marshy character of the ground in this neighbourhood at the period.

By-product Coking

ON March 17, G. W. J. Bradley, in a paper presented to the Institute of Fuel, briefly reviewed the history of the coking industry from its inception at the beginning of the eighteenth century to the present day. This development has gradually culminated into a tendency for the industry to split into two sections, the section connected with iron and steel works and regarded as an auxiliary part of steel works technique and the section situated at the collieries. During the years 1934–37 orders have been placed by British steelworks for plants to carbonize approximately six and a half million tons of coal per year. This figure is equivalent to one third of the total carbonizing capacity of the industry. Naturally this prodigious increase in the number and capacity of plants provided by steelworks has deprived colliery-owned coke ovens of a large proportion of the market for furnace coke. Nevertheless, there is no cessation of coking at the collieries, as is apparent from the fact that, during the period 1934–37, 664 coke ovens were ordered by British collieries. So far as future developments of the industry are concerned, much depends upon the attitude adopted by coal owners and on the education of popular opinion towards a correct understanding of the principles involved. Carbonized fuel, whether solid or gaseous, is eminently suitable for domestic heating. The coal trade must be brought to realize this and steps should be taken to compensate for the inevitable loss of revenue which will follow the disappearance of raw coal from the domestic fuel market. Instead of fighting to retain raw coal in this market by raising the price of coal to those who make smokeless fuel, the coal trade should develop a widespread scheme of collaboration with producers of carbonized fuel. By-product coking is as fundamentally important an industry to the nation as a whole as is the coal industry, and as such it should be developed both technically and commercially with the greatest possible foresight.

A Bridge Without Bolts or Rivets

It is stated in *Electric Welding* of February, a bi-monthly magazine published by the Quasi-Arc Co., Ltd., of London, that the London Passenger Transport Board has placed the contract for the building of a new bridge to carry the Hammersmith and City Railway over Ladbroke Grove, just outside Ladbroke Grove Station. The new bridge is to be of all-welded construction, and will be the first of its type and size in Great Britain. The present bridge has been in service for seventy years. The advantages of having a bridge without bolts and rivets are: the reduction of weight by one fifth, a substantial reduction of cost and much less noise during construction. The new bridge will be 60 ft. long; it will be built on three girders instead of two, and there will be a ballasted track instead of a timber track. These improvements will give much quieter running and also more steadiness and strength. It will be erected on trestles beside the present bridge, and early one Sunday morning the old structure will be rolled away and the new one rolled into place. Dr. Schaper, chief engineer of the German State Railways, stated in a paper last May read before a joint meeting of the Institution of Civil Engineers and the Institution of Structural Engineers that already at that time there were 150 all-welded railway bridges in service on the Reichsbahn up to spans of 177·2 ft. At least as many all-welded bridges have been constructed in connexion with the new German arterial motor roads with spans nearly 100 ft. long. In Belgium nearly fifty welded bridges of the Vierendeel type up to spans of 295 ft. have been constructed over the Albert Canal. It seems certain that, in the future, welding will play an increasingly large part in the technique of construction.

Safeguarding London's Water Supply

Much information of considerable interest to the biologist and hygienist, chemist and bacteriologist is included in the thirty-first annual report of the Metropolitan Water Board, which contains the results of the chemical and bacteriological examinations of London waters during 1936, compiled by the Director of Water Examination, Lieut.-Colonel Harold (London: P. S. King and Son, Ltd. 10*s*. 6*d*.). The daily supply of water in 1936 averaged 287·7 million gallons, yielding 96·5 per cent of samples regarded as being of first-class quality. In the laboratories, 35,075 samples were examined in order to keep a watch upon the purity of the supply. In the Bacteriological Section investigations were conducted on the routine methods for the isolation and identification of *Bacillus coli* and allied bacteria, and on the isolation of *B. paratyphosus* B and of streptococci. Turbidity estimations, and the action on metals of tap-water before and after softening, have been investigated in the Chemical Section. Much trouble is sometimes caused in the reservoirs by the growth of Algæ, and the relation of chemical composition of the water to problems of algal production is one of the subjects investigated in the Biological Section. An interesting find was the blind well shrimp, *Niphargus aquilex*, which is naturally a subterranean species, but which has established itself in the filter beds at the Kempton Park Works. The report concludes with the tables containing the chief analytical results obtained.

Transport of Tropical Fruits and Vegetables

The Imperial College of Tropical Agriculture, Trinidad, publishes, as Memoir No. 7, November 1937, a very valuable summary of the methods now available to bring the produce of the tropics to the English markets, which goes far to explain the greater variety and interest of the window display of the greengrocer and the fruiterer throughout all the months of the year. Some 150 names of vegetables and fruits are listed—for many of these, as citrons, bananas and pineapples there is already much experience gathered and a long bibliography to cite, while others like mangoes and the papaw attract attention as household words of the tropics from which much is to be hoped if distance and time can be conquered; but so far their transport is evidently in the experimental stage. Many of the fruits and vegetables enumerated have been but names, if that, to dwellers in the temperate zones so far; the litchi has arrived in much larger quantities lately and been much appreciated; the mangosteen and the langsat are still awaited. This list raises many hopes, and this concise summary of practical experience should prove of material value in enabling importers and transporters to learn how much has already been achieved and what possibilities there are for the future. Copies of this publication may be obtained (price 4*s*., British; 4*s*. 6*d*., foreign) on application to the Editor, *Tropical Agriculture*, Imperial College of Tropical Agriculture, Trinidad, B.W.I.

Marine Biology in Ceylon

The administration report of the Marine Biologist (A. H. Malpas) for the year 1936 (Part 4, Education and Art (G), Ceylon, 1937) states that the Advisory Committee of the Colonial Development Fund has recommended the offer of a grant of Rs. 87,500, from the fund, to meet the cost of the erection and equipment of a fisheries research station and hatchery in accordance with the scheme approved by the Ministry of Local Administration and submitted to the Secretary of State in 1935. Provision of Rs. 175,000 has been included in the Schedule to the Public Works Loan Ordinance to meet the cost of erection and equipment of an aquarium to complete the scheme. The aquarium is a necessary adjunct to the research station in that its large aquaria tanks will provide essential facilities for investigation and research into the bionomics of food fishes and other marine and freshwater animals of economic importance. Besides this it is proposed to establish fish culture ponds within easy reach of Colombo and to purchase a demonstration fishing vessel—a Yorkshire motor coble with auxiliary sail. The department's research vessel *Nautilus* is to be replaced by a somewhat smaller teak-built vessel with diesel engine, which will be equipped with various types of modern fishing gear and essential research apparatus. This, in conjunction with the coble, will undertake a comprehensive scheme of fisheries research in the coastal waters.

Electron Optics

In the issue of the *Revue générale des Sciences* of February 28, M. R. Fritz, of the University of Besançon, gives a short review of the progress made in the first ten years of its existence of this new branch of optics, which he also denominates electron physics. He starts from the fact that electrons radiating from a point may by means of a uniform magnetic field be made to pass through a second point on the line of the field on which they originated. The analogy with the action of a converging lens on light leads to the term 'magnetic electron lens'. An 'electric lens' may be constructed from three thin parallel conducting sheets with equal circular holes through them, if the outer sheets are at the same and the middle one at a different potential. With these elements he shows how apparatus has been constructed which reproduces the action of microscopes and spectrographs, and he explains how electron optics has rendered the theory of the action of older apparatus such as valves and Braun tubes clearer, and has specified the functions of parts originally introduced empirically. The newer apparatus dealt with is connected mainly with the utilization of secondary electron radiation in television.

The Rockefeller Foundation

The annual report of the Rockefeller Foundation for 1936 contains a review by the president, Mr. Raymond B. Fosdick, the reports of the secretary and the treasurer, and detailed reports of the work of the divisions. The International Health Division has continued investigations on yellow fever, malaria, tuberculosis and other diseases, and has now included scarlet fever and influenza among its inquiries ; it has also been largely instrumental in the production of an effective method of preventive vaccination against yellow fever. In medicine, attention has been mainly concentrated upon mental and nervous diseases, and the Foundation has supported studies in endocrinology, genetics and physiology, and the application of chemical and physical methods and mathematical analysis to biological problems. In the humanities, appropriations have been made, among others, for the development of radio programmes of cultural and educational value, and for education in China. Fellowships to the number of 504, spread over a wide field of knowledge, have been directly financed by the Foundation, and much aid has been given to exiled German scholars.

Land Utilization in Tasmania

As an example of the application of scientific assessment of a country's resources, the survey of the "Land Utilization Regions of Tasmania" by Mr. A. G. Lowndes and Mr. W. H. Maze is important (University of Sydney Publications in Geography, 1937. Price 2*s.* 6*d.*). The authors recognize seven qualities of land values, some of them with subdivisions. These were determined during the summer of 1935–36, and the resultant map may be regarded as an agricultural census of that year with indications of the areas in which further development is possible. The survey shows that climate and topography sets definite limits to possible utilization. The whole of the west and south, with a few local exceptions in the interests of mining, is mountainous and undeveloped and offers little scope for settlement ; some is deforested and has lost its topsoil. On the other hand, the north and east afford great scope for settlement, especially as regards dairying, grazing and horticulture. A number of distributional maps add to the value of the survey.

American Literature on Social and Political Affairs

A further list of inexpensive pamphlets on social, economic, political and international affairs, revised to February 1937, has been issued by the Office of Education, U.S. Department of the Interior, under the title "Public Affairs Pamphlets" (*Bulletin* No. 3, 1937). The compilation, which is limited to material published in the United States, was prepared primarily to meet the needs of the ten public forum demonstrations organizing programmes of public discussion. It is based on information supplied by publishers and is limited to brief pamphlets costing not more than 50 cents. No attempt is made to evaluate the contents of the pamphlets listed, although a brief statement of the contents is given in amplification of the title. Although not a comprehensive list, the indexing and arrangement of this publication according to publishers and authors as well as by subjects, make it a very useful guide to this type of literature.

American School Buildings

SCHOOL building problems in the United States have assumed such importance that a National Advisory Council has been organized under the auspices of the Office of Education, Washington, at the request of State superintendents and commissioners of education. At the Council's first conference it was determined to begin with a study of the "functional planning of elementary school buildings", and a report on this subject has been published by the United States Government Printing Office (pp. 84, 25 cents). The report, which is illustrated with numerous photographs, floor plans and charts, shows, among other things, that the elementary school curriculum is changing in ways which radically affect the planning of buildings, and that costs depend largely on the extent to which school work is organized so as to get a simultaneous, balanced use of all facilities. Taxpayers often protest against the excessive cost of providing for the numerous additions to the traditional "three Rs" demanded by the modern elementary school curriculum: music, art, science, crafts, training for leisure, physical culture, play, etc. The report claims that, by the adoption of the so-called 'platoon' system, accommodation for all these activities can be provided without extra cost. Under this system, the classes are all duplicated, and while one set occupies the 'home rooms' the other set uses the rooms set apart for special activities, and vice versa.

Reading Administratively

A GENERAL administration course of reading has been drawn up by Mr. W. R. Dunlop, 57 Gordon Square, London, W.C.1., designed to introduce the idea of reading administratively. While the course is intended primarily for those holding administrative positions, it has a cultural value and aims at serving as a practical form of education for citizenship, including membership, not only of a country or nation but also of businesses, services and institutions. It is intended to provide standards for criticism, imitation and inspiration. Utilizing material of administrative interest to be found in general as well as specialized works and including fiction and poetry, the course should give a general insight into how man governs in different fields and at different levels in the complex hierarchies of administrative control. While there is no time limit it is suggested that, reading eight hours a week, the recommended literature could be studied adequately in six to nine months, after which the practical reader will begin to specialize. Tuitional assistance is given by post in the form of instruction regarding the meaning and principles of administration and what to look for, more detailed treatment of examples, criticism of readers' notes and the like.

Aquarist and Pond-keeper

WE are glad to note that the *Aquarist and Pond-keeper* is to be published monthly in future instead of every two months. Ever since it was founded by the late Mr. A. E. Hodge, amateur aquarists have had cause to be grateful for its helpful articles on the many aspects of their hobby. These articles have, on the whole, reached a high standard without being too technical. The illustrations, too, have generally been good, some of the photographs of living fishes taken by Mr. W. S. Pitt, for example, deserving special mention. There have, in addition, been regular articles on reptiles and amphibians and their management in vivaria; these must have had considerable effect in popularizing the keeping of such creatures as pets. A section giving notes and news from the big public aquaria is a welcome feature newly introduced. We wish the *Aquarist and Pond-keeper* a long and useful life as a monthly publication.

Campaign against Cancer in Algeria

THE recent establishment of an anti-cancer organization in Algeria is of interest, in view of the particular conditions of race, custom, and climate existing in that country. Already at Algiers, attached to the surgical clinic of the hospital, a centre for treatment and investigation of cancer is in existence, with radiological equipment including a 300 kv. radiotherapeutic installation, and with the necessary laboratory services for cancer research. It is also proposed to install a larger quantity of radium for teletherapy, to set up secondary centres in the country, and to launch a scheme of propaganda against cancer.

Teaching of Technical Optics

IN the article under this title in NATURE of April 9, p. 654, in the reference made to the examinations held by the British Optical Association and the Spectacle Makers Company and to the schools recognized by the former body, it was stated that, outside London and Manchester, the attendance is "of the order of a dozen students in the session". The Principal of the Bradford Technical College writes to point out that the number of evening students taking the technical optics course at the College has in the last eight years averaged upwards of forty students, and that fifteen students have attended the full-time day course in the last five years.

Co-operation between Great Britain and France

A CORRESPONDENT, referring to principles of comity amongst nations, writes: "René A. F. de Réaumur (1683-1757), the French physicist, was elected a fellow of the Royal Society in 1738, during the presidency of Sir Hans Sloane. Later, on May 4, 1745, Réaumur, writing to Martin Folkes, then president, said: 'I heartily wish there was in the world as strong a moral attractive power as there is a natural one that might dispose our two nations particularly to seek to unite by mutual acts of friendship and goodwill.' "

Agricultural Scholarships

THE Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland invite applications for agricultural scholarships from students who propose to follow the career of agricultural organizer or instructor or lecturer in agriculture (including horticulture, dairying and poultry-husbandry). The object of the scholarships, of which not more than four will be awarded annually, is to broaden the agricultural knowledge and experience of students and so to qualify them for the position of agricultural organizer, instructor or lecturer. The value of the scholarships will not exceed £200 together with an allowance for approved fees and travelling expenses. The period of the scholarships is normally one year and commences on October 1. Further information can be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

Announcements

The U.S. National Academy of Sciences, Washington, has awarded the Agassiz Medal for Oceanography to Dr. E. J. Allen, who was for forty-two years director of the Plymouth Laboratory of the Marine Biological Association. The Murray Fund, which was established for the award of the medal, was founded by Sir John Murray in 1911 to commemorate the oceanographical work of Alexander Agassiz. The medal was received on behalf of Dr. Allen by Mr. L. McCormick-Goodheart of the British Embassy at Washington, at a dinner held by the Academy on April 26.

The Earl of Radnor has been appointed chairman of the Committee of Management of the Rothamsted Experimental Station. This appointment is in accordance with the long-established usage at Rothamsted of choosing a chairman from among those who are intimately associated with the land; previous chairmen have included such well-known agriculturists as Lord Clinton, Sir Merrik Burrell, Lord Bledisloe and others. Lord Radnor's active interest in rural development and his wide knowledge of the many intricate problems of modern agriculture will undoubtedly prove of great value to the Station.

The Medical Research Council has appointed Dr. Karl Stern to the Kathleen Schlesinger research fellowship for the year 1938–39. This fellowship is provided from a fund established by the late Mr. Eugen M. Schlesinger and Mrs. Schlesinger in memory of their daughter: it is given for investigations of cysts of the brain or allied conditions, and is ordinarily tenable at the National Hospital for Diseases of the Nervous System, Queen Square, London.

The annual visitation of the Fuel Research Station, East Greenwich, will be held on Tuesday, May 31 at 2–6 p.m.

A course of thirty lectures on genetics and cytology and on related studies in pomology and plant biochemistry, for research and post-graduate students and university teachers, will be given at the John Innes Horticultural Institution, Mostyn Road, Merton, London, S.W.19, on July 11–23. Inquiries should be addressed to the Registrar at the Institution.

The next award of the Swiney Prize, which is decided by a joint committee of the Society of Arts and the Royal College of Physicians, will be made in January 1939. The prize, consisting of a cup and the sum of £100, is offered alternately for the best published work on medical and general jurisprudence, and this time is offered for medical jurisprudence. Applications should be made to the Secretary, Royal Society of Arts, John Street, W.C.2, before November 30.

Prof. Hermann Stieve has been nominated president of the International Committee for the Improvement and Unification of Anatomical Terms.

Prof. Martin Kirschner, director of the surgical clinic at Heidelberg, has been nominated a member of the Kaiser Leopold Caroline German Academy of Natural Sciences at Halle.

Dr. Alexander Koenig, professor of ornithology at Bonn, has been awarded the shield of nobility of the German Reich, and Dr. Gottlieb Linck, professor of mineralogy and geology at Jena, has received the Goethe Medal for art and science.

The foundation of a Ministry of Health in Japan has been indefinitely postponed owing to the war with China.

The third Frankfort Conference for Collaboration between Medicine and Natural Science, organized by Profs. R. Otis, K. Felix and F. Laibach, will be held at Frankfort on June 2–3, when the subject for discussion will be the chemistry and physiology of albumin. Further information can be obtained from Universitäts-Institut, Weyerstrasse 3, Frankfurt-a.-M.

The first Pan-American Congress of Endocrinology, which is also the first congress on this subject to be held, will take place at Rio de Janeiro on July 17–23 under the presidency of Prof. Aloysio de Castro. There will be four sections devoted respectively to the experimental, clinical, surgical and medico-social aspects of endocrinology. Further information can be obtained from Academia Nacional de Medicina, Avenida Augusto Severo 4, Rio de Janeiro, Brazil.

The seventh International Congress of Genetics will be held in Edinburgh in 1939 under the presidency of Prof. N. I. Vavilov, vice-president of the Lenin Academy of Agricultural Science and director of the Institute of Plant Industry, Leningrad, and of the Institute of Genetics of the U.S.S.R. Academy of Sciences. The dates of the Congress will probably be August 23–30. Further information can be obtained from Prof. F. A. E. Crew, Institute of Animal Genetics, West Mains Road, Edinburgh, 9.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return. or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 879.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Cytochrome *a* and Cytochrome Oxidase

A HEART muscle preparation obtained by a method previously described[1] contains several dehydrogenases, a very powerful cytochrome oxidase and the three components (*a*, *b*, and *c*) of cytochrome. This material contains a high concentration of cytochrome *a* and is therefore very suitable for the study of this component.

Spectroscopic examination of this preparation shows only a very diffuse absorption with two or three narrow and scarcely perceptible bands. Neither the removal of oxygen by boiling the preparation in a vacuum nor the addition of potassium cyanide affects this absorption spectrum. Cytochrome remains in the oxidized state, which shows that the preparation is completely devoid of reducing substances and metabolites.

On addition of sodium hyposulphite, the absorption spectrum of reduced cytochrome rapidly appears; showing an exceptionally strong band *a* occupying its usual position at about 605 mμ. Succinic acid added to the preparation also reduces cytochrome, but not so completely as does sodium hyposulphite.

On passing carbon monoxide through the reduced preparation, the bands *b* and *c* remain unmodified, while the band *a* undergoes a very marked change. The short-wave portion of this band becomes pale and spreads towards the band *b*, partly obliterating the clear space between these two bands. This pale portion of the band *a* shows, moreover, a slight reinforcement at about 593 mμ. It looks as if a portion of component *a* combines with carbon monoxide forming a derivative which has its absorption band less defined than the original band *a* and lying at about 593 mμ.

The addition of potassium cyanide to a preparation containing sodium succinate does not affect the absorption spectrum of the reduced cytochrome. On shaking such a preparation with air, only a small portion of cytochrome *a* undergoes oxidation, which is indicated by the band *a* becoming slightly narrower. If, however, this preparation is now treated with carbon monoxide, the carbon monoxide compound does not appear and the band *a* remains unchanged. Only after long standing does the band *a* undergo a characteristic modification due to the appearance of the carbon monoxide compound.

This experiment seems to show that potassium cyanide combines with the trivalent iron of the hæmatin, which inhibits to some extent its reduction by the succinic system and the formation of a compound with carbon monoxide.

On the other hand, if potassium cyanide is added to the preparation when its cytochrome is completely reduced by sodium hyposulphite, the band *a* undergoes a change somewhat similar to that obtained with carbon monoxide, which indicates that the cyanide combines also with the divalent iron of this hæmatin.

Sodium azide added to the reduced preparation does not affect its absorption spectrum. Azide does not prevent the formation of the carbon monoxide compound, which is, however, somewhat delayed owing to the slight inhibitory action of azide on the reduction of all the components of cytochrome by the succinic system.

The effect of carbon monoxide on the absorption band of cytochrome *a* is shown not only by heart muscle preparations but also by preparations obtained from skeletal muscles of mammals, pectoral muscles of the pigeon, fresh thoracic muscles of bees and wasps, and suspensions of living *Bacillus subtilis* or of baker's yeast. In the last two cases, however, owing to the lower intensity of the band *a*, the effect of carbon monoxide, although quite definite, is less marked than in muscle preparations.

All these observations seem to show that the band *a* of cytochrome belongs to two slightly different hæmochromogen compounds having the same hæm nucleus. One of these compounds (a) is not autoxidizable and does not combine with potassium cyanide or carbon monoxide, while the other (a_3) is autoxidizable and combines with both. In this respect it resembles the components a_1 and a_2 which occur only when component a is missing[2].

The carbon monoxide compound of this component has its absorption band at 593 mμ, that is, in the position occupied by the band in the photochemical absorption spectrum obtained by Warburg and his co-workers.

That this compound may be responsible for the photochemical absorption spectrum is, moreover, supported by the fact that the carbon monoxide inhibition of respiration is found to be light sensitive only in the organisms showing the presence of cytochrome a (605 mμ) or of its derivative a_1 (583 mμ).

At first sight, these results seem to suggest that the autoxidizable component (a_3) of cytochrome a is cytochrome oxidase itself. Several facts, however, militate against this view, namely: (1) the existence of cytochrome oxidase in cells devoid of cytochrome a, (2) the oxidation of the three components of cytochrome in air, while the component a_3 remains still combined with carbon monoxide, and (3) the oxidation of the carbon monoxide derivative of this component in presence of sodium azide while the other components remain reduced.

The component a_3, although it may be responsible for the photochemical absorption spectrum, cannot therefore be identified with the oxidase, and the problem as to the nature of this enzyme remains open for further investigation.

The fact that the enzyme is so intimately bound to the insoluble material of the cell makes it extremely difficult to study this problem by the ordinary methods of purification and isolation. In the circumstances, every possibility should be carefully examined and tested by suitable experimental methods, and of these possibilities the following three deserve special consideration :

(1) The enzyme may yet be a hæmatin-protein compound similar to cytochrome *a*, or even a protein sharing with cytochrome *a* its hæmatin nucleus. Owing, however, to its possible low concentration, it may still be spectroscopically invisible even in our strong enzyme preparations.

(2) The enzyme may be an iron-protein compound devoid of porphyrin and resembling some other iron-protein compounds known to occur in tissues.

(3) The enzyme may be a copper-protein compound. Although there is no direct evidence yet in favour of this supposition, it is nevertheless strongly supported by the following considerations :

(*a*) Copper salts are so far the only known simple metal salts which rapidly oxidize all the components of cytochrome. (*b*) The addition of copper to nutrient media for yeast and to copper deficient diet for rats produces not only an increase in the concentration of cytochrome *a* in the cells of these organisms but also greatly intensifies their indophenol reaction[3,4,5]. (*c*) There is a rough parallelism between the intensity of the indophenol reaction of various tissue preparations measured in terms of Q_{O_2} (at 39° C. and *p*H 7·3 in presence of excess of cytochrome *c* and of *p*-phenylenediamine) and their copper contents. (*d*) The only other known intra-cellular enzyme which has many properties in common with cytochrome oxidase is the polyphenol oxidase of plants. This enzyme, as was recently demonstrated[6,7], is a copper-protein compound. (*e*) Moreover, the inhibition by carbon monoxide of cytochrome oxidase in cells devoid of cytochrome *a* resembles that of polyphenol oxidase in being insensitive to light.

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Preparation of Radio-Element $^{32}_{15}$P in Weighable Quantity by Means of an Electric Field

In order to obtain large quantities of radiophosphorus for certain experiments, we have attempted to find a method of concentrating the radio-element by means of an electric field. Some attempts of this kind have already been made with success by J. W. J. Fay and F. A. Paneth on bromine, iodine and arsenic[1].

The radiophosphorus was produced by the neutrons from a source of 120 mgm. of radium + beryllium. Very pure carbon disulphide, prepared by shaking for two days with corrosive sublimate and distillation, was placed in a tall glass flask of about 1 litre capacity ; two brass rods with two rectangular brass electrodes soldered at their extremities pass through the stopper ; the field applied was of 70 volts per cm. After nine days of irradiation we examined the electrodes with a Geiger-Müller counter and we measured, on the four faces of the electrodes, the following activities :

anode		cathode	
inside	outside	inside	outside
827	367	427	191

that is, a total of 1,800 kicks per minute. These figures show that the activity of the anode was about double that of the cathode.

The carbon disulphide was submitted to the chemical concentration described by O. Chievitz and G. Hevesy[2]. The result showed that during this first attempt a large part of the radiophosphorus escaped concentration. In order to be sure that this was really $^{32}_{15}$P, we followed the activity of the electrode and the resulting products of chemical concentration for 50 days, and we observed that the activities decreased with a period of 14–15 days, which is that of $^{32}_{15}$P.

Cleaning the electrode with emery paper removes all its activity but boiling it in distillated water does not affect its activity ; though this latter entirely disappears if one puts the electrode in dilute nitric acid for one minute ; in this case, practically all the activity is found again in the residue after evaporation of the acid.

The appearance of the electrodes after irradiation was totally changed, for they were darkened. Experiments done under the same conditions as above, but without neutrons, left the electrodes unaffected in appearance. From this we can conclude that the visible deposit is due to radiophosphorus. It is very probable that the $^{32}_{15}$P formed was combined with the copper or another element of the brass and formed a phosphide of this element.

When repeating the experiment but dissolving a little yellow phosphorus in carbon disulphide and without any irradiation we obtained the same alteration of the brass. In other attempts similar to these, we used pure copper electrodes ; we observed that the copper was altered and covered with a black layer. A qualitative chemical analysis showed that this layer contained phosphorus and copper : so there is very probably formation of phosphide of copper. This determined us to use pure copper electrodes in the following experiments.

These second attempts were conducted in a similar way. The irradiation lasted nine days ; the field was 70 volts per cm. during the first days and 90 volts per cm. during the last three. The electrodes were covered with a black deposit, and the anode alone showed an activity of 1,800 kicks per minute. The electrode weighed before and after the irradiation showed an increase of 3·7 mgm. The remaining carbon disulphide submitted to the chemical concentration had an activity so insignificant that we may conclude that practically all the activity has been collected on the electrodes.

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Elimination of the Mosaic Crystal Imperfection Effect on the Width of X-Lines

ON the basis of results obtained by means of different spectroscopic methods, I wish to show that the highest attainable resolving power does not always correspond to the perfection of the crystal measured by means of the double-crystal spectrometer. High resolving power can be attained both with imperfect (mosaic) crystals and with perfect ones.

For example, in the case of crystals of sodium chloride, for the reflecting width w_c the minimum value of 87″ has been found experimentally[1]. According to this value, the width W of the copper $K\alpha_1$ line should correspond at least to 88″ (if the validity of the Gauss equation[2], $W = \sqrt{w_c^2 + D^2 w_\lambda^2}$, is assumed). According to Hoyt's equation[3], $W = w_c + Dw_\lambda$, the value of W for the copper $K\alpha_1$ line should amount to at least 102″. It will be shown here that these relations cannot be used generally.

With Prof. Dolejšek[4], I have obtained by means of the symmetrical spectrographic arrangement, in which the distance slit to crystal equals the distance crystal to photographic plate, with a crystal of sodium chloride an uncorrected value of $W = 15''$ for the true width of the copper $K\alpha_1$ line measured at half maximum of the rocking curve, which corresponds to 0·41 X.U. A similar result was obtained with the lines of molybdenum, where $W = 11''$, that is, 0·30 X.U.

This indicates that the imperfection of the sodium chloride crystals cannot in this case have any influence on the width of the lines as given by the equations referred to above. It is further evident that the values of the width of the lines obtained by us correspond to the true width of the lines of the above-mentioned elements determined by means of the double-crystal spectrometer.

These facts can be explained if two kinds of imperfection of the crystal are assumed. The first kind of imperfection is caused by the mosaic structure of the crystal, which will be designated by $\Delta\sigma$; the second one consists in an irregular arrangement of the atomic planes in the crystal, $\Delta\delta$, or in some other factors. However, it can be shown (unpublished work) when using the symmetrical spectrographic arrangement that reflection on mosaic crystals leads to an angular broadening of the line towards the short wave-lengths:

$$w_\sigma = (\Delta\sigma)^2 \cot \varphi,$$

where φ is the angle of the deflection. The broadening of the lines calculated by means of the formula given above, which holds for the crystal of sodium chloride, can be neglected for X-rays of medium wave-length. When, however, the photographic plate is shifted in the direction towards or from the crystal, so that the distances slit to crystal and crystal to photographic plate are made unequal, a broadening of the line due to the mosaic structure of the crystal is produced. From such a broadening of the line at different distances of the plate from the crystal, the value of w_c for the crystal of sodium chloride was determined, which gave a value of about 100″. If this value is substituted in the above formula, the angular broadening of the lines w_σ is 0·2″ (which corresponds to about 2 per cent of the true width of the lines copper $K\alpha_1$) at half maximum of the rocking curve. This broadening of the line $\Delta\lambda_\sigma = 0{\cdot}008$ X.U. lies below the limit of accuracy attainable by the most accurate methods.

It is thus obvious that crystals with imperfect mosaic structure allow us to get the extreme resolving power when the symmetrical arrangement is used, since the broadening of the lines due to the mosaic structure is negligible.

The second kind of imperfection of the crystal (which cannot be eliminated by means of the symmetrical arrangement) is, as can be seen from our results given above, inappreciable. These facts are in agreement with the findings of Ewald and Renninger[5], which have shown that the small planes of the crystal of sodium chlorine reflect according to the perfect structure, but not according to the mosaic. Thus the influence of $\Delta\sigma$ is approximately the same as in the case of perfect crystals, that is, in the absence of the mosaic structure. According to these results, new methods for measurements of the imperfection of crystals can be worked out; further, the equation for the physical resolving power of crystals, as given by Allison[6],

$$\frac{\lambda}{\Delta\lambda} = \frac{\tan\varphi,}{w_c}$$

must be modified, putting in instead of w_c the function of w_σ and w_δ.

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---

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Formation of Negative Ions at Surfaces

ARNOT has described experiments[1] which he has interpreted as showing that a positive ion striking a surface can be converted into a negative ion by capture of two electrons. The negative ions drawn off may have energies in excess of that imparted to them in the accelerating electric fields. Some of this work was not in agreement with other results which one of us had obtained for negative ions, and we have therefore repeated and extended it.

Using an apparatus somewhat similar to Arnot's, but constructed entirely in a blown pyrex tube which could be degassed at high temperature, we were unable to find the negative ion of mercury once the apparatus was thoroughly clean, although initially, whilst a certain amount of impurity was present, a negative ion with approximately the mass of the Hg− ion was found, in agreement with earlier work by Stille[2]. However, bombardment of metal surfaces in the ionization chamber, by presumably mainly Hg+, did produce several light negative ions ($C_2H_2^-$, CO−, etc.), and these possessed excess energy. Subsidiary experiments indicated that this energy did not come from electrical oscillations within the tube; in particular, negative ions with excess energy could be drawn off normally from a flat plate bombarded normally with the positive ions.

These new experiments raised the question of the uniqueness of the mechanism of negative ion formation proposed by Arnot; they seemed rather to support the idea that a major cause of the production of negative ions might be sputtering of persistently occluded electronegative films by bombardment with positive ions. We have now been able to show that the latter process does occur, by using a double mass-spectrograph.

Positive ions were drawn from a mercury discharge, and after magnetic sorting were projected on to a nickel-chrome disk. Negative ions again appeared and were identified by a second magnetic analysis. It was found that Hg^+ and Hg^{++} both produced a spectrum of light negative ions, with maximum peak currents of the order of 10^{-11} amp. Again Hg^- was not detected, although the Compton electrometer used could have measured currents of the order of 10^{-16} amp. A complex positive ion beam of mass about 28 (presumably mainly CO^+) also gave a negative ion beam of about the same mass. In all cases the yield of negative ions was proportional to the bombarding positive ion current. The light negative ions of mass about 28 produced by bombardment with Hg^+ were found again to have excess energies; the other beams have not yet been studied in this way.

The fact that we did not obtain Hg^- is not necessarily incompatible with Arnot's observation of it. We cannot exclude the possibility that differences in surface structure may be responsible for the discrepancy. A question of greater moment is whether in fact any process other than sputtering occurs.

Experiments similar to ours, except that magnetic sorting of the positive ions was not employed, were apparently done by J. S. Thompson[3] in 1931, but, so far as we know, details of this work have never been published.

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April 5.

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Response of Barrier-Layer Cells to X-Rays of Long Wave-Length

In 1931 Selenyi and Lange[1] reported that they had obtained photo-currents from barrier-layer cells exposed to X-rays of short wave-length. Later, Gleason[2] studied the effect of X-rays on a large number of cells, and Scharf and Weinbaum[3] made a thorough investigation on this subject.

However, these investigations were all made with hard X-rays; nothing has so far been known of the response of barrier-layer cells to X-rays of long wave-length. I therefore undertook to study this question. Naturally, in this wave-length region such an investigation has to be carried out in a vacuum, and a special apparatus was built for this purpose. The intensity of the radiation falling on the barrier-layer cell could be varied by changing the distance between the focus and the cell. Visible light was completely screened off by two aluminium foils, each of them 0·5 μ thick. For the preliminary investigations two commercial selenium cells of different origin were used. Both these cells had a protective foil of celluloid. This foil together with the two aluminium foils brought the long wave-length boundary of the effective radiation somewhat below 20 A. The short wave-length boundary was given by the voltage of the X-ray tube.

The data in the accompanying table may give a conception of the sensitivity of the cells in this wave-length region. A rough calculation gave the order of magnitude of the photo-electromotive forces to 10^{-4} volt. It has to be observed that in the first case the radiation contained the whole *M*-series of tungsten, and in the second that part of it which contains the strongest lines, but in the last case none of it was present.

Current through the X-ray tube	Distance focus—cell	Short wave-length boundary of radiation	Photo-current
30 m. amp.	15 cm.	3·5 A.	0 86 μ amp.
50	15	5·5	0 66
150	15	8·0	0·62

Further, below 0·9 μ amp., the photo-current was found to be a rectilinear function of the intensity, when the outer resistance was 100, 300 and 1,100 ohms, thus giving a complete resemblance to the conditions in the case of visible light.

Full particulars of the experimental arrangements and further results will be published later.

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Composition of Minima in Binary Systems of the Solid Solution Type

In about twelve of the completely isomorphous binary systems which so far have been investigated, the freezing-point curve passes through a minimum. The compositions of these minima are expressed as chemical formulæ in the accompanying table. This table makes clear the remarkable fact that a simple integral relationship exists between the numbers of the atoms of the two metals in the alloy of lowest freezing-point.

System	Composition of minimum point
Au—Cu	Au_3Cu_2
Au—Ni	Au_3Ni_2
Rb—Cs	RbCs
Rb—K	Rb_2K
Pd—Fe	PdFe (?)
Pd—Co	PdCo
Pd—Ni	Pd_9Ni_{11}*
Pt—Co	$PtCo_3$ (?)
Fe—Ni	$FeNi_2$
Fe—Cr	Fe_3Cr
Fe—V	Fe_2V
Sb—As	Sb_4As

* Perhaps more exact experiment may give PdNi, analogous to PdFe and PdCo.

According to Stockdale[1,2], there is a similar relationship between the components of a binary eutectic mixture. However, perhaps owing to some unknown factor, the relationship is not always one of simple integers in this case, but somewhat complex numbers are sometimes given. The law of simple integral ratios seems to be particularly applicable to binary systems of the solid solution type. A system of this type in which the liquidus curve passes through a minimum may be considered as intermediate between the more familiar continuous solid solution system of the gold-silver type and a typical eutectiferous system such as the copper-silver system.

Therefore it is to be expected that as the composition at the minimum of a solid solution system can be expressed by a simple integral ratio, so also can the eutectic composition in a simple eutectiferous system be so expressed. Thus the eutectic compositions of the systems copper-silver and rubidium-sodium, simple eutectiferous systems, can be written Cu_2Ag_3 and the $NaRb_3$ respectively, while the compositions at the minima in the copper-gold and potassium-rubidium systems can be written Cu_2Au_3 and KRb_2.

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Relation of Strength of Wood to Shrinkage

The swelling and shrinkage or 'working' of wood under varying atmospheric humidity is an important property of the material, and at most laboratories devoted to the study of wood the measurement of shrinkage is made as a matter of routine on all species. With the view of gaining a further insight into the shrinkage process, measurements have been made here on the shrinkage of very small samples of sitka spruce under conditions where changes in vapour pressure and moisture content could be measured simultaneously with the resulting shrinkage.

These experiments have shown that the volumetric shrinkage S could be connected with the Katz swelling pressure P by a simple relation, $S = aP^k$, where a and k are constants. The equation holds between the waterlogged state (approximately 250 per cent moisture content for sitka spruce) and about 20 per cent moisture content, corresponding to vapour pressures between saturation and about 75 per cent. This range comprises those moisture contents at which most of the water is held by capillary forces. At lower moisture contents, where molecular sorption predominates[1], the shrinkage becomes proportionately smaller than is predicted by the equation. The results of these experiments for the first and second desorption cycles of a particular pair of samples of sitka spruce are shown as a broken line in Fig. 1, together with the results obtained by averaging several routine shrinkage determinations of the same wood, shown as a full line. This graph is, in fact, the stress-strain curve for the shrinkage process, and although neither the shrinkage nor the vapour pressure isothermals for the first cycle are reproducible in subsequent cycles[2], it is interesting to note that the stress-strain curves for the two cycles are indistinguishable in Fig. 1, which suggests that the changes in shrinkage and vapour pressure are due to some modification in the capillary structure of the wood rather than in the material of which this structure is composed.

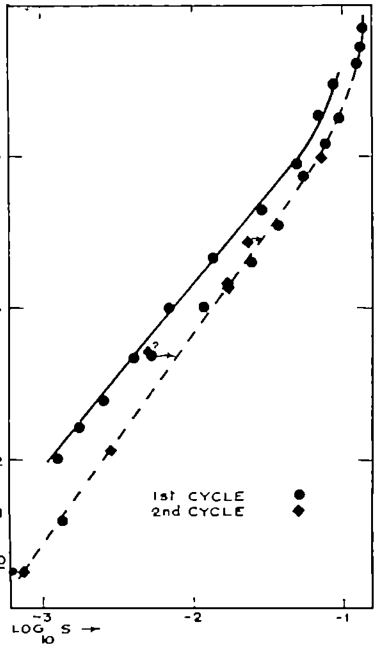

Fig. 1.

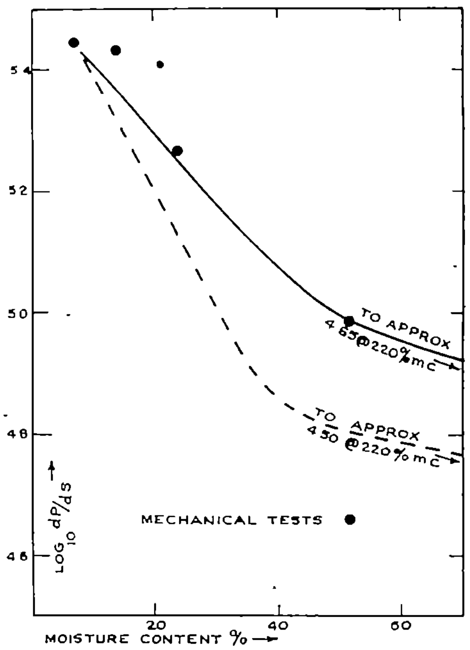

Fig. 2.

Further, dP/dS at any moisture content gives the resistance of the wood to unit hydrostatic compression, which may be compared with dp/ds, that found for external mechanical pressures at the same moisture content. In practice, a uniform hydrostatic pressure cannot be applied to a cellular structure such as wood, so that dp/ds is obtained by calculation from unidirectional pressures and the corresponding Poisson ratios. In Fig. 2 the lines show dP/dS against moisture content for the same material as Fig. 1, while the individual points are average values of dp/ds obtained from mechanical tests on some four or five specimens at each of several moisture contents, p being the stress per unit area of wood-water aggregate. It will be seen that dP/dS resulting from shrinkage forces shows, in the case of the routine tests, a close agreement with *dp/ds* resulting from mechanical pressure, a fact which it is believed has not been previously established. The lower values obtained from the small samples are explicable as being due to chance selection from a very variable material, but it may well be that very small thin specimens would offer proportionately less resistance to shrinkage forces than the larger material used in the routine tests.

It may be further noted that the lines for log dP/dS are straight at moisture contents less than 30 per cent, which agrees with the well-established fact that for most of the strength properties of wood the logarithm of the property increases linearly as the moisture content falls. Owing to the variability of wood, the individual points in Fig. 2, which concern only a small number of samples, would not be expected to demonstrate this relation accurately.

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April 5.

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[2] Barkas, W. W., *Proc. Phys. Soc.*, **48**, 576 (1936).

Two Near Extra-galactic Systems

THE reference in NATURE of April 9, p. 636, to the interesting announcement by Shapley of the discovery of another extra-galactic stellar system similar to the two Magellanic Clouds, at probably double their distance, affords another example of the absolute excess of these near systems in the south galactic hemisphere, within a radius of 10^6 light years. Although the position of the centre of the star cluster is not given, it is stated that it lies in the constellation of Sculptor. It must, therefore, lie not far from the south galactic pole, which is included in this constellation, and in the vicinity of the two spiral systems N.G.C. 55 and 300, both of which are of large angular diameter and therefore among the nearer systems to our Galaxy.

Another comparatively near spiral system which has been observed in recent years at Mt. Wilson and Harvard is that of which the nucleus appears in Dreyer's Index Catalogue as I.C. 342. Originally discovered visually about 1889 by the late W. F. Denning in his sweeps for comets, photographs have revealed that I.C. 342 is the centre of a large condensed spiral system, 40′ × 33′, and therefore at a distance only about twice that of the Andromeda nebula and the condensed spiral M. 33. Its position in the northern constellation of Camelopardus places it actually in the north galactic hemisphere, but its galactic co-ordinates, $\lambda = 105°$, $\beta = +11°$, show that it lies unusually near the galactic equator, in fact it is owing to its situation behind the galactic star fields that its real character was not detected before. In this case galactic longitude is more important than galactic latitude, for in reality it is one of the elongated group of comparatively near systems, which includes the Andromeda nebula and N.G.C. 891 on the other side of the galactic equator.

J. H. REYNOLDS.

'Low Wood',
Harborne,
Birmingham.
April 14.

Effect of Acetylene on the Ripening of Kelsey Plums

THE Kelsey plum, a Japanese variety, is at its best a plum of outstandingly high quality, but as grown in South Africa, it is notoriously difficult to ripen after picking, even when gathered at fairly advanced maturity and kept at ordinary atmospheric temperatures.

The capacity for ripening appears to vary from season to season, but a 30 per cent ripening is probably above the normal. In the season just concluded (1938), approximately 9,000 fruits of export standard were kept under observation and only 10 per cent of them have ripened satisfactorily at atmospheric temperatures.

During this season Mr. D. J. Dreyer, senior fruit inspector, and I have made experiments on the effect of acetylene on the ripening capacity of Kelsey plums.

The use of acetylene or ethylene as an agent to accelerate the ripening of fruits is, of course, by no means new; but in the present instance the refusal of the fruit to ripen in ordinary circumstances is so obstinate, and its reaction to gas treatment so striking, that it is of interest to put preliminary details on record.

The typical treatment was to expose the freshly picked Kelsey plums, for 24 hours, at atmospheric temperatures (approximately 70° F.) to an atmosphere containing approximately 1 per cent of acetylene, and then to store them at the same temperatures for ripening. Fruits initially green, or green with a trace of red, were fully ripe within five days after treatment; they were full red in colour, luscious and of good flavour. (The uniformity in ripening is a remarkable feature of the reaction, contrasting as it does with the irregular ripening of usual consignments.) Of the control fruits, only 11 per cent had ripened normally after this period, the remainder being unchanged. By the ninth day, altogether 13 per cent of the control fruits had ripened; by the fifteenth day no more had ripened and the remaining fruits had become shrivelled and rubbery.

Ripening initiated by gas treatment appears to proceed quite normally in so far as acid and sugar changes are concerned. The following figures are typical:

	Total dissolved solids	Malic acid	Ratio of dissolved solids to acid
Unripe fruit	15·2 per cent	0·91 per cent	16·7 : 1
Gas-ripened fruit	14 2	0·15	92 8 : 1
Naturally ripened fruit	16·1	0·14	111·8 : 1

These observations have only been made with fruit picked during the latter part of the Kelsey season, and it is impossible to say whether the earlier fruit would have reacted as vigorously.

A positive result was, however, obtained with fruits which had already been stored at atmospheric temperatures for four weeks, and which had given no indication of ripening. The reaction in this case was much slower than with the freshly picked fruit.

In further experiments it has been shown that unripe Kelsey plums can also be ripened by enclosure for a time in a container with naturally ripened fruits. By the third day there was a noticeable difference between the experimental and the control fruits; and by the fifth day the former were full red, while the latter showed from a trace to one quarter of red colour. By the fourteenth day the control fruits had advanced to about three quarters red.

It appears therefore that, just as in the case of the apple and the banana, an active substance (perhaps ethylene) is produced by ripe Kelsey plums, which is capable of accelerating the ripening process in unripe Kelsey plums. There is, however, reason to believe that relative humidity also plays a part, but critical experiments on these lines have still to be made.

V. A. PUTTERILL.
(Chief Fruit Inspector.)

Union of South Africa,
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Cape Town.
March 26.

The Polysaccharide produced from Sucrose by *Leuconostoc dextranicum*

THE chemical investigation of the 'dextran' formed when *Leuconostoc dextranicum* is grown on media containing sucrose[1] has given information concerning the structure of the polysaccharide and has revealed facts which have a bearing on the general biological question of enzymatic synthesis.

The purest dextran isolated is a water-soluble and non-reducing white powder with a high positive rotation ($[\alpha]_D^{20^\circ}$ + 180° in water); it appears to be constituted entirely of glucose units. After hydrolysis by boiling normal sulphuric acid, glucose in crystalline form was separated from the hydrolysate in 92 per cent yield.

No difficulty was experienced in methylating the dextran by the usual procedure with methyl sulphate and sodium hydroxide, and fractional precipitation of the methylated product showed it to be essentially homogeneous ($[\alpha]_D$ 210–214° in chloroform; OMe, 44·5 per cent). The methylated dextran is more stable to hydrolytic agents than is methylated starch. Complete hydrolysis of the methylated dextran was achieved by heating with the reagent usually employed in this laboratory for the hydrolysis of methylated cellulose, namely, 50 per cent aqueous acetic acid containing 4 per cent concentrated hydrochloric acid. Separation of the hydrolytic products was effected in the usual way by treatment with methyl alcoholic hydrogen chloride and fractional distillation in a vacuum.

The principal product of hydrolysis was 2 : 3 : 4 trimethyl glucopyranose isolated as the crystalline β-methyl glucoside (m.p. 94–95°; $[\alpha]_D$ − 21° in water). The trimethyl sugar ($[\alpha]_D$ + 68° equilibrium value) gave a crystalline anilide (m.p. 145–6°), was oxidized by bromine water to a δ-lactone ($[\alpha]_D + 80^\circ \rightarrow + 32^\circ$ in 21 hr.) and by nitric acid to 2 : 3 : 4 trimethyl saccharolactone methyl ester (m.p. 106–107° alone or in admixture with an authentic specimen).

The fractions obtained in the vacuum distillation of the glucosides were contaminated with methyl lævulinate (characterized as the phenylhydrazone, m.p. 106°), and it was found advisable to remove this constituent by treatment with barium hydroxide and then to refractionate the glucosides. There were indications, chiefly from the refractive index, of the presence of a small amount of tetramethyl methyl glucoside in the first fraction which, after hydrolysis with aqueous acid, had OMe 46 per cent (a trimethyl sugar requires OMe 41·9 per cent). This was confirmed when the methylated sugars from the hydrolysed first fraction were heated with aniline. The anilide which separated was tetramethyl glucose anilide (found OMe 40·3 per cent; $C_{16}H_{25}O_5N$ requires OMe 40 per cent). After recrystallization from absolute alcohol, the anilide had m.p. 135–6° and there was no depression of melting point in admixture with an anilide prepared by the same method from crystalline tetramethyl glucopyranose.

Full details will be published later, but it would appear from these results that the dextran resembles starch and cellulose in that it is constituted solely of glucose residues united to form a chain molecule. The fact that 2 : 3 : 4 trimethyl glucose is the main product of hydrolysis of methylated dextran establishes the nature of the link between the glucose units as being 1 : 6-glucosidic (the gentiobiose linkage) and the isolation of tetramethyl glucose suggests a terminated chain. The proportion of tetramethyl glucose is estimated to be approximately 0·23 per cent of the weight of methylated dextran, which corresponds to a chain length of 550 glucose units. No finality is attached to this latter figure, especially as an osmotic pressure determination gave 200 units, and the possibility of effecting a quantitative separation of tetramethyl glucose as the anilide is being explored.

S. PEAT.
M. STACEY.
E. SCHLUCHTERER.

A. E. Hills Laboratories,
University of Birmingham,
Edgbaston.
April 8.

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[1] Carruthers, A., and Cooper, E. A., *Biochem. J.*, **30**, 1001 (1936).

The Oxidation-Reduction Potential in Lignifying Cells

DURING the lignification process of the cell walls the carbon content increases considerably. A strong reduction must take place in the living cells which begin to lignify. We have tried to determine the reduction potential of the tissues by means of the colorimetric method applied thus far only to isolated cells (unicellular organisms, and in yeast- and bacteria-suspensions). The results are still of a qualitative character, but they seem significant.

Tissues scraped from the hypocotyledons of the stems of sunflowers by means of a piece of broken glass were used: (1) cortical parenchyma; (2) cambium tissue near the xylem; (3) cambium tissue near the phloem; (4) older wood tissue; and (5) medullary parenchyma. These tissues, after carefully washing off the adherent cell juice, were brought into Thunberg-tubes filled with 8 c.c. of very dilute (0·001–0·005 per cent) solutions of oxidation-reduction indicators (six dyes were used, ranging from rH 18 to rH 8) and 2 c.c. of the Sorensen phosphate buffers ($pH = 7$). After evacuation, the glass tubes were placed in an incubator at 30° C. Tubes filled only with solutions of the dyes for comparison of the colour, and tubes filled with liquid and killed tissues, which do not reduce, served as controls.

The cambium tissue near the xylem reduced most quickly and intensely. In the cortex the reduction was less marked. The medullary parenchyma had a much weaker action, while the activity of the older wood tissue (of course dead for the greater part) was very scanty.

A corroborative result was obtained with transverse sections of the stem. The results were very satisfactory in most cases, notwithstanding the unfavourable period (autumn). They were, however, variable according to the vitality of the plants used. The later in autumn the experiments were carried out the more the reducing power was diminishing. In November the reducing power has become very small but, at all times, the cambium showed the highest activity.

K. GRIFFIOEN.

Laboratory for Technical Botany,
University College of Technology,
Delft.
April 6.

Developmental Forms of the Virus of Lymphogranuloma Inguinale (Climatic Bubo)

IT is now generally agreed that in lesions produced by the virus of lymphogranuloma inguinale (climatic bubo) there can be seen small elementary granules which by staining and by differential filtration appear to be 100–175 mμ in size. These granules almost certainly represent the etiological agent of the disease. In smears from infected mouse brains these granules may occur (1) diffusely scattered outside the cell, in the form of colony-like masses; (2) within the cell cytoplasm, when they may be surrounded by a definite membrane; or (3) closely adherent to ruptured cells. The granules are stained blue by Castaneda's stain, blue with Victoria B, and reddish-violet by Giemsa's method.

In addition to the small forms, though less numerous, we have been able to find, in lesions produced by three strains of the virus, large bodies three to four times the size of the small forms. These large forms are present especially in very early lesions, and are somewhat irregular in shape, often suggesting division by fission: intermediate bodies between the large and small forms also occur. Very occasionally small masses of large forms only are seen occurring in plaques; more commonly collections of small granules are found containing a few large forms.

The evidence at present available suggests that the small granules are derived by division from the large forms. These large forms stain a bluish-violet by Giemsa and a reddish-purple by Castaneda's method. The various forms of the virus of lymphogranuloma inguinale present many analogies to those exhibited by the causal agent of psittacosis.

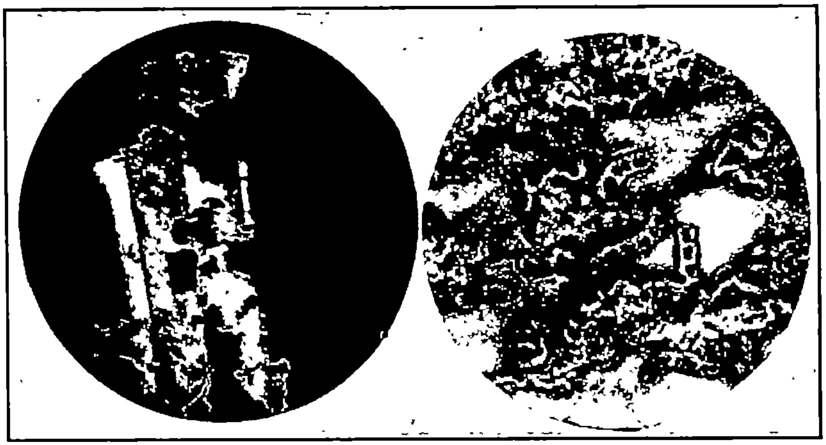
G. M. FINDLAY.
R. D. MACKENZIE.
F. O. MACCALLUM.

Wellcome Bureau of Scientific Research,
London, N.W.1.
April 11.

Disintegration of Cell-Wall Substances in the Gastro-Intestinal Tract of Herbivora

THE process of cellulose digestion in herbivora, in addition to its economic importance, throws considerable light on a number of cognate biological topics. Biochemical aspects of the problem have received considerable attention. Pure cultural investigations have been attempted though it is questionable whether the species isolated *in vitro* are those primarily concerned with the process taking place *in vivo*. It is therefore remarkable that so few attempts have been made to study the changes occurring *in situ* by direct microscopical observation. This method has been successfully applied by us to material derived from the cæcum of non-ruminant herbivora.

Disintegration is evidenced by the formation of clearly defined zones of erosion termed *lacunæ*. In the affected regions loss of double refraction corresponds precisely to changes in microchemical and staining reactions. Stages in micellar disorganization are indicated by diminution or loss of dichroic intensification. Pectic substances are dissolved (ruthenium red). Cutin entirely resists attack (Sudan III). Heavily lignified structures are immune. By the use of appropriate reagents and stains, the cytoclastic micro-organism can be demonstrated in the interior of lacunæ.


(*a*) (*b*)

PLANT STRUCTURES FROM CÆCUM OF THE HORSE.

(*a*) Epidermal tissue. Polarized light. Crossed nicols. Localized disappearance of double-refraction in the zones of erosion or lacunæ (black). × 400 approx.

(*b*) Stained Congo-red and iodine. Lacunæ situated in pink substratum which shows dichroic intensification with a single nicol (Ambronn effect). At the edges of the lacunæ the cytoclastic micro-organisms can be seen (blue, with iodine). The staining at the margins of the lacunæ is intensified. × 1,200 approx.

The above methods when applied to material from the cæcum of the guinea pig[2,4], rabbit[3] and horse (in the press) yield strictly comparable results. The cytoclastic micro-organisms include vibrionic, coccoid and giant forms[3,4]. It appears that they are stages in the life-cycle of some polyphasic species. The coccoid and giant forms give a blue (amylodextrin) reaction with iodine. Their shapes correspond with precision to the contours of the excised lacunæ.

These investigations have recently been extended to the stomach of ruminant herbivora. In the sheep, disintegration of the optically birefringent substances of the wall has been demonstrated by the application of the methods outlined. The primary agents are iodophile micro-organisms very similar to those observed in the cæcum of the species mentioned. To the indigenous protozoa of the paunch only a subordinate role can be assigned. The size of the plant fragments originally present is such as absolutely to prohibit ingestion. Smaller fragments are afterwards ingested; but these have in the majority of cases been detached, and in consequence already in part disintegrated, by the activities of the iodophile micro-organisms. Similar considerations hold for the protozoa of the horse. In both instances, however, digestion of starch grains and iodophile micro-organisms has frequently been observed.

Frank Baker.
Rollo Martin.

14 Applegarth Road,
Brook Green, W.14.

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[1] Baker, F., Preliminary Note on the Role of the Coccoid Micro-organisms in the Disintegration of Cell-Wall Substances", *Zent. f. Bakt.*, Ab. II, **84**, 452 (1931).

[2] Baker, F., "Studies in the Microbiology of Organisms associated with the Disintegration of Vegetable Remains", *Zent. f. Bakt.*, Ab. II, **88**, 17 (1933).

[3] Baker, F., and Martin, R., "Some Observations on the Iodophile Microflora of the Caecum of the Rabbit: with special Regard to the Disintegration of Cell-Wall Substances", *Zent. f. Bakt.*, Ab. II, **96**, 18 (1937).

[4] Baker, F., and Martin, R., "Observations upon the Disintegration of Cell-Wall Substances in the Caecum of the Guinea Pig", *Zent. f. Bakt.*, Ab. II, **97**, 201 (1937).

Scientific Tests of Telepathy

It is probable that most psychologists and practically all physiologists regard the evidence in support of 'clairvoyance' and 'telepathy' as worthless from a scientific point of view. So naïve, as a rule, are the arguments used by those anxious to give verisimilitude to the results of imposed tests that few scientists are willing to discuss or even seriously to consider these subjects with their question-begging titles. This is regrettable, as the public are apt to draw erroneous conclusions when they see reiterated statements in the popular press pass unchallenged. For this reason Mr. S. G. Soal, senior lecturer in pure mathematics at Queen Mary College, University of London, is to be congratulated on having conducted detailed investigations into certain alleged 'psychometrising' faculties of the medium 'Marion', and for having published in the press[1] and elsewhere[2] his conclusions thereon. It is yet more a subject for congratulation that a periodical of the scientific status of Nature[3] is willing to devote space to reports upon investigations of this subject.

"In spite of all the vast tomes that have been published on psychical research," writes Mr. Soal in the Bulletin (p. 3) to which reference has been made, "I have yet to meet the human being who under similar conditions can do what Marion has failed to do !" This, one of many comments—all adverse to a telepathic interpretation—appended by Mr. Soal to the results of the experiments, both recalls and endorses the following dictum by the late Sir Ray Lankester.

"Telepathy is simply a boldly invented word for a supposed phenomenon which has never been demonstrated. It is an unfair and unwarranted draft on the credit of science which its signatories have not met by the assignment of any experimental proof. There is not one man of science, however mystic and credulous his trend, among those who pass this word 'telepathy' on to the great unsuspecting, newspaper-reading public, who will venture to assert that he can show to me, or to any committee of observers, experimental proof of the existence of the thing to which this portentous name is given."

The late Sir Bryan Donkin, a psychiatrist of considerable repute who had devoted no little attention to the claims of 'thought-readers', used to say of the above quotation that it constituted a masterful summing up of the whole case for telepathy.

Charles M. Beadnell.

Egham,
Surrey.

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[1] *Sunday Times*, March 13, 1938.

[2] Bulletin 3. University of London Council for Psychical Investigation.

[3] Nature, **141**, 565 (March 26, 1938).

Science and the Unobservable

In Prof. Dingle's lucid rejoinder to my letter[1] the difference in our points of view stands out very clearly. It hinges on the meaning of such terms as "denial" and "pronouncement".

I do not think that relativity as a scientific theory "denies" the existence of absolute simultaneity in the dogmatic sense in which Prof. Dingle seems to employ that word; the third horn of the dilemma on which he would impale me thus turns out to be made of sand. Stated explicitly, relativity as a scientific theory makes only such pronouncements as the following concerning absolute simultaneity: (1) at present it is not a significant concept in physics; (2) known facts raise a presumption or expectation that it never will be; (3) if we assume certain postulates or working hypotheses which preclude the existence of absolute simultaneity, such and such conclusions follow. That is all.

Precisely this careful avoidance of *dogmatic* pronouncement seems to me to be of the very essence of the scientific method, and I think it is a mode of approach that is badly needed in attacking many other problems.

E. H. Kennard.

Cornell University.
April 8.

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[1] Nature, **141**, 557 (March 26, 1938).

I agree with Prof. Kennard's three statements on the pronouncements of relativity, but if, as he truly says, "That is all", what has become of the "world existing independently of experience" which was regarded as essential in his first letter ? Of the three attitudes which I considered incompatible, he has chosen those of the relativist and the non-professor of omniscience, and abandoned that of the realist as defined; he is now entirely in the realm of concepts, known facts, assumptions and rational deductions. In the terms of my former letter, he has shown no reason for giving $A - A' - A''$ a non-zero value. Immediately, therefore, he adds the realist contention that it has such a value, he makes an unfounded statement and so becomes dogmatic.

I would add that I am in complete agreement with Prof. Kennard concerning the undogmatic character of the scientific method, and the need for its more general application. The importance of this matter, particularly in the social, political and religious spheres, is, indeed, one of the chief reasons why I think it is necessary to see science exactly as it is without adding to it a totally irrelevant "independent universe" which fulfils no function but that of making false philosophies plausible.

Herbert Dingle.

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London, S.W.7.
April 29.

Social Relations of Science

THE Association of Scientific Workers has been mentioned in several of the contributions to the supplement in NATURE of April 23 on the proposed Society for the Study of the Social Relations of Science. On behalf of the A.S.W., I venture to direct the attention of readers to our work during the last ten years in the field which the S.R.S. proposes to cover.

The A.S.W. has a dual policy which includes the study and the improvement of the relations between science and society as well as the promotion of the professional interests of scientific workers. The Association has endeavoured to pursue the first object of its policy by publishing a journal called *The Scientific Worker*, by holding public lectures, and recently, by arranging showings of scientific films. For lack of adequate means we have not been able to satisfy the urgent need for properly organized research into the influence which many aspects of science are now exerting on our social life. Such work could only be done under the auspices of a society such as the S.R.S., and we are glad to notice that, in the contributions to the supplement in NATURE, several of our vice-presidents emphasized this aspect of the future work of the S.R.S. It is also necessary that the general public should be kept more in touch with the actual nature and purpose of scientific education and research.

The potentialities of an S.R.S. seem to us to be very great, and we should both welcome its formation and willingly co-operate in its work.

W. A. WOOSTER.
(Honorary General Secretary.)

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London, S.W.5.

Points from Foregoing Letters

FROM the behaviour of a special preparation of heart muscle, containing a high concentration of cytochrome *a*, when treated with various reagents, Prof. D. Keilin and Dr. E. F. Hartree deduce that the absorption band *a* of cytochrome belongs to two slightly different compounds, one of which is autoxidizable and combines with potassium cyanide or carbon monoxide, while the other does not possess these properties. They also enumerate reasons for suggesting that the enzyme which oxidizes cytochrome may be a copper-protein compound.

By irradiating carbon disulphide for several days with neutrons in presence of a strong electric field (70–90 volts per cm.), J. Govaerts has been able to concentrate the radiophosphorus produced almost entirely upon the anode, which increased in weight by 3·7 mgm.

There are two kinds of imperfection causing loss of resolving power in the X-ray spectra of crystals, according to J. M. Bačkovský. One is due to mosaic structure and the other to the regular atomic planes. By using a symmetrical spectrographic arrangement for X-ray study in which the distance slit to crystal equals the distance crystal to photographic plate, the author has been able to reduce the broadening of the lines due to mosaic structure and to render its effect negligible.

Dr. R. H. Sloane and R. Press describe some new experiments on the formation of negative ions by the bombardment of metal surfaces with positive ions. These experiments show that positive ions of one species can produce negative ions of another species, and this seems to require a sputtering mechanism for its explanation.

Photo-electric selenium cells are found by Dr. A. E. Sandström to be susceptible to X-rays of long wavelength, somewhat below 20 A. Under suitable conditions the photo-electric current is proportional to the intensity as in the case of ordinary light.

A table is given by M. Hara, showing that in twelve bimetallic alloys with lowest freezing point the metals are in simple atomic ratio, corresponding to that of simple chemical compounds (Au_2Cu_3, $FeNi_2$, etc.).

Graphs showing the relation of swelling pressure to shrinkage in the case of samples of sitka spruce, and also the resistance of the wood to compression at different moisture contents, are submitted by W. W. Barkas and H. Q. Golder.

Successful ripening of the Japanese Kelsey plum grown in South Africa, by treatment of acetylene, is reported by V. A. Putterill.

Chemical investigation of 'dextran', a compound synthesized by the seaweed *Leuconostoc dextranicum*, when grown in a sugar solution, shows that carbohydrate to be similar to starch and cellulose, being constituted solely of glucose residues. There appear to be several hundred glucose units in the dextran molecule.

During the lignification of plant cell-walls, an increase in the carbon content and consequently a reduction process takes place, according to K. Griffioen. Colour tests with oxidation-reduction indicators support this view as they show that the cambium layer near the wood cells has greater reducing power than other cells, particularly during the growth season.

Dr. G. M. Findlay, R. D. Mackenzie and F. O. MacCallum report the presence of Giemsa-stained granules in early lesions of the virus disease, climatic bubo, these being three or four times larger than the previously observed (presumably virus) granules. The authors suggest that the smaller granules are derived from the larger ones by division.

F. Baker and R. Martin demonstrate the disintegration of optically birefringent cellulose and other cell-wall substances in the cæcum of the horse, etc. Loss of double-refraction in the zones of erosion is accompanied by changes in microchemical reaction. Pectins are also attacked. Lignin and cutin appear to be immune. The cytoclastic agents are iodophile micro-organisms, probably stages in the life-cycle of a single polyphasic species. Protozoa, where present, play, if any, only a subordinate part in the process of disintegration.

Research Items

Navaho Ceremonial

IN view of the comparatively limited character of knowledge of the ceremonial complexes of the south-western Indians of the United States, the Department of Anthropology of the University of Chicago has been induced to sponsor a series of studies combining the study of Navaho ceremonialism with an intensive study of the language. The first of the series is the text of "Enemy Way", commonly known to the white population as the war dance, one of the most popular ceremonials ("Origin Legend of the Navaho: Enemy Way". Text and Trans. by Father Berard Haile. *Yale Univ. Pub. in Anthropology*, 17, 1938; Oxford Univ. Press. Price 16*s*. net.) In Enemy Way there are a number of ceremonies, each with a specific ritual function, such as "decorating the rattle-stick", "strewing the ashes", etc., each of which is accompanied by sets of songs. The term 'shaman', as generally understood, is foreign to native conception. Though the 'singers', both men and women, are a distinct class in the tribes, their organization is very loose: they do not form lodges, fraternities or schools, while a singer does not offer his services, but awaits a summons. Their knowledge is not restricted by clan, or heritable. It may be purely mechanical and limited to the reproduction of songs required by a given ritual. The power to function as a singer, however, is transmitted from singer to pupil; and no one, however familiar with the material, would act as singer, unless he had been inducted. Women are not barred, although there are few female singers to-day, and in Enemy Way none, because women are not warriors. The Enemy Way legend, conceived as a whole by the narrator, may for convenience be treated as falling into three parts. Of these, the first deals with the origin of the people from the underworld, and their struggle with the man-devouring monsters, who originated from the sexual misdeeds of the women. This struggle made the earth fit for the present human race, which is identified with the Navaho. The second part of the text describes the war on Taos, in which a number of ritual practices, typical of tribal war, are described. The third gives an account of the Enemy Way ceremonial by which the patient, personifying the earth suffering from these conflicts, is put right.

Function of Golgi Apparatus

IN a further study of the structure of the Golgi apparatus, Dr. M. K. Subramaniam has observed in alimentary canal cells of *Lumbriconereis* two types of secretion (*Proc. Indian Acad. Sci.*, 8, Sect. B, 125, March 1938). In cells producing a watery mucous secretion, the Golgi apparatus consists of granules and vesicles. The secretion vacuoles arose in contact with the chromophilic rim of the Golgi vesicles. In cells producing the granular type of secretion three types of association between the Golgi bodies and the secretory product were observed: granules arose in intimate relation with the idiosome of the Golgi batonettes, developing granules were closely pressed against small Golgi vesicles, and typical Golgi batonettes, double-rimmed batonettes and Golgi vesicles were seen plastered on the surface of a secretory granule. The author is convinced that there is some fundamental plan in the Golgi apparatus common to all cells, whether vertebrate or invertebrate, and that the different patterns in different cells when analysed resolve into variations of a single basic procedure.

Indian Breeds of Cattle

THE study of native breeds of cattle has assumed great importance since it was realized that they possess a power of disease resistance often lacking in imported breeds of European strains, and that united with this quality they often possess a potentiality of improvement under suitable conditions of husbandry. The humped cattle of India are of special importance in such studies on account of their numbers, estimated at 200 million, and of the part they have played in the development of some of the widely diffused breeds of African native cattle. In "A Brief Survey of some of the Important Breeds of Cattle in India", published at the instance of the Imperial Council of Agricultural Research (*Miscellaneous Bulletin* No. 17; 1938), Sir Arthur Olver describes the distribution and outstanding characters of twenty-one breeds of cattle and four breeds of buffaloes, illustrated by 52 plates of photographs. The cattle breeds fall into five basic types, which appear to have been brought to India at different times with waves of immigration from various centres. The descriptions and photographs convey the impression that India possesses great wealth of fine cattle breeds, well worthy of development by selection and research. The possibilities are great, for it has already been shown that, in comparatively few years, selected milch breeds of pure Indian origin can, by scientific feeding and management combined with systematic breeding control, be raised to levels of efficiency as high or higher than those of imported European cattle or their cross-breeds.

Tobacco Leaf-curl in Northern India

DR. B. P. Pal and R. K. Tandon of the Agricultural Research Institute, New Delhi, have presented a first report (*Indian J. Agric. Sci.*, 7, Pt. 3, June 1937) on the investigation undertaken at Pusa on the tobacco disease known as leaf-curl, which is becoming a serious menace in northern India. They identify the disease with that described by Thung in Java under the name of 'kroepoek' and with the leaf-curl of East Africa which Storey studied and showed to be conveyed by a species of white fly. The authors distinguish five different types of disease, four of which they regard as distinct and due to different virus agents, and the fifth as due to a mixture of two or more of the former. Indeed, by grafting scions from two of the distinct types on to a healthy plant, they have reproduced a clinical condition indistinguishable from that regarded as the fifth disease under review. There is evidently a close resemblance between the types of disease found in

India and those observed by Thung in Java. The presence of carriers amongst weeds common to the Indian plantation is suspected,* but no definite evidence of such has been adduced.

Silicon Monoxide

W. Biltz and P. Ehrlich (*Naturwiss.*, 26, 188; 1938) report the interesting fact that on heating a mixture of equimolecular proportions of silicon and silica to 1400° in a vacuum, volatilization occurred to the extent of 80 per cent in an hour. Silicon itself would only volatilize to the extent of 10 per cent under the same conditions, and quartz has no appreciable vapour pressure. A vitreous sublimate, which was brown in thin layers, and brownish-black in thicker deposits, was obtained, and most of it could be resublimed. It seems possible, but not certain, that the product may be silicon monoxide. This substance has, of course, been previously prepared by the reduction of silica with carbon in the electric furnace, and has been used as a pigment, and for other purposes.

Heat Resisting Steels

PROGRESS in the metallurgical industry during recent years has been towards the provision of a number of alloy steels which are capable of withstanding both oxidation effects and high stresses at enhanced temperatures. On March 24, W. H. Hatfield presented a paper to the Institute of Fuel in which he recorded the results of experiments carried out on fourteen different compositions, including mild steel. The purpose of this experimental work was to make a comparison of the properties and characteristics of these steels and at the same time evolve a basis of evaluation of their efficiency for specific purposes. Consideration of the data shows that there are steels available which have a time yield of not less than 3,360 lb. per sq. in. at 700°C., whereas that of mild steel at the same temperature is of the order of 400 lb. This in point of fact means, when translated to everyday requirements, that reasonable permanence of dimensions can be anticipated from certain steels, and reasonable stresses can be borne by them even at a red heat. Further, various ingredients such as nickel and tungsten may be added to increase the strength of steel. It is therefore incumbent upon the engineer before selecting steel to consider carefully the service required of it and also the conditions of service, such as temperature distribution, atmosphere and general physical conditions, so that the right ingredients may be incorporated in the steel in suitable proportions.

A Randomizing Machine

IN certain statistical investigations it is necessary to have a set of random sampling numbers. The only table of such numbers at present in existence is due to L. H. C. Tippett, who compiled it by taking digits at random from census reports. There is some difference of opinion as to whether this method is reliable, but whether it is so or not, there is certainly a need for more extensive tables. To produce these, M. G. Kendall and B. B. Smith have designed a randomizing machine (*J. Roy. Statistical Soc.*, 101, 147; 1938). This consists of a disk divided into ten equal sections, on which the digits 0 to 9 are inscribed. The disk rotates rapidly, in a dark room, at a speed which can be made very approximately constant by means of a tuning fork, and it is illuminated by a series of flashes from a neon lamp. At each flash a number is chosen from the apparently stationary disk by means of a pointer fixed in space. The first five thousand digits obtained in this way are given in the appendix to the paper mentioned above. Four tests for randomness (the 'frequency', 'serial', 'poker' and 'gap' tests) were applied to these numbers, with satisfactory results in each case. Further experiments are needed before it can be established that the results will be equally satisfactory for much more extensive sets of numbers, but the preliminary results are very encouraging.

Observations of Meteor Showers in Japan

SHOWERS of Orionid, Leonid and Geminid meteors were observed last year by Mr. K. Komaki, Mrs. Komaki, and Mr. K. Yosii, at Kanaya and Takehara. The Orionids were not so rich as in the previous year, but the Leonid shower was slightly richer than it has been for some years. Mr. Yosii discovered a new stream, the radiant of which was R.A. 72°, Dec. + 37°. These meteors were white or yellow and their motions were slow. The Geminids were observed on December 6–15, and the frequency was about the same as in previous years, the maximum occurring on the morning of December 14. On December 12 and 13 the radiant was close to R.A. 112°, Dec. + 32°, and on the morning of December 14 Mr. Yosii detected two showers from R.A. 109°, Dec. + 30°, and R.A. 122°, Dec. + 33·5°.

A Variable-Frequency Telescope Drive

THE recent paper by Mr. H. W. Cox under this title (*J. Brit. Astro. Assoc.*, 48, 6; April 1938) will be useful to amateurs who wish to instal an efficient and cheap drive for their telescopes. The mechanism depends upon the principle that in a synchronous type of motor the motor speed is proportional to frequency, and this latter is varied by what is practically a radio set on the bottom end of the telescope. If a coil and a condenser are connected in parallel, they have a natural resonant frequency, and this can be regulated by varying the capacities. Hence it is possible to arrange a resonant frequency of the circuit which will coincide with the operating frequency suitable for any synchronous motor that is desired. The tuned circuit is unable to drive the motor, but by connecting the tuned circuit to an ordinary radio valve, the circuit and valve can be made to oscillate and produce a 50-cycle voltage of 10 or 20 volts, which can be brought up to 200 volts by another ordinary type of radio valve. When the voltage and power have been amplified to the correct amount, connexion to the motor is made through a transformer, just as a loud-speaker is connected to a radio receiver. The frequency is varied, as already mentioned, by altering the condenser or coil, and as the former is made up of a number of small units, each of these smaller condensers being connected independently into the circuit by a switch, the rate of the motor can be regulated. Mr. Cox supplies three diagrams with his paper, and those who are skilful with manipulating wireless sets should be able to fix up the drive for their telescopes, as the diagrams show the method of connexion and also various refinements introduced to produce the most accurate results.

Speech and Civilization

By Sir Richard Paget, Bt.

IT is a very remarkable fact, little known to students of human speech, that uneducated deaf mutes, even to-day, have no inborn knowledge of any sign or symbol equivalent to a word. They naturally symbolize their ideas by a general pantomime describing events as a whole. They have not got the power of analysing their environment into separate categories of objects, actions, qualities, etc., or of symbolizing such separate elements by bodily signs equivalent to our spoken words.

The fact that intelligent human beings, skilful with their hands and capable of craftsmanship, are still in this primitive and unanalytic state of mind—in which they are unable to define anything because they have no units with which to define—seems to indicate that our present powers of analysis and of separate symbolization of the elements out of which our general impressions are composed, may be a comparatively recent acquisition of mankind. It also seems possible that the acquisition of this power may be closely allied to what we call 'civilization'.

Assuming that the development of true speech arose from primitive man's acquisition of the power of analysing his environment (as presented to him by his various senses) and of symbolizing the component parts in units and categories—equivalent to our 'parts of speech'—how did this process begin ?

Perhaps the evidence of primitive man's artistic skill, for example, in his early cave drawing, sculpture and modelling, may give the clue.

Primitive man—keen hunter—skilled in recognizing shapes (cf. Pavlov's dogs)—must have often come across natural flints (which were of special interest as the raw material of his tools and weapons) of peculiar shape, which reminded him of certain animals—birds—or even human beings. Stones with curious holes through them—so that they could be made into 'knob-kerries' by pushing a stick into the hole—or smaller stones which could be threaded on a leather thong or a fibre string, and worn as ornaments, would also be very interesting, and 'magical' to him. It would not be long before man would try his hand at improving such finds, for example, by knocking off excrescences which 'spoilt' the form of a particular piece of natural sculpture.

It would also be natural that man should observe the plastic qualities of clay, and the way it preserved the imprints of animals and birds and of man himself, which appeared on it. As we know, he did make imprints of his hands on the walls of some of his caves.

Beginning thus with sculpture and modelling, it would not be long before man began outlining other objects, just as the imprint of his foot or hand on a soft surface of clay incidentally outlined the shape of the palm, or the sole of the foot.

The new factor in all this was that the artificial animal, bird or human, or the imprint or drawn outline symbolize the creature in question apart from its environment. The object symbolized could be considered by itself, apart from any environment; it could be viewed in any position, at any time, in any place where its owner chose to take it, or wherever he modelled or drew or impressed it.

Primitive man was not limited to the symbolizing of objects ; he could also symbolize actions, such as hunting, dancing and other bodily movements or postures, namely, by drawing crude representations of the actions in question.

The same method of representing actions was later developed by the Red Indians of North America, so that it became a complete script. The Chinese, Sumerians and Egyptians developed a similar technique, which ultimately became formalized as the Chinese ideograph, cuneiform and hieroglyph, respectively.

Thus, it may be that primitive man acquired the art of analysis of impressions, and of the symbolization of separate elements of his impression, from his first observations of natural objects which he recognized as being like other objects !

The moment he began to study natural objects with the view of drawing or modelling them, he had to concentrate his mind on them and, in fact, to isolate them from their environment, for the act of drawing or modelling was in itself a symbolizing of the model, or of the action or quality which he portrayed.

It seems likely enough that this process of symbolizing by drawing or modelling should have been used very early, in magical practice ; indeed, the power of producing stones, clay shapes or drawings, which looked like or suggested living forms, must have appeared highly magical to the tribal contemporaries of the earliest artists. It may well be that the artists were in fact the earliest 'priesthood'.

Turning now to the evolution of speech, the pre-analytic stage of sign language was, obviously, accompanied by an emotional 'gabble', due to the (Darwinian) sympathy of movement between man's hands and mouth. As man acquired the art of symbolizing animals, men, women, bodily actions, relative positions, sizes and other qualities, etc., namely, by drawing symbols of them on a flat surface, he would equally acquire the art of symbolizing these elements by bodily pantomime (including in this the art of outlining in the air) as educated Chinese to-day draw ideographs to be read by a Chinese who speaks a different dialect but uses the same method of ideographic writing. In this way, an analytic form of sign language would naturally grow up ; combined, of course, with general (non-analytic) pantomime. The gabble would thus tend to be gradually combined with particular mouth movements (due to corresponding hand movements) which always meant the same thing—that is, with actual words.

It would be interesting to know whether a study of the speech of the most primitive tribes of mankind gives any evidence of this process—the use of bodily pantomime of a more or less free and unstandardized type (accompanied by an emotional vocal gabble) combined with the use of standardized words for such objects, actions, etc., as would naturally be symbolized in very early stages of human development. It would also be interesting to know whether

Science News a Century Ago

Publication of Newton's "Principia"

AT a meeting of the Ashmolean Society, Oxford, on May 14, 1838, over which Dr. Buckland presided, Prof. S. P. Rigaud (1774–1839) the Savilian professor of astronomy, read a paper on the first edition of the "Principia" of Newton. After referring to Newton's early speculations on gravitation, Prof. Rigaud said that the statement in the "Commercium Epistolicum" that he communicated some of his principal propositions of the "Principia" to the Royal Society, in 1683, was certainly a year too early. The first notice of them was given at the latter end of June 1684, and a more specific specimen of the treatise was probably sent in February 1685. The commonly received opinion was that the Royal Society was at the expense of publishing the "Principia" but this was decidedly a mistake. A resolution to that effect was passed at a general meeting, but was not adopted by the council; and Halley was not only at the pains of superintending the publication of the work, which he had induced Newton to complete, but also undertook to do so at his own risk. The printing was commenced in the summer of 1686, but some delay took place, so that not more than eleven sheets appear to have been finished in February 1687. Halley then resumed his work, which he finally accomplished about the latter end of June 1687; and he must therefore, in this last effort, upon an average, have carried two sheets through the press in each week. This speed was not occasioned, as some have imagined, by any fear of Newton's receding from his engagement. The irritation which he felt in 1686 at Hooke's unfounded claims to a prior knowledge of the true nature and laws of gravitation, induced him to think of suppressing the third book of the "Principia"; but after that irritation had subsided, there is not the slightest indication, in his correspondence with Halley, of any backwardness on his part, in drawing up the work or supplying what was necessary to prepare it for the press.

Royal Premium of the Royal Geographical Society

ON May 14, 1838, Colonel Francis Rawdon Chesney (1789–1872) was presented with the Royal Premium of the Royal Geographical Society. In making the presentation, W. R. Hamilton, the president, said: "You have been the pioneer, to point the way, and to open the road into a large range of country, hitherto imperfectly known; you, and those under your command, have really navigated, for the first time in modern history, two of the most celebrated rivers of the ancient world—the Euphrates and the Tigris; you have added largely to our knowledge of Syria and Mesopotamia, Assyria and Susiana; you have carried a line of levels from Iskanderûm to Bír, and thence along the whole course of the Euphrates to the Persian Gulf; you have laid down the course of the Orontes, from its mouth to Jisr Hadía, and you have done more than enough to secure to yourself a place among the distinguished geographers of our time. These are the grounds upon which the Council of the Royal Geographical Society have judged it right to award to you the first Royal Premium, which the munificence of our illustrious patron, Queen Victoria, has placed at their disposal, for the reward and encouragement of geographical researches."

In acknowledging the honour conferred upon him, Col. Chesney said: "I cannot help feeling some regret, that the rules of the Society do not permit me to urge the claims of those which were greater than mine individually; for I, at least, cannot forget, that the almost unequalled labour of the transport across Syria was chiefly accomplished when I was confined with a brain fever, and that the leading discoveries in geography were made when I was not present." He then went on to refer to the part played in the work of the expedition by Major Escourt, Mr. W. F. Ainsworth, Lieutenant Cleaveland and others.

A Large Montgolfier Balloon

IN the *Athenæum* of May 19, 1838, was the announcement of a proposed "Ascent of the Great Montgolfier Balloon from the Royal Zoological Gardens, Surrey, under the Immediate Patronage of Her Majesty". "On Thursday next, May 24," said the notice, "one of the most extraordinary novelties ever presented to the Public will take place: viz., the Ascent of several Aeronauts with a stupendous new Balloon on the original plan of Montgolfier, of inflation by rarified air instead of gas, being the first Aerial Voyage ever made in England with a Balloon on this principle. It is the largest Aerostatic machine ever fabricated in this country being more than half the height of the Monument, and of proportionate dimensions, and containing 170,000 Cubic Feet of Air. Its vast powers, and the peculiar method of inflation renders this first Ascent unparalleled in the history of Aerostation . . ."

University Events

CAMBRIDGE.—Dr. G. R. Owst has been elected to the newly created professorship of education that comes into operation on October 1. Dr. Owst came up to Emmanuel in 1913 and after an absence for war service took his degree in 1920. He taught in South Africa for the next two years and then returned to England and began to work under Prof. Claude Jenkins at King's College, London, on the subject of medieval preaching. This work and other studies arising from it, have been recognized by the award of D.Lit. London and the Litt.D. Cambridge. Since 1928 Dr. Owst has been an inspector of schools both elementary and secondary and is at the present moment staff inspector for history.

GLASGOW.—Dr. James Small, lecturer in the theory and practice of heat engines, has been elected to the James Watt chair of the theory and practice of heat engines, in succession to Prof. William J. Goudie.

Mr. C. R. Ribbands has been appointed assistant in zoology, in place of Mr. D. S. Bertram, who has joined the staff of the School of Tropical Medicine, as lecturer in entomology.

Mr. H. H. Brown has been awarded the degree of Ph.D. for a thesis entitled "A Study of a Tectibranch Gasteropod Mollusc *Philine aperta* (L.)".

OXFORD.—A. N. Black, Exeter College, has been appointed University demonstrator and lecturer in engineering for four years as from October 1.

The Frazer Lecture for 1938 will be given in the Examination Schools at 5 p.m. on May 23 by Dr. J. H. Hutton, William Wyse professor of social anthropology in the University of Cambridge. His subject will be "A Primitive Philosophy of Life".

Societies and Academies

London

Royal Society (*Proc. A.*, 165, 313–452; April 14, 1938).

E. A. Milne: On the equations of electromagnetism. (1) Identifications. (2) Field theory.

H. J. Gough and W. A. Wood: Crystalline structure of steel at fracture.

Edmund C. Stoner: Collective electron ferromagnetism.

W. Mandell: Resonance in crystal beams of sodium-ammonium seignette salt.

R. B. Randall, M. Benger and C. M. Groocock: Alkaline permanganate oxidation of organic substances selected for their bearing upon the chemical constitution of coal.

Paris

Academy of Sciences, March 14 (*C.R.*, 206, 793–864).

Gabriel Bertrand and Lazare Silberstein: The distribution of boron in the organs of the white lily. The amount of boron in the plant as a whole is small compared with other plants: it is lowest in the stem and highest in the reproductive organs.

Pierre Lejay and Chang Hung Chi: Gravimetric chart of the south of China.

Etienne Halphen: Research on the most independent chance variables.

Aryeh Dvoretzky: The geometrical basis of the theorem of M. Mandelbrojt and analogous theorems.

Béla de Sz. Nagy: The extremal properties of Fourier series transformed by absolutely monotonic series.

Kwok-Ping Lee: The Borel directions of meromorph functions of finite order higher than 1/2.

Carlos Biggeri: The singular points of a Taylor's series external to the circle of convergence.

Georges Dedebant, Michel Kiveliovitch and Philippe Wehrle: A method of establishing the equations of hydrodynamics.

Louis Viaud: An experimental method for the study of an air blast in interaction with the soil.

M. and Mme. Lucien d'Azambuja: The velocity of rotation of solar prominences deduced from their successive passages on the central meridian of the star.

Paul Muller: A new double refracting prism and its application to the measurement of double stars.

V. Frolow: The analysis of the maregraphic series of Norway.

René Lucas: New properties of double refraction of liquids submitted to ultra-sounds. A column of liquid, placed between Nicol prisms set to extinction, shows reappearance of light when the liquid is submitted to ultra-sounds produced by piezo-electric quartz. These optical effects are very clear with some liquids (castor oil, linseed oil) but are inappreciable with others (glycerol, ethyl acetate).

Georges Déchêne: The capacity at the contact of a metal with a semi-conductor.

Frantz Perrier: The determination of the wavelengths of the radiation emitted by electrified insulators: an attempt at a theoretical interpretation. From the measurement of the absorption coefficients in celluloid it is shown that the frequency of the radiation is proportional to the potential difference between the two faces of the dielectric.

Mme. Thérèse Grivet-Meyer: Some properties of the penetrating fraction of the cosmic radiation. The properties of the hard variation vary with the thickness of the total screen interposed. It is not possible to represent the absorption of the radiation by a simple exponential.

Ladislas Goldstein and Anatole Rogozinski: The use of an ionization chamber with a liquid dielectric for the study of neutrons.

Marcus Brutzcus: The thermochemistry of the sulphur compounds.

Mlle. Yvonne Garreau: The constitution of some compounds formed by the oxidation of hydroquinone in the presence of ammonium sulphite or of primary amines.

Tryphon Karantassis and Constantin Vassiliadès: New oxyiodine compounds of the dialkyl derivatives of tin.

Jean Vène: Syntheses starting from the bisulphite derivatives of the camphoric β-aldehyde esters.

Henri Longchambon: Cordierite gneiss and granites in the French Central Massif.

Gilbert Mathieu: The structure of the island of Yeu.

Louis Eblé and Gaston Gibault: The values of the magnetic elements at the Observatory of Chambon-la-Forêt (Loiret) on January 1, 1938.

Georges Dubois and Mme. Camille Dubois: The peats of Cragou (Finistère). Results of pollen analyses: the Cragou peat is relatively recent, neolithic.

Georges Deflandre: Study of the organic materials forming certain fossil plankton microorganisms. Attempts at microchemical analysis. Results of the application of various staining reagents. The present ideas on the microchemistry of cellulose membranes, or of similar composition, based on the study of existing bodies or living beings, cannot be applied to plankton microfossils.

Mlle. Marie Celan: The structure of the central cells of *Halopitys pinastroides*.

Arthur Brunel: The degradation of substances of puric origin in the lamellibranch molluscs. *Mytilus edulis* possesses the property of degrading uric acid to urea and ammonia: allantoin and allantoic acid are the intermediate terms of this reaction.

Michel Macheboeuf and Francois Tayeau: The state of the lipids and of cholesterol in the blood serum: the destruction of certain lipidoproteinic cenapses and the liberation of their lipoid substances by a soap.

Gustave Guittonneau and René Chevalier: The attack of the benzene nuclei and the utilization for food of phenol by the *Azotobacter* of the soil. A strain of *Azotobacter* has been cultivated which grows on silicogel containing phenol, and which also grows on media containing mannitol, sodium benzoate, sodium *p*-oxybenzoate, but does not develop in the presence of *m*-oxybenzoate or *o*-oxybenzoate. This would appear to be a new physiological type of *Azotobacter*.

Moscow

Academy of Sciences (*C.R.*, 18, No. 2, 1938).

S. Sobolev: A class of integro-differential equations with several independent variables. (2).

K. Persidskij: The law of large numbers.

K. Brodovitskij: Statistical analysis of the rhythm of fundamentally unobservable regularities, observed manifestations of which are subject to some unknown perturbations.

I. M. Goldman: Breakdown of compressed nitrogen in small gaps.

E. Gross: The splitting-up of the Rayleigh line and the acoustic spectrum of crystals.

P. Petrenko-Kiritschenko: The law of periodicity.

M. V. Gorlenko: Resistance of winter wheats to black bacteriosis (*Bacterium translucens* var. *undulosum* S.J.R.).

A. A. Isakova and A. A. Andrejev: The excretion of nitrogenous compounds by the roots of leguminous plants (lupin) and the conversion of these compounds in the presence of bacteria.

M. Abakumova: Problem of photo-periodical and temperature after-effects.

V. G. Aleksandrov and O. G. Aleksandrova: The flintiness and flouriness of wheat endosperm.

N. G. Chlopin: Attempt at an experimental analysis of the auxiliary components of the nervous system.

J. A. Vinnikov: Growth and transformation *in vitro* of myoneural elements (sphincter and dilator of the iris).

V. P. Michailov: Growth and transformation *in vitro* of the covering cells of the vascular plexuses of the brain.

N. N. Kannegisser: Growth and transformation *in vitro* of the elements of the pia mater.

G. A. Schmidt: Ectoderm of the Anuran gastrula under the inductive influence of dead organizers and parts of organs of Amphibia and mammals.

Tokyo

Imperial Academy (*Proc.*, 14, No. 2, 27–85, Feb. 1938).

S. Kakutani: The uniqueness of Haar's measure.

Shin-ichi Izumi and Tatsuo Kawata: Notes on Fourier series. (3) Absolute summability.

Hitoshi Hombu: The projective theory of 'paths' of the third order

$$x^{(3)i} + H^i(x, x^{(1)}, x^{(2)}) = 0.$$

Kenzo Joh: A theorem of K. Löuner on univalent functions.

Masao Sugawara: Siegel's modular function of the higher degree.

Hantaro Nagaoka and Tadao Mishima: High terms of Paschen series in hydrogen and deuterium.

Ken Sugawara: Decompositions in shallower waters of a lake in summer and the supply of oxygen from the atmosphere.

Masao Kubokawa: Activated adsorption of methane on reduced nickel.

Shigehiko Sugasawa, Kûchiro Kakemi and Tôru Tsuda: Synthesis of 6,7-dimethoxyquinoline.

Hidekichi Yanagisawa and Eûchi Yokoi: Purification of hirudin, an active principle of *Hirudo medicinalis*.

Tetûchi Kobayashi and Hisashi Mochizuki: Outline of the structure of the Kibi plateau on the inner side of western Japan.

Saburô Ôishi: The Japanese equivalents of the *Lepidopteris* and *Thaumatopteris* zones of East Greenland.

Gihei Yakama: (1) Hydrogen ion concentration, etc., of the anther sap of *Lilium* species. (2) Potential measurements of the dividing pollen mother cells of *Lilium speciosum*.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 16

King's College, London, W.C.2, at 5.30.—Prof. Th. J. Stomps: "Recent Developments of the Mutation Theory".*

Wednesday, May 18

Royal Society of Arts, at 8.30.—Prof. K. W. Braid: "Bracken and its Present Menace to Heather and Pasture".

Thursday, May 19

Royal Society, at 2.30.—Discussion on Turbulence in Fluid Motions, to be opened by Prof. G. I. Taylor, F.R.S.

London Mathematical Society (at the Royal Astronomical Society, Burlington House, W.1), at 5.—Prof. W. V. D. Hodge: "Harmonic Integrals".

British Institute of Radiology, at 6.30.—Annual General Meeting.

Sir John Cass Technical Institute, Aldgate, London, E.C., at 7.—A. J. Murphy: "The Selection of Non-Ferrous Materials for Engineering Purposes" (succeeding lectures on May 26 and June 2).*

Chemical Society, at 8.—Discussion on "Organic Intermolecular Complexes". Opened by Prof. G. M. Bennett.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Engineer and Civil Engineering Assistants in the Roads Department of the Ministry of Transport—Assistant Secretary, Establishment Department, Ministry of Transport, Metropole Buildings, Northumberland Avenue, W.C.2 (May 16).

Lecturer in Mathematics (woman) in Darlington Training College—Principal (May 18).

Senior Scientific Officer in the Directorate of Civil Research and Production, Air Ministry—Permanent Under-Secretary of State, Air Ministry (S.2.d.), Adastral House, Kingsway, W.C.2 (May 20).

Scientific Officer, Junior Scientific Officer, Technical Officers and Assistants (II) for work on wireless apparatus, etc., at the Signals Experimental Establishment, Woolwich, S.E. 18—Superintendent (May 20)

Lecturer in Physiology in the University of Queensland—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1 (May 20).

Assistant Lecturer in Chemical Pathology in the University of Manchester—Registrar (May 21).

Senior Scientific Officer in the Admiralty scientific pool (physics, particularly acoustics)—Secretary to the Admiralty (C.E Branch) quoting Ref. No. C.E. 3326/38 (May 21).

Lecturers in Mathematics, Physics, Chemistry, and Civil and Mechanical Engineering Department of Woolwich Polytechnic, S.E 18—Secretary (send stamped addressed envelope) (May 21).

Two Assistants (one with knowledge of aeronautics) in the Civil and Mechanical Engineering Department, a Lecturer in Chemistry and a Lecturer in Mathematics in the Northampton Polytechnic, St. John Street, London, E.C.1—Secretary (May 23).

Lecturer in Zoology in King's College, Newcastle-upon-Tyne—The Acting Secretary to the Council (May 25).

Pathologist and Bacteriologist at the Memorial Ophthalmic Laboratory, Cairo—Horace H Rew, Examination Hall, Queen Square, London, W.C.1 (May 28).

Head of the Department of Physics at the Chelsea Polytechnic, London, S.W.3—Principal (May 28).

Chemists in the War Department—Under-Secretary of State (C.5), War Office, S.W.1, quoting Appts./83 (May 28).

Lecturer in Mathematics and Lecturer in Chemistry in the Derby Technical College—Clerk to the Governors (May 28).

Assistant Meteorologist in the Meteorological Service of the Sudan Government—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, London, S.W.1 (May 31).

Bacteriologist in the Veterinary Department in Kenya—Director of Recruitment (Colonial Service), 8 Buckingham Gate, London, S.W.1 (May 31).

Demonstrator in the Department of Zoology at Bedford College for Women, Regent's Park, N.W.1—Secretary (May 31).

Lecturer in the School of Agriculture near Khartoum—University Appointments Board or Controller, Sudan Government (London Office), Wellington House, Buckingham Gate, S W.1, marking envelope "Lecturer" (May 31).

ASSISTANT METEOROLOGIST in the British West African Meteorological Service—Director of Recruitment (Colonial Service), 8 Buckingham Gate, London, S.W 1 (May 31).

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING in the Manchester Municipal College of Technology—Registrar (June 1).

LECTURER IN BIOLOGY in the School of Science, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1 (June 1).

PRINCIPAL of the Marine School, South Shields—The Secretary (June 1).

ASSISTANT IN THE DEPARTMENT OF ARCHÆOLOGY in the Leicester Museum and Art Gallery—The Director (June 11).

DEMONSTRATOR IN ANATOMY in the University of Sheffield—Registrar (June 15)

LECTURER IN ZOOLOGY (marine zoology or physiology) in the University of Sydney—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1 (July 12).

JUNIOR RESEARCH INVESTIGATORS in the British Non-Ferrous Metals Research Association—Secretary, B N.F.M.R.A., 1–6, Regnart Buildings, Euston Street, London, N.W.1

INSTRUCTOR IN RADIO ENGINEERING for the Education Department, Straits Settlements—Crown Agents for the Colonies, 4 Millbank, London, S W.1, quoting M/5561.

LECTURER IN CHEMISTRY with qualifications in physical chemistry in the University of Reading—Registrar

LECTURER IN ELECTRICAL ENGINEERING in the University of Birmingham—Secretary.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Brompton Hospital Reports: a Collection of Papers recently published from the Hospital. Vol. 6, 1937. Pp. iv+183+6 plates (London: Brompton Hospital) 2*s*. 6*d*. [238

Imperial Bureau of Soil Science. Technical Communication No. 36 (Imperial Bureau of Pastures and Forage Crops, Herbage Publication Series, Bulletin 25). Erosion and Soil Conservation By G. V. Jacks and R. O. Whyte. Pp. 206. (Harpenden: Imperial Bureau of Soil Science; Aberystwyth: Imperial Bureau of Pastures and Forage Crops.) 5*s*. [84

Annals of the Cape Observatory. Vol. 14, Part 2: Observations of Major Planets made with the Heliometer at the Royal Observatory, Cape of Good Hope, during the Years 1932 to 1934. Pp. v+38 (London: H.M. Stationery Office) 4*s*. net. [114

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Broadcasting as a Social Service

IN the admirable essay on the British Broadcasting Corporation in the volume of essays "Public Enterprise: Developments in Social Ownership and Control in Great Britain" by a group of contributors belonging to or associated with the New Fabian Research Bureau, Dr. W. A. Robson, while recognizing the achievements of the Corporation, the merits of its organization and the high degree of public spirit in its staff, referred to the deplorable absence of serious criticism and intelligent information concerning broadcasting in Great Britain. The general public indeed is scarcely aware either of the achievements or the shortcomings of British broadcasting, or the possibilities and the dangers of broadcasting as affecting international relations.

A more searching and discriminating attitude towards broadcasting activities is undoubtedly essential if the vitality and future progress of broadcasting are to be assured, and the same plea is advanced in Dr. Cleghorn Thomson's recent suggestive survey of radio development and its problems in our changing world under the title "Radio is Changing Us". Dr. Cleghorn Thomson writes in a disarmingly bantering tone but never loses sight of the serious aspect of his thesis. His seven years' experience inside the British Broadcasting Corporation add weight to many of his criticisms, although his attitude is that of the keen listener, and he lays his main stress on the importance of creative imagination in the development of broadcasting services whether in Great Britain or elsewhere.

Without a more critical approach to broadcasting problems and a more imaginative and creative appreciation of the social and cultural elements involved, technical development is likely to lag far behind what is possible, and much of the value of efforts, such as those of the International Broadcasting Union and the International Committee on Intellectual Co-operation, to use this new means of spreading information in the service of peace and understanding between the nations, may well be lost.

The problems and difficulties so far encountered are, of course, essentially those which have been raised and stressed repeatedly of late, notably in Mr. T. H. O'Brien's study of "British Experiments in Public Ownership and Control" and in the essays on the British civil servant edited by Dr. W. A. Robson. Fundamentally, the problem is one of linking efficient administration and effective safeguards against abuse or damage to the public interest with the creative imagination which is alive to the human and social issues involved and the service which technical developments can render to them. It is this which has brought into the forefront at the present time the whole question of training for administration, and the importance of securing those who possess the scientific background to assess technical factors as well as creative ability and the capacity to promote energetic and far-reaching projects. Caution and regard to existing interests can never be a substitute for vision and initiative; and the severest criticism that has been made of the Governing Board of the British Broadcasting Corporation is just that its personnel does not inspire confidence in its contact with progressive thought, its receptivity to new ideas and its capacity to promote energetic development. It suggests the retrospective rather than the forward-looking mind which is so imperatively needed in such positions to-day.

Statements in the Press that the quality of broadcasting programmes in Great Britain is likely to be affected by the financial stringency through which the British Broadcasting Corporation is passing give further point to some trenchant criticism by Dr. W. A. Robson in the essay to which we have alluded. Dr. Robson notes that the British Broadcasting Corporation, a public service undertaking carried on without a divisible profit on a self-supporting basis, has been required over a long period of years to pay to the Treasury out of its licence revenue not only a heavy percentage deduction amounting in 1934 to £1,134,315 out of £3,369,000 but also a series of "emergency contributions" levied annually to meet the financial crisis of 1931, amounting in 1934 to £187,500, as well as a further sum by way of income tax amounting to £113,000 in the same year. Thus in 1934, out of each ten shillings paid for a licence, only 4*s*. 9*d*. was available for broadcasting, and, though the Government has accepted the view of the Ullswater Committee that the Corporation should receive a larger share of the licence revenue, the change is estimated to bring the net licence revenue in 1937–38 to £2,800,000, on which basis about 6*s*. 5*d*. out of the ten shilling licence will be available for the broadcasting service.

This, therefore, is a step in the right direction; but on any broad or long-range view of the broadcasting service these payments must all be regarded as unjustifiable. They are drained out of the broadcasting revenue derived from the licence fee at the expense of the listener, and are due to demands made by the Treasury, regardless of the purposes for which new enterprises are run.

What is needed here is, of course, some central planning organization which is competent not merely to stimulate such a philosophy of public finance, but also to assess the significance of broadcasting as an element in the social services or educational system of the nation, and to determine the broad lines along which it can work out its own policy and contribution in harmony with other public or social services. Only in such a way can we be sure that adequate financial resources will be available, and machinery developed for co-ordinating the work when required and avoiding friction or overlapping between different public utilities or services.

This is, of course, a matter involving much more than questions of finance alone. It affects questions of technical development, the recruitment of staff and most matters in which the utilization of creative thought, a scientific outlook and progressive opinion are concerned. Above all, it means constructive and fundamental thought about the place of broadcasting in national economy and its contribution to cultural or social development as a basis for the framing of a policy. Moreover, if, as Mr. Cleghorn Thomas holds, it is in its contribution to the fuller and more abundant life—in the stimulation of intellectual life and individuality in the arts, the sciences, the humanities —that broadcasting can most permanently justify itself, the fullest opportunity for its expression can only be secured when those in direct or indirect control of it are fully alive to the opportunities it holds and in sympathy with the service it can render to humanity.

The danger indeed is not greater in the financial than in the political or other spheres. Indeed one reason why the public should be afforded much more information about the expenditure of the British Broadcasting Corporation, as urged by Dr. W. A. Robson and Mr. T. H. O'Brien, is to facilitate an intelligent understanding of the work which the Corporation is doing and the way in which financial difficulties hamper development. The attention focused upon staff problems and especially recruitment by Dr. Herman Finer in his essay in "The British Civil Servant" is of significance because of the vital importance of securing staff and conditions of service in which the psychological atmosphere is favourable to creative thought and imaginative development. The relations of the Corporation to the Government and the composition of its Governing Board similarly not only affect these matters but also the firm establishment of continued belief in the impartiality of the Corporation, its freedom from propaganda and prejudice and its willingness and ability to serve the changing needs of the public to the maximum of its opportunities, both within the territorial limits of the nations and on the international scale also. The appeal for constructive criticism which is so striking a note in Mr. Cleghorn Thomson's book and in the other essays we have noticed is founded on the belief that only by such means can an institution be assisted to develop its services and keep itself imaginatively alive to the magnitude of its opportunities. In such criticism scientific workers have a part to play which has special claims upon their interest, because of the rapidity with which the problems presented have themselves arisen out of the application of scientific discovery and thought.

From Galileo to Einstein

The Evolution of Physics:
the Growth of Ideas from the Early Concepts to Relativity and Quanta. By Albert Einstein and Leopold Infeld. (Cambridge Library of Modern Science.) Pp. x+319+3 plates. (Cambridge: At the University Press, 1938.) 8*s*. 6*d*. net.

THE interpretation of science to the lay reader—and we may quite candidly admit that 'lay reader' must be interpreted as including practically all men of science who do not happen to be professionally interested in the particular branch of science under consideration—is a task both important and difficult. Of books which might be described as being suitable for some "Wonders of the Universe" series there is an excellent supply, and very good some of them are. The universe *is* a wonderful place, and to explore it under the guidance of a distinguished cicerone is both pleasant and profitable. Too often, however, one lays the book down with an uneasy feeling that something is missing. It reads like a detective story from which all the middle pages are missing. The first chapter, with its neatly arranged pile of corpses, is there, and the last page or so in which the name of the villain is disclosed; but the account of the search, and in particular, that thrilling chapter, near the end, where the 'little grey cells' come into play, is wanting, and the real interest of the book has vanished with it. While it is, no doubt, edifying to learn that a lump of matter is nothing but a whirl of flying electric charges, what the reader would like to know, and what it is important that he should know, is how, and by what stages, the physicist arrives at this astounding conclusion. If, as Prof. Einstein and his co-author claim, "Physics is a creation of the human mind, with freely invented ideas and concepts", it is this intellectual content which gives to physics one of its chief claims to cultural significance, and provides for the thoughtful non-technical reader his main source of interest in it. It is with this aspect of the subject that the authors are concerned in this very distinguished book.

The fact that they are "mainly concerned with the role of thoughts and ideas in the adventurous search for knowledge in the physical world" makes the task of the authors at the same time easier and more difficult. On one hand they can, and do, dispense with the experimental and mathematical scaffolding which is so terrifying to the lay reader—there is not a single mathematical equation in the whole book; on the other, the concepts of modern physics (though the authors describe them as "simple and natural") are by no means easy to grasp. The historical approach was obviously the one which offered the best chance of success, and, as the title implies, it is the historical method which the authors have chosen. "Our aim will be accomplished", they write, "if these pages give you some idea of the eternal struggle of the inventive human mind for a fuller understanding of the laws governing physical phenomena".

A fascinating story they make of it. The first chapter sketches the rise of the mechanical theory of the universe, from Galileo to Newton, from Newton to Joule and the kinetic theory of matter. The second chapter foreshadows difficulties for the hitherto triumphant mechanical view of Nature, in the discovery of the curious interrelation between the electric and magnetic fields, and in the wave theory of light. The difficulties were not felt very seriously at the time—in fact, the ether wave theory of light was regarded as one of the highest achievements of mechanical theory. Nevertheless, attempts to construct a reasonably acceptable model of the electromagnetic field, or to assign consistent mechanical properties to the luminiferous ether, all ended in failure. The conclusion is drawn that the trouble lies in the fundamental assumption that it is possible to explain all events in Nature from a mechanical point of view.

A new chapter opens with Faraday's discovery of electromagnetic induction, and Maxwell's conception of the electromagnetic nature of light. From this it is a short step to the problem of the ether drift and the decisive experiments of Michelson and Morley. The stage is now set for the introduction of the principle of relativity, an exposition of which, both in its restricted and in its general form, occupies the rest of the chapter. The story here reaches a true climax. The gathering difficulties; the search for a weak link in the apparently unbreakable logical chain of reasoning constituting the classical mechanical theory which nevertheless had led to predictions that experiment had failed to confirm; the final resolution of the difficulty in the principle of relativity is set forth with a genuine excitement, which betrays that the author was also an actor in the drama which he portrays. A final chapter on quanta reveals that "the eternal struggle" is far from having reached its final phase.

It will be evident from this brief synopsis that the authors have made no attempt to cover the whole of physical theory—they have followed only one of its main channels. How far they have succeeded in their gallant attempt to make clear to the intelligent non-technical reader the fundamental conceptions of modern physics, the reader himself must decide. He may at any rate be assured that he is unlikely to find a more authoritative, lucid or genial guide. Although no previous technical knowledge is assumed, the book is not easy reading; indeed, no book of this kind can be that, unless its author has shirked the real difficulties of his task; and Prof. Einstein is not the man to shirk difficulty. What can be done by a singular lucidity of style, by apt illustration, and by occasional flashes of humour to smooth the path, the authors have done. The reader who pursues the path to its end will find that it brings him very near to the heart of physics. This is a book of real distinction, which no one interested in physical and philosophical ideas can afford to neglect.

J. A. CROWTHER.

Problems of National Survival

Political Arithmetic:
a Symposium of Population Studies. Edited by Lancelot Hogben. Pp. 531. (London: George Allen and Unwin, Ltd., 1938.) 30*s*. net.

"THE present volume sets forth some of the enquiries undertaken by the Department of Social Biology [of the London School of Economics and Political Science] during the Editor's tenure of office therein. . . . About half of the material is presented for the first time. Any profits arising from the sales will be devoted to the publication of other *factual* social studies."

The title of this collection of essays devoted to "realistic social enquiries" derives from the "Politicall Arithmitick" (1691) of William Petty, the "man of affairs" who was one of the founders of the Royal Society. The choice of title is appropriate in that, though probable (or standard ?) errors and correlation coefficients are given in places, quite elementary methods are still used, these being mainly discriminating tabulation and interpolation by proportional parts. The result, however, is an impressive contribution to the investigation of problems which are ever more urgently being thrust upon us.

The chapters are grouped under two headings: "The Survival Minimum" and "The Recruitment of Social Personnel". The thesis implied in the former is that "the rate of reproduction has sunk below the limit compatible with continued survival in many countries". This is established by studies of trends of fertility, mortality and nuptiality in Great Britain and in Australia; but the first chapter, by Dr. Kuczynski, deals with the international decline of fertility, while the last, by the same author, is a reprint from the *Annals of Eugenics* of a carefully documented and illuminating article, "British Demographers' Opinions on Fertility, 1660 to 1760". The second part is chiefly concerned with "a field of enquiry which has been conspicuously neglected" yet is less highly speculative, namely, in particular, the waste of ability in the denial of opportunities of study to many who would profit from further study, and conversely, due to the structure and working of English education. The relation of this wastage to parental occupation is also investigated. Further, the inducement we give to juveniles to take up unskilled work is exposed, and the differential fertility of skilled and unskilled wage-earners examined. A final chapter on an unrelated topic, the distribution of the blood-groups and its bearing on the concept of race, gives a very useful synopsis of the facts and a careful examination of what is involved in classification; this chapter also has a bibliography.

The general tone of the book suggests that it is but a preliminary attack on the problems to be studied; in fact, after the manner of the pioneers of the Royal Society with regard to British agriculture, a programme of "heads of enquiries" has been prepared with the help of a group of economists. The volume will certainly be convenient as a starting-point or a source of data, even for those who are using more advanced methods in the approach to population problems. A book like this should win recruits to these studies, and it would have been still more usable had it contained an index, or even a detailed table of contents. The excellent summaries at the end of most chapters do not compensate for this lack.

In the introduction to Part I, Prof. Hogben gives an outline of the tradition to which the work belongs, and incidentally makes an almost medievally vigorous attack on the scholastic tradition which he finds dominating the modern teaching of economics. It is in response to this tendency, he says, that Malthus "the phlogistonist of demography is far better known than Petty or Graunt".

We are attracted by "self-evident principles", rather than aware of the importance of definite data or of the possibilities of changing the facts of our social relations. This attitude is evidence of the stimulating, and possibly provocative, character of this work. Like medicine, economics must be indubitably freed from complete submission to merely deductive methods.

It is unfortunate, however, that in producing a book that is to be used, a little more care had not been given to ensure that the task of appreciating masses of data was made as little burdensome as possible. The difficulty in facing up to such appreciation may be essentially educational—how make it possible not to be oblivious to all save over-simplified ideas, such as those of Malthus ? How encourage a vigorous openmindedness ? For this reason it seems well to emphasize the obvious, that those who have been able to steep themselves in the details of such topics may be forgetful of how difficult it is for most who come fresh to them to get a satisfactory viewpoint.

Graphs are freely used in most of the chapters here, but it is not realized how depressing is the meticulous marking of all the graduations of a scale—indeed the over-detailed yet ambiguous marking of the class scale in Fig. 1 of page 126 raises doubt as to consistency with Table I of p. 108 ; the marking of a couple of salient graduations gets the range of variation most easily into perspective. The tables of gross reproductive rates, occupying pp. 54–59, would have been more readable if rows and columns had been interchanged. Comparison would have been facilitated had closely related maps been printed together on a folded sheet ; and so on with such elementary matters.

But one wonders that, while the project of Petty for "A Dictionary of Sensible Words" is so strongly commended, this is neglected in a book which is in danger of being rather loosely knit. Progress in such studies has consisted in considerable degree in a refinement of the criteria to be applied, and reference to an authoritative list of the definitions of the various possible 'coefficients' would relieve the strain on those who have to form a fresh judgment as to which criteria are appropriate in particular cases. Some of the chapters too could with advantage be more fully documented ; this can be remedied in a second edition. J. M.

Gas Attacks and Defence

Breathe Freely ! the Truth about Poison Gas
By Prof. James Kendall. Pp. xi+179. (London : G. Bell and Sons, Ltd., 1938.) 3*s*. 6*d*. net.

In calculating the chances of air raids being carried out against Great Britain, Prof. Kendall thinks that Germany is the only nation that need be seriously considered, and it is on her policy that everything really depends. In his opinion, it is unlikely that there will be another war with that country in this generation, so that German air raids constitute, in the present state of Europe, nothing but an empty threat ; but if they should come, and gas is used, it would be ineffective provided that adequate preparations are made and reasonable precautions are taken against it.

Prof. Kendall says that chemists are absolutely confident that no 'super gas' has been found, and he thinks that it is most unlikely that since the Great War poison gases have been discovered which are markedly superior to phosgene as an offensive weapon or to mustard gas as a defensive one. In fact, gas is only likely to be used in future if one side has a desperate reason for its employment and when effective retaliation is either impossible or likely to be impracticable owing to the demoralization caused. Germany no longer enjoys a monopoly in chemical manufacture, so that she can never again depend on a six-months start over her opponents. If she failed after taking this step, she would be shown no mercy a second time and would be ruled with a rod of iron for generations.

The author refers at some length to the scare-mongers and he exposes their extravagances : "It is all so pathetic and at the same time such arrant rot" ; and he even comments on the disproportionate effort expended by the Home Office on anti-gas instruction in its Air Raid Precautions Handbooks. This seems a little unreasonable, because there was an obvious need for instructing an ignorant and apathetic public. It was only by stressing the danger—within limits—that an effect could be produced, and once this danger was realized adequate preparations would do much to render gas ineffective, so that the inclination to use it would be discouraged, and one at least of the risks of an air raid would be eliminated.

While instructed readers will be in general agreement with the author in the main purpose of this book, they will not so readily accept his conclusions when he makes excursions into regions outside his own province. For example, with the experience of the prolonged and dangerous situation caused by a civil war in Spain—a second-class country—is a general European war within the next few years "exceedingly improbable" ? Prof. Kendall says that barking dogs never bite, but when good faith is lacking, armaments are mounting, militarism is being inculcated in the whole youth of the totalitarian States, and recent aggressive steps have met with such astonishing success, it seems more probable that the next moves are merely a matter of opportunity and careful timing ; and that Great Britain would be drawn, however unwillingly, into any conflict between first-class Powers, regardless of the apparent limitations of its existing treaty engagements.

Does the use of gas merely involve a prolongation of hostilities ? If chemical warfare had continued into 1919, would the main bodies of troops have taken shelter in huge dug-outs while squads of men relieved each other at frequent intervals in the exhausting task of decontaminating scores of square miles of territory ? Are the huge new blocks of flats in Germany much more vulnerable to incendiary bombs than the isolated houses which predominate in British towns ? Were the casualties sustained by the German troops caused by the imperfection of what their commanders termed their "iron gas discipline", or rather by the various weaknesses of human nature which would be displayed to a much more pronounced extent by a civil population ?

However, these expressions of opinion are not the primary object of the author, which is to examine in an impartial way the possible use of gas and its probable effects in an air raid. Even if he has told us nothing new, he has succeeded in placing the actual facts before the public in proper perspective, so that "the way to avoid Bedlam is not to go insane in advance".

C. H. FOULKES.

Extinct Mammals of the Western Hemisphere

A History of Land Mammals of the Western Hemisphere

By Prof. William Berryman Scott. Revised edition, rewritten throughout. Pp. xiv+786. (New York : The Macmillan Co., 1937.) 32*s*. net.

A PERIOD of a quarter of a century has elapsed since the first appearance of Prof. W. B. Scott's admirable account of the mammals of the western hemisphere. The new edition that has just appeared gives a measure of the increase in our knowledge of extinct mammals during this time, the result of praiseworthy activity on the part of many museums of the United States and Canada. This increase has necessitated so much revision and rewriting that, with the exception of the title and a couple of chapters, the work is more properly to be described as a new book than as a new edition. There are also more than a hundred additional figures, including many new restorations.

The author in the preface to his first edition said that so rapid was the uninterrupted course of discovery that parts of the text became antiquated while in the press. The same statement could still be repeated to account for the absence of notice of the late W. D. Matthews' work on the fundamentally important Palæocene fauna of New Mexico which, published last year, appeared too late for incorporation. On the other hand, most new results or discoveries of scientific interest that were available seem to have found a place and their first home in a general text-book. The skull of *Thylacosmilus*, a sabre-toothed marsupial which, when compared with the totally unrelated sabre-toothed tiger *Eusmilus*, gives as striking an instance of convergent and highly specialized adaptation as one could hope for; and, to quote only one more example out of many, the radiation into numerous and bizarre forms of antler in the pronghorn and other deer families described by Child Frick, are examples of recent discoveries.

The author also in his preface states that his book is written for the "non-professional" and that "perhaps it is unjustifiable optimism to assume the existence of a body of readers of this subject", but that he hopes that nevertheless they are to be found. It is much to be hoped that this book itself will create such a body, once they are introduced to this fascinating subject of mammalian palæontology. The first four chapters are introductory and are by no means unduly technical, so that the "non-professional" reader should be able to continue to the end with increasing interest. It is, however, the professional palæontologists, who, knowing the difficulties that have to be surmounted in the production of a summary account of so wide a field, will be the ones that feel not only interest but also admiration for Prof Scott's achievement.

The Linnean Society

A History of the Linnean Society of London
By Lieut.-Colonel A. T. Gage. Pp. 175 + 11 plates.
(London: Taylor and Francis, 1938.) 5*s.*

THE hundred and fiftieth anniversary of the founding of the Linnean Society of London, which is being celebrated on May 24–27, is a very suitable occasion for the publication of its history. Several previous attempts to compile the history of the Society had been made, but they did not come to fruition. In Colonel Gage, the Society was fortunate in finding not only an energetic and faithful historian, but also one whose intimate knowledge of the Society and its archives rendered him peculiarly fit to put on record the growth and development of the Society and the vicissitudes through which it has passed.

The hundred and fiftieth anniversary is an occasion for the fellows to praise great men and the fathers that begat the Society, that triumvirate James Edward Smith, who had purchased the Linnean collections and books, Samuel Goodenough and Thomas Marsham, for many years president, treasurer and secretary of the Society respectively. But just as many infants pass through very critical periods in their lives, so the Linnean Society, after some years of initial prosperity, found its meetings becoming poorly attended and the subscriptions of its fellows less regularly paid. To crown these difficulties, the president, Sir James E. Smith, moved from London to Norwich in 1796, taking the Linnean collections and books with him. This was like removing the Ark of the Covenant from the Temple. To counteract these difficulties, some active fellows urged the obtaining of a charter for the Society, and this display of energy as well as the enhanced prestige which the Society obtained thereby, had the desired effect, and by the beginning of the nineteenth century the Society had attracted more than two hundred members.

Smith, though absent from London, remained president of the Society for forty years, until his death in 1828, when his executors offered to sell to the Society the collections and library of Linnæus, together with other specimens and books acquired by Smith, for the sum of £5,000. With great difficulty, but with superb courage, the Society managed by various expedients to raise the necessary funds and thus regained possession of the collections, the free use of which, while their president lived in London, had formed a centre of attraction for the fellows and had inspired the name of the Society.

There were other difficult times to live through. The hiving off (in 1826) of the Zoological Society no doubt took away some members and prevented some potential ones from joining, though the main object of the new Society was the maintenance of a Zoological Garden rather than the furtherance of scientific zoology. This is indicated by the election of Thomas Bell, professor of zoology at King's College, to the presidency of the Linnean Society in 1853, though he was for eleven years a vice-president of the Zoological Society. Incidentally, it may be mentioned that he was one of the most active presidents the Society has ever had. He introduced the idea of annual presidential addresses and also the discussion of papers after they had been read at the general meetings.

Other critical periods were due to internal dissention on questions of procedure and some on policy, as when the admission of women to the Society was being urged and ultimately agreed upon in 1904. In connexion with this innovation, Colonel Gage shows conclusively that it was not made, as has been suggested, with a view of improving the finances of the Society.

The continued prosperity of the Society may be summed up in the words, slightly altered, which the president Carruthers used when referring to the centenary meeting. "The story of the Linnean Society during the last 100 years is the history of Biology". The names of such leading fellows as James Edward Smith, Robert Brown, Bentham and Hooker, Wallace and Darwin, and all they stood for, more than justify the existence of the Society Its future prosperity and usefulness depend upon its power to adapt itself to new conditions and to the further development of the biological sciences. Colonel Gage does not merely praise the past, he is rightly critical of many actions of former presidents and councils, and future members of the latter will do well to study the history now under review. It may enable them to avoid possible difficulties, and in addition they will find much valuable information in the later chapters of the history, which deal with the publications, the library and the finances of the Society.

The future fellows of the Society, like the present ones, will, we are sure, be deeply grateful to Colonel Gage for his careful and painstaking history, carried out with courageous determination in spite of considerable set-backs due to ill-health. It will remain an enduring memorial of the handiwork of a faithful and discerning fellow of the Society.

Reports of the Progress of Applied Chemistry

Issued by the Society of Chemical Industry. Vol. 22. Pp. 818. (London: Society of Chemical Industry, 1937.) n.p.

THIS annual volume fully maintains the high standard which chemists and chemical manufacturers have learned to expect. It is presented in the traditional form of sectional reviews on the principal branches of applied chemistry, fully documented by reference to the relevant technical literature and patent specifications, and to abstracts thereof published by the Bureau of Chemical and Physiological Abstracts. The series is therefore almost indispensable to anyone taking an active interest either in the progress of chemistry or in the advancement of any branch of industry which involves the use of chemical operations, a knowledge of the chemical composition or behaviour of materials, or the employment of chemists for control or research. Further, it is a convenient guide-book in the hands of those who wish merely to take a bird's-eye view of modern technology in its chemical aspects.

The present issue deals, *inter alia*, with fuels, with dyes and textiles; with paper, glass, cement, steel, drugs, oils, paints, rubber, leather, sugar, and soil; with foods and water; with electrochemistry and photography. Explosives, which are treated biennially, do not appear in this volume. The section dealing with bleaching, dyeing, printing, and finishing has this year been incorporated with that on fibres, textiles, and cellulose, the combined chapter occupying between eighty and ninety pages.

Name and subject indexes are provided.

A. A. E.

Fermente, Hormone, Vitamine:

und die Beziehungen dieser Wirkstoffe zueinander. Von Dr. Robert Ammon und Dr. Wilhelm Dirscherl. Pp. xvi+451. (Leipzig: S. Hirzel, 1938.) 30 gold marks.

EULER has classified the hormones and vitamins together as "ergones", and has laid stress on the fact that ergones may act as coferments. The best examples are vitamins B_1 and B_2, which are important parts of the molecules of cocarboxylase and Warburg's yellow ferment. It seems probable that many ergones may act by influencing enzymes. The authors of the present book class together as "ergines" all the organic substances which act in small doses—enzymes, hormones and vitamins. These groups interact in many ways and are conveniently considered together.

The book is written from the point of view of the biochemist, but clinical observations are also discussed. Authorities are not quoted with full references; but the author's name and the year are usually mentioned, and there should be no serious difficulty in tracing the originals. The book contains much information and is usually fairly accurate, but uncritical. The vasodilator substances which are found in tissue extracts are included as *Gewebshormone*. The work of Rowntree and his collaborators on the thymus is not mentioned.

Land of Ice and Fire

By Hans Wilhelmsson Ahlmann. Pp. xiii+271+16 plates. (London: Kegan Paul and Co., Ltd., 1938.) 12*s*. 6*d*. net.

THE Vatna Jökull of Iceland, with an area of well over three thousand square miles, is larger than any other glacier in Europe. It is rugged, crevassed and even chaotic in parts, and is associated with an undue share of fog, wind, snow and rain. The heavy precipitation and the extensive ablation make it an area of important investigation into the relations between the growth and wastage of glaciers. From time to time it has been crossed, notably in 1932, when the Cambridge expedition, which is not mentioned in this book, made a double traverse.

Prof. Ahlmann's Swedo-Icelandic expedition of 1936 was designed to penetrate the eastern interior of the ice sheet, chiefly in order to measure growth and wastage. This entailed the digging of pits in which the thickness of each year's accretion could be seen and the planting of surface posts against which wastage could be noted. It is not an easy area in which to travel, and in Prof. Ahlmann's book the task loses nothing of its reputation for difficulty, but there were some fine days and on the whole the expedition achieved its aims, though this book does little more than touch on the conclusions.

However, the work of the expedition was not confined to Vatna Jökull. Several other parts of Iceland were visited, and there is much of interest in the account of peasant life in Iceland and the struggle with adverse soil and climate that Icelandic agriculture and stock raising have to face. These chapters give a good picture of modern Iceland. It is a pity that the translation from the Swedish is somewhat laboured and in places lacking in idiomatic English usage. The photographic illustrations are excellent, and the map, though rather meagre, serves its purpose.

R. N. R. B.

The Dissection and Study of the Sheep's Brain:

as an Introduction to the Study of the Human Brain. By James Wilkie. (Oxford Medical Publications.) Pp. xvi+95. (London: Oxford University Press, 1937.) 6*s*. net.

THE object of this little work, as stated in the preface by the author, who is attached to the department of biology at Guy's Hospital Medical School, is "to enable the student of comparative anatomy to use the text books of human anatomy; and to help the medical student who wishes to improve his knowledge of the anatomy of the brain, or to begin the study of the human brain with a certain background of comparative anatomy".

The book is divided into five chapters, devoted respectively to removal of the brain, its general anatomy, the first dissection in which a general study is made of the cerebral hemispheres, cerebellum and brain stem, the second dissection, and hand sections.

The text is liberally interspersed with diagrams of the human brain as well as that of the sheep, and is provided with a full index.

Disorderly Molecules and Refrigerating Engineering*

THE many facets of the jewel of truth are only too often exposed in a sequence that is bewildering but, even so, it is not often that succeeding facets reflect such dissimilar beams as at first sight to seem to demand the ascription of conflicting virtues to the body of the jewel behind. Sir William Bragg, giving the James Forrest Lecture last year, dealt with the orderly arrangement of the atoms within crystals: Sir Frank Smith, the lecturer for this year, was concerned to demonstrate how the disorderly or random nature of the molecular motions within a substance make it possible for chemical actions on one hand, and the refrigeration industry on the other hand, to exist.

Accepting the identity of the motion of molecules with heat and the corollary that the temperature of a body is a measure of the intensity of their translatory movement, Sir Frank pointed out, in illustration, that if at a given moment the molecules in the air in the lecture theatre were all to be in simultaneous collision with each other, the temperature of the air would drop to absolute zero. Incidentally, under the influence of the gravitational pull, they would fall to the floor. With his assertion that the attainment of very low temperatures has been one of the great scientific advances in recent years, few—and certainly no engineer—would disagree: the knowledge gained of the motion of liquid molecules and of the evaporation of liquids has found widespread application at more elevated temperatures in many fields, of which refrigerating engineering in particular is the obvious example.

Sir Frank Smith purposely refrained from embarking on a historical résumé of low-temperature work, and from employing a mathematical treatment or the empiricisms of Boyle's Law or its various refinements to explain the phenomena he was considering. Instead, he tried to make his approach solely from considerations of the general nature of atoms and molecules, their movements and their interactions. Assuming only that atoms consist of charged nuclei surrounded by electron shells, he proceeded to consider in general terms what might be expected to happen in a collision between two similar atoms. The collision would inevitably set up some, probably electromagnetic, stress and if the collision were such that, for a moment of time, both were brought to a standstill, then the kinetic energies of each of the atoms would disappear and the electromagnetic stresses would simultaneously reach their maximum values. Afterwards, the stressed systems would cause repulsion to take place and the atoms would then move away from one another. However, in addition to this force of repulsion effective at distances comparable with molecular diameters, there is a general force of attraction between atoms and molecules which he suggested might be of the nature of electromagnetic induction. These forces and their resultant were shown graphically, plotting nuclear distances against the force exerted, and it was shown that the curve embraces the solid, liquid and gaseous states and that it indicates that increase in the temperature of a substance will cause expansion. The slope of the curve at zero force is a measure of the elasticity of the material, and the maximum value of the 'resultant' force indicates the maximum force which can be applied without rupture to the substance in the solid form. The value of the nuclear distance at this point represents the ideal elastic limit of the substance; but, in practice, factors introduced by the presence of impurities or other causes modify the attainable elastic limit and rupturing force.

Attention was then directed to a consideration of the Joule-Thomson effect. In every gas there are two effects on expansion, one tending to lower and the other to raise the temperature. The cooling effect depends on the degree of separation of the molecules, and the heating effect depends on molecular collisions, increasing with increase of temperature. At sufficiently high temperatures the net effect is to produce a rise in temperature, at the inversion point there is no change and below it there is a fall in temperature on expansion. Liquefaction of air by compression alone is impossible at ordinary temperatures, and preliminary cooling to below the critical temperature is necessary, although by the use of a cold regenerator or heat-exchanger the need for very high pressures and very low initial temperatures is made unnecessary.

After a brief explanation of the Claude expansion method of refrigeration, Sir Frank Smith passed to the production of relatively pure atmospheric gases by rectification (or the separation of the various constituents of liquid air by making use of their different boiling points) and indicated various commercial uses of the gases so obtained. The same method is applied to water gas and coke-oven gas and can be, and sometimes is, used commercially to produce relatively pure hydrogen.

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* Account of the James Forrest Lecture delivered by Sir Frank Smith, K.C.B., F.R.S., before the Institution of Civil Engineers on May 3.

These methods have been used under suitable conditions to attain temperatures less than 1° K., but, while it is admitted that it is most improbable that the absolute zero of temperature will ever be reached, advantage has been taken of the magnetic properties of matter to approach it very closely. The phenomena we know as magnetism are due to the existence of atomic magnetic dipoles which, in a magnetic field, are pulled in the direction of that field. The motion of the atoms which is associated with heat resists this pull, and so the resultant magnetic field depends on the temperature as well as on the intensity of the applied magnetic field: the higher the temperature, the less the magnetization. In general, the magnetic dipoles become arranged in orderly fashion at comparatively high temperatures, but there are a few substances, such as iron ammonium alum, in which random orientation still exists at very low temperatures. When such substances are at the lowest temperature attainable by the methods already described, application of a magnetic field modifies the dipole directions and heat is developed. This heat is slowly absorbed by the cold surrounding surfaces, and when the original low temperature has been restored the magnetic field is removed. The dipoles then tend to revert to their previous random orientation and, in so doing, absorb heat, so that the temperature drops. By making use of this effect, a temperature as low as 0·003° K. has been reached.

Turning back from very low temperatures, a pause was made to consider in some detail the mechanism of the evaporation of liquids. Maxwell's law of distribution shows that at any time some molecules are moving with a velocity ten or twenty times greater than that of others. Such fast-moving molecules are the ones which escape from a liquid, and in so doing they tend to lower the average velocity, and hence the temperature, of the remainder. Equally, it is the fast-moving molecules of vapour which tend to re-enter the liquid and increase the average velocity of the molecules there. This counter-effect produces a heating of the liquid. The actual temperature of the liquid will thus be determined by an algebraic summation of these two effects and in order, on balance, to produce cooling it is necessary to eliminate the 'counter-effect' by removing the molecules of vapour as soon as they leave the liquid. By this device, quite low temperatures may be attained.

This effect is the basis of most modern commercial refrigeration machines. Even a century ago, Faraday reached a temperature of 160° K. by evaporating a liquid under an air-pump and to-day, by using helium, a temperature of 1° K. may be attained. Present refrigerating practice utilizes substances (principally ammonia and carbon dioxide) which are vapours at ordinary temperatures and pressures and can be liquefied by subjection to increase of pressure but without preliminary cooling: atmospheric temperature is well below their critical temperatures. It is necessary, therefore, that any pumping mechanism should not only exhaust the vapours from the upper surface of the liquid but should also be able to compress them. When compressed, the gas molecules are brought closer together and the heat produced is extracted by cold water surrounding the compression chamber. The attractive force between the gas molecules becomes greater and greater as the pressure is increased and eventually the substance liquefies. This cold liquid is passed through an expansion- or throttling-valve, and at the same time the pressure to which the liquid is subjected on emergence from the valve is so reduced by suction that the liquid boils. Brine which is circulating around this chamber is therefore cooled and then passes through pipes and tanks as may be desired. It is part of the process to collect the vapours removed from the expansion chamber and to recompress them so that they undergo a continuous process of compression and expansion, liquefaction and evaporization.

Refrigeration engineering now finds application not only to the production of ice and, extensively, to the transport and storage of food of many kinds, but also to the cold storage of bulbs, the conditioning of air for public rooms, cold depositories for furs, carpets and many textile goods, the production of ice in skating-rinks and the freezing of ground for shaft-sinking and tunnelling in water-logged strata.

Whereas, sixty years ago, there was no refrigerating machine and certainly no cold storage provided in ships, to-day the refrigerated space in ships bringing food to Great Britain alone amounts to not less than 100 million cubic feet, equivalent—as it was rather strikingly put—to a single cold store as wide as Victoria Street, London, 20 feet high and 13 miles long. No fewer than thirty countries contribute to our food supply by the help of refrigeration, and it may truly be said that our food can now be practically independent of the seasons.

In very low temperature work, however, progress has not been so rapid, and Sir Frank Smith confessed to a hope that engineers might be persuaded to take an active interest in the problems involved, and commended to his audience the work in progress in the laboratories at both Oxford and Cambridge.

H. W.

Some Aspects of Chemical Kinetics in Gaseous Reactions*

By Dr. H. W. Melville

SINCE the realization, half a century ago, that free energy furnishes an exact criterion for the direction in which chemical changes occur, the control of such processes to the desired end-point is easily accomplished. Indeed this is one of the main functions of chemical thermodynamics. That knowledge, however, provides absolutely no information about the nature and speed of the interactions between molecules. Moreover, in view of the fact that the control of reaction rate is not less important than the production of the specified products, an understanding of the mechanism of reaction is an essential complement to a knowledge of free energy change.

Although chemical kinetics and thermodynamics both came into being practically simultaneously, the latter science soon forged ahead. The reason is not far to seek. Most reactions were studied in the liquid phase, in spite of the fact that there was and still is no satisfactory kinetic theory of liquids. But when an intensive study of gas reactions was commenced about ten years ago, aided by the kinetic theory of gases, material progress soon became evident. Although the subject is still in active state of development[1], it would appear that the broad principles are now firmly established.

No matter how complicated a gaseous reaction may be, it consists essentially of a very few collision processes. For purposes of classification four such processes may be distinguished, namely, unimolecular, bimolecular, trimolecular reactions and collisions in which there is a specific transfer of large amounts of energy between dissimilar molecules. The relationship between the absolute velocity of these reactions and the energy changes involved is now sufficiently well understood to enable predictions to be made regarding new reactions falling into one of the several classes. Thus by suitably altering the conditions under which the reaction takes place, it is possible to isolate and identify the elementary processes, so that some conclusions may be drawn about the chemical constitution of the entities taking part. The greater volume of current work in kinetics is directed towards this goal, thereby making the subject extensive. Only a few of the more recent developments can be mentioned in this article.

One of the most important developments is the use of isotopes of the common elements in tackling certain problems unassailable by conventional methods. For example, if phosphine is irradiated with ultra-violet light, only one molecule is decomposed for every two quanta absorbed, although the absorption spectrum of the molecule indicates that each quantum on absorption dissociates the molecule thus: $PH_3 \rightarrow PH_2 + H$. It was suspected that the recombination $PH_2 + H \rightarrow PH_3$ was responsible for the low quantum yield. This was at once proved[2] by adding deuterium to the phosphine, when deuterium atoms are produced by the reaction $H + D_2 \rightarrow HD + D$, followed by $D + PH_2 \rightarrow PH_2D$, the phosphine thus becoming 'heavy'. The question then arises about the fate of the PH_2 radical. It may decompose to a P atom and an H_2 molecule or it may interact with another of its kind, thus $H_2P + PH_2 \rightarrow P_2 + 2H_2$. If a mixture of PH_3 and PD_3 is decomposed, H_2 and D_2 molecules will be produced in the first mechanism, whereas in the second H_2, HD and D_2 molecules will appear. In point of fact HD molecules are present in their equilibrium amount in the hydrogen gas. Similar experiments give a clue to the mechanism of the photodecomposition of ammonia.

Likewise the possibility of following exchange reactions, such as the rate of formation of HD molecules from $H_2 - D_2$ mixtures or the rate of conversion of para to normal hydrogen, provides important evidence about the nature of the rate-determining step in heterogeneous reactions involving hydrogenation and dehydrogenation. For example[3], in the hydrogenation of ethylene to ethane on a nickel catalyst, a purely kinetic analysis cannot provide any indication whether the dissociation of hydrogen is the rate-determining step. Actually, in absence of ethylene the hydrogen is dissociated far faster than the ethylene is hydrogenated, whereas in presence of ethylene at temperatures around 100° C., dissociation is inhibited altogether. In other words, the hydrogen probably gains access to those parts of the nickel surface not covered with ethylene, is dissociated there and immediately hydrogenates the ethylene. At higher temperatures, the surface becomes denuded of ethylene, when dissociation of hydrogen proceeds more quickly than hydrogenation, owing to the fact that hydrogen atoms then have an opportunity of recombining and so returning to the gas phase. Again, in the exchange reaction, $D_2 + CH_4 \rightarrow CH_3D + HD$[4], a similar technique showed that the dissociation of hydrogen was not the rate-determining step. The following alternatives are open: (*a*) the reaction of a D atom with a methane molecule adsorbed as such, $D + CH_4(ads.) \rightarrow CH_3D + H$, or (*b*) the dissociation of methane followed by the reaction $CH_3 + D \rightarrow CH_3D$. The decision in favour of the second alternative was reached by measuring the rate of interaction of CH_4 and CD_4 molecules to give methanes of intermediate D-content, CH_3D, CH_2D_2, CHD_3, when it was found that the latter reaction went at approximately the same speed as the exchange reaction.

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*Substance of a series of afternoon lectures delivered at the Royal Institution on February 17 and 24 and March 8.

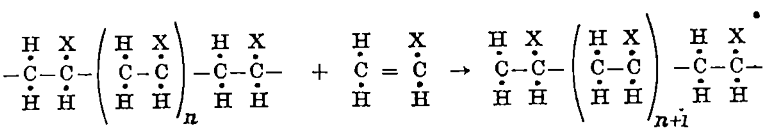
The homogeneous exchange reactions of deuterium atoms with hydrides have also brought under discussion a number of points regarding interactions in simple systems. Here there are two possibilities: (*a*) a simple exchange reaction, $D + HX \rightarrow DX + H$ or (*b*) a dehydrogenation reaction $D + HX \rightarrow HD + X$. Examples of both types are known and appear to fall into a general classification[5]. The simple hydrides of the fourth group are all dehydrogenated, namely, CH_4, SiH_4, GeH_4, whereas NH_3, PH_3, OH_2 and probably ClH exchange atoms without dehydrogenation. With the more complicated hydrides such as C_2H_6, Si_2H_6, N_2H_4, decomposition to simpler fragments CH_4, NH_3 appears to be the general rule. Recent theories[1] of reaction rates have shown that the activation energy required is controlled by the dissociation energies of reactants and products, the internuclear distances, the anharmonic constants of the molecular vibrations and the ratio of Coulombic to exchange forces between the atoms. Hence it is extremely difficult even to predict whether exchange or dehydrogenation will take place in any given instance. The behaviour of CH_4 on one hand and NH_3 on the other might, however, be accounted for in the following way. NH_3 may form a complex NH_3D, such as is supposed to exist in ammonium amalgam. This complex, although of transitory existence, as is known from the fact that ammonia has no influence in reducing the stationary concentration of atomic hydrogen, afterwards decomposes, when any one of the four bonds may break. With methane there is no possibility of forming such a complex; hence if the deuterium atom is to react at all, it can only do so by abstracting a hydrogen atom from the molecule.

It is to be emphasized that the activation energies of the exchange reactions range from about 7 to 14 k.cal., whereas the energy required to sever a hydrogen bond in the hydride is of the order of 100 k.cal. The difference in the two values must be ascribed to what has been termed 'driving force' in chemical reactions[6]. Consider the simple interchange $D + XH \rightarrow DX + H$, then the maximum possible activation energy, that is, the potential energy which the system has to acquire, is the energy dissociation of HX. When a D atom is pushed up towards HX, repulsive forces come into play while there is a simultaneous increase in nuclear separation of HX. On continuing the process, however, a stage or transition state is reached when the attraction between X and D is equal to that between X and H. The system may then revert to its original or final state without having to acquire further potential energy. The rate of this latter process, multiplied by the number of systems in the transition state, determines the rate of reaction. Although the state is essentially one of unstable equilibrium, many attempts[1] have recently been made to compute by the methods of statistical mechanics the concentration of systems in this state. While the results are often roughly in quantitative agreement with experimental measurements, it seems that, owing to lack of precise data, the method is not more accurate than that of the classical collision theory of reactions. What it does provide, however, is a picture of the more intimate details of a chemically effective collision—a process necessarily neglected by the older theory.

Another important outcome of the study of isotopic reactions is the estimation of the part played by the half quantum of residual vibrational energy postulated by quantum theory. All reactions of deuterides are slower than the corresponding changes with hydrides, owing mainly to the lower energy of activation of the latter reaction[5]. Since the vibrations of such molecules are not appreciably excited at reaction temperatures—20°–600° C.—the vibrational energy of molecules consists only of residual energy. In deuterides the vibration frequency is lower than that in hydrides, hence the residual energy is lower. Consequently, in order that the system should reach the transition state, a larger energy is required for the deuterium reaction with a corresponding decrease in reaction velocity. Again, theory and experiment are in qualitative agreement, although an increase in accuracy on both sides is to be desired.

On the more strictly classical side, methods of reaction kinetics are being applied to study polymerization reactions in the gas phase. Suitable examples are difficult to find. In fact there are scarcely any true thermal gas polymerizations known, and it is consequently necessary to start the reaction catalytically or photochemically. At present the latter method is the more useful and has been employed in investigating the mode of growth of polymers from ethylene derivatives The conditions under which polymerization occurs are well defined. Ethylene and all monosubstituted ethylenes of the general formula $CH_2 = CHX$, where X may be halogen, C_6H_5, CN,

$COOCH_3$, etc., polymerize. Likewise, disubstituted derivatives $CH_2 = CXY$, where X is similar to or identical with Y also aggregate readily, but if X or Y is transferred to the other carbon atom, thus $CHX = CHY$, polymerization is completely prevented. For example, methyl methacrylate $CH_2 = C.(CH)_3COOCH_3$ readily polymerizes; methyl crotonate refuses to do so[7]. The precise explanation of these facts has not yet been discovered. When polymerization is initiated photochemically, the radiation invariably enters the molecule by the X or the Y group and thereby renders the double bond reactive. If a short enough wave-length is employed—around 2000 A.—where the double bond itself exhibits absorption, then the energy of the quantum is so big that the molecule is often broken up and very little polymerization can be detected. The nature of the initiation process also raises the question of the mechanism of growth. In view of the fact that one quantum will polymerize, in some instances, a thousand molecules of monomer, it is evident that, once a molecule is activated, monomer molecules add on comparatively readily. The question which arises is whether the growth occurs through (*a*) the intermediacy of a free radical, or (*b*) by the so-called double bond mechanism.



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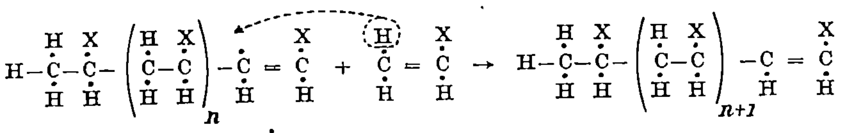
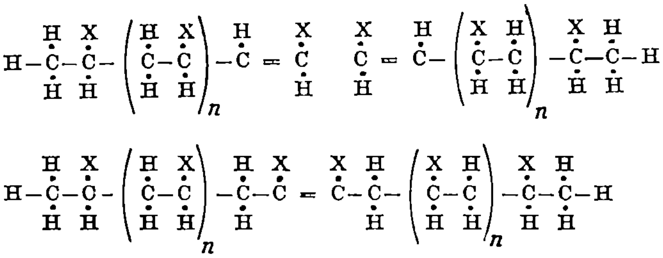


$$H-\overset{H}{\underset{H}{C}}-\overset{X}{\underset{H}{C}}-\left(\overset{H}{\underset{H}{C}}-\overset{X}{\underset{H}{C}}\right)_n-\underset{H}{C}=\overset{X}{\underset{H}{C}} \;+\; \overset{H}{\underset{H}{C}}=\overset{X}{\underset{H}{C}} \rightarrow H-\overset{H}{\underset{H}{C}}-\overset{X}{\underset{H}{C}}-\left(\overset{H}{\underset{H}{C}}-\overset{X}{\underset{H}{C}}\right)_{n+1}-\underset{H}{C}=\overset{X}{\underset{H}{C}}$$

(*b*)

A method of discriminating between the two mechanisms is by intentionally making a free radical by generating, photochemically, H atoms or methyl radicals. These react with the monomer to form $CH_3-\overset{H}{\underset{H}{C}}-\overset{X}{\underset{H}{C}}-$. With some molecules, for example, methyl methacrylate, $CH_2 = C.(CH)_3.COOCH_3$, the normal photopolymerization and the radical-induced polymerization have quite different characteristics. In the radical polymerization, the reaction occurs wholly in the gas at a rate proportional to the square root of the intensity of the light and is completed within 10^{-3} sec. when two growing polymers come into collision. On the other hand, in the normal reaction the polymerization certainly starts in the gas phase but continues on the walls of the reaction vessel, when the light is switched off, for hours and even days. The maximum dark rate is proportional to the area of the vessel illuminated and is independent of the intensity of illumination. There can therefore be no doubt that the normal growth occurs by the double bond mechanism.

This does not explain why the molecule keeps on growing indefinitely. An explanation for the reason of this behaviour is obtained when methyl acrylate is examined. This polymer does not grow indefinitely. It dies soon after polymerization has proceeded to some considerable extent in the gas phase. Its death is due to a collision between two growing polymers thus:



$$H-\overset{H}{\underset{H}{C}}-\overset{X}{\underset{H}{C}}-\left(\overset{H}{\underset{H}{C}}-\overset{X}{\underset{H}{C}}\right)_n-\overset{H}{C}=\overset{X}{\underset{H}{C}} \quad \overset{X}{\underset{H}{C}}=\overset{H}{C}-\left(\overset{X}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}\right)_n-\overset{X}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$$

$$H-\overset{H}{\underset{H}{C}}-\overset{X}{\underset{H}{C}}-\left(\overset{H}{\underset{H}{C}}-\overset{X}{\underset{H}{C}}\right)_n-\overset{H}{\underset{H}{C}}-\overset{X}{C}=\overset{X}{C}-\overset{H}{\underset{H}{C}}-\left(\overset{X}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}\right)_n-\overset{X}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-H$$

involving the simultaneous migration of two hydrogen atoms. If two methacrylate polymers were to interact in this way, two methyl groups would have to migrate—a rather improbable process. The long life of the methacrylate polymers is apparently due to the immobility of a methyl group. The methacrylate polymer can, however, be stopped growing by hydrogenating the end of the molecule by atomic hydrogen.

Kinetic methods also permit of the determination of the molecular weight of a polymer produced photochemically. The obvious method of computing the molecular weight by multiplying the number of molecules polymerized per quantum absorbed by the molecular weight of the monomer is based on the unjustifiable assumption that each quantum absorbed starts off a chain. A more satisfactory method consists in discovering a suitable inhibitor, one molecule of which (in the inhibited photo-reaction) adds on to each chain started, thereby stopping growth. The ratio of molecules polymerized to molecules of inhibitor consumed then gives the chain length of the inhibited and therefore that of the normal reaction Butadiene has been used in this way for methyl acrylate polymers.

The question of the estimation of the cross-linking of polymer chains is still an outstanding problem in this branch of the subject, as the method hitherto available for computing branching in ordinary explosive chain reactions is not applicable in the present instance.

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The Spring Drought in the British Isles

By E. G. Bilham

THE spring of 1938 has been rendered memorable in the British Isles by a remarkable sequence of meteorological events, the results of which have been disastrous to the horticultural and farming sections of the community. The main purpose of this article is to furnish data in regard to the drought, but it is important to realize that the deficiency of rain, unprecedented as it has been, is only one aspect of a singularly unfavourable meteorological complex. Thus the fruit growers would probably have made little complaint about the drought if they had been spared the frosts of April and early May, following upon an exceptionally mild March in which all vegetation made rapid growth. Incidentally, March and April have provided an example of the untrustworthiness of the generalization that the rainfall of the British Isles is related to the direction of the prevailing wind; in March we had a great shortage of rainfall and the winds were persistently south-westerly; in April we also had a very dry month and the winds were persistently north-easterly.

The period of exceptional rainfall deficiency began in February, following upon a wet January. In February pressure exceeded the normal by about ten millibars in all parts of the British Isles, and as is usual when anticyclonic conditions predominate, rainfall was markedly below normal, though there was an excess in the west and north-west of Scotland, and in small areas in Yorkshire and south-west Ireland. At Kew Observatory the total fall for the month was only 0·31 inch, or 20 per cent of the normal. The general fall over England and Wales, deduced from the observations at a selection of representative stations, was 1·34 inches, or 52 per cent of the normal. For Scotland, the percentage was 80, for Ireland 66, and for the British Isles as a whole, 62.

The corresponding values for March and April, and for the whole period February to April, are included in the accompanying table. It will be seen that March was very decidedly drier than February in England and Wales, though Scotland had nearly the normal rainfall. The drought was particularly severe in the western Midlands, and at Ross-on-Wye the total for the month was no more than 0·02 inch, the smallest total for March in records going back to 1859. On the other hand, exceptionally heavy rains occurred in parts of western Scotland. At Loan (Loch Quoich), in Inverness-shire, the total for March was no less than 50·03 inches, one of the largest monthly totals ever recorded anywhere in the British Isles.

GENERAL RAINFALL OF THE BRITISH ISLES, FEBRUARY TO APRIL, 1938

	England and Wales	Scotland	Ireland	British Isles
February Per cent of normal	1·34 in. 52	3·34 in. 80	2·33 in. 66	2·02 in 62
March Per cent of normal	0·72 in. 27	3·93 in. 97	2·18 in. 65	1·67 in 52
April Per cent of normal	0·28 in 13	1·02 in. 34	0·20 in. 7	0·43 in. 17
Total Per cent of normal	2·34 in. 32	8·29 in. 74	4·71 in 49	4·12 in. 45

Although the total fall for February and March was exceptionally small in many areas, the drought had not achieved a record-breaking character at that stage. For England and Wales, the general fall in the two months was 2·06 inches, and we only have to go back ten years to 1929 to find a substantially smaller fall, 1·60 inch, in the same two months. April, however, brought a very great and general intensification of the shortage. With a general fall of no more than 0·43 inch over the British Isles as a whole, it was not only the driest April in our annals, but also the driest month of any name of which we possess records. The general rainfall was, however, only slightly exceeded in February 1891, June 1925 and February 1932.

For England and Wales the percentage of normal was 13. So far as our information goes, only three previous Aprils have yielded percentages less than twenty; namely, those of 1817 (16 per cent), 1893 (18 per cent) and 1912 (15 per cent). April 1893 was remarkable for having yielded no rainfall at all over a large area in south-east England. April 1938 achieved that distinction at only a few stations; the main feature was the widespread distribution of the drought. The very small percentage of normal, 7, in Ireland is particularly striking. No previous April has produced anything like such a deficiency in that area.

The total rainfall of the three months February to April 1938 amounted in England and Wales to 2·34 inches, or 32 per cent of the normal. No previous combination of three successive months has yielded so small a total since comparable evaluations began in the year 1870. It is possible to carry the comparison back for more than another century, with some approach to certainty, by referring to a series of estimates of general rainfall percentages by Dr. J. Glasspoole and Miss F. J. Nicholas published in *British Rainfall*, 1931. From these estimates it appears that a comparable period occurred in 1785, when the combined total for February to April amounted to about 2·1 inches. No more recent sequence of three months has been drier than that experienced this year.

To the natural question "why?", we can only reply at the moment that the dry weather was due to an exceptional persistence of anticyclonic conditions, combined in April with a prevalence of north-easterly winds. At the present stage of our knowledge of the causes of seasonal weather changes, the reasons for such persistence cannot be clearly made out; still less can they be foreseen. It has long been realized that the investigation of such problems demands a study of meteorology on a world-wide scale, and we may recall that the exceptional summer of 1911 provided the initial incentive which led to the regular publication of the collection of world weather statistics known by the name of the *Réseau Mondial*. If the harvest has not yet been garnered, we may, however, derive some satisfaction from the fact that there are many workers in the field, and also from the fact that some degree of success has rewarded the essays in 'seasonal foreshadowing' made in India and elsewhere.

Obituary Notices

Mr. J. E. Marsh, F.R.S.*

THE numerous friends and old students of James Ernest Marsh will have learned with regret of his death on April 13 at the age of seventy-seven years. He was one of the few remaining chemists whose most active period of work belongs to last century, having been University demonstrator in chemistry at Oxford from 1886. In my undergraduate days, 1896–98, Marsh in organic chemistry and V. H. Veley, who died at just the same age in 1933, in inorganic chemistry, were almost the only ones in Oxford keeping the flag flying as regards original work in the subject.

Marsh's influence on me started, indeed, at school, under R. E. Hughes, science master at Eastbourne College, who, whilst at Jesus College, had worked with Marsh, and was still being provided by him with materials and help in its continuation. Few schoolboys certainly can have prepared camphoryl chloride. But I still have a vivid recollection of carrying out this preparation on a large scale in the open playing field, adjoining the school laboratory, from camphoric acid and phosphorus pentachloride, and of the traditional 'torrents' of hydrochloric acid gas evolved. That, to a schoolboy, was the joyous beginning of a lifetime admiration.

At that time Marsh was deeply immersed in the study of camphor and the related group of terpenes. The problem of the constitution and synthesis of camphor was then very much to the fore, and some of the most eminent chemists, including the late Prof. W. H. Perkin, were engaged on it. In conjunction with his students, notably J. A. Gardner and A. Hartridge, Marsh published about twenty important papers in this field between 1889 and 1910, in the first of which he had suggested for camphor a highly original structural formula. Although this was ultimately disproved in favour of one propounded by Bredt in 1893, he made, in the course of the work, many interesting and important discoveries. The stereochemistry of this group led to great advances in our knowledge of that subject, and Marsh himself was the first to obtain, for the case of camphoric acid, *optically active* stereo-isomers of the *cis* and *trans* variety associated with the ring structure.

At this time Marsh was an acknowledged leading authority in the field of stereochemistry, and his lectures on the subject, drawing his illustrations and examples from this field, and many others such as the sugars, then undergoing intensive study, were most inspiring and threw an interesting light over the whole field of organic chemistry. Another topic on which he used to lecture regularly was the history of chemistry. In 1929 he collected in a book entitled "The Origins and the Growth of Chemical Science" his main conclusions, the chief of which was that the earlier work on salt formation and the fixation of gases by the British chemists, Boyle and Black, were the real beginning of the subject as a science rather than the later work of Lavoisier on combustion to which it is often ascribed.

In later years, largely with R. de J. F. Struthers, Marsh worked much on the numerous curious and interesting complexes formed by certain compounds of mercury with organic solvents and radicals, now ascribed, in the modern theory of valency, to the unique character of mercury among the metals and its power of forming covalent linkages of unusual type.

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Another subject that attracted Marsh was the preservation of stone from decay, and in 1926 he wrote a highly original little monograph on the subject entitled "Stone Decay and its Preservation". Finding in decayed stone from diverse localities the presence of nitrates, he concluded that the decay was due to forms of life in the stone, such as the micro-organisms known to exist in it. The treatment to preserve it should aim at sterilizing it and keeping it sterile. The book concludes : "All that is recommended is to keep the walls of a building clean and thus prevent them from becoming nests of living organisms". In the last conversation I had with him, he discussed the chemistry of taste and was then working upon it.

Marsh was educated at Rugby and Balliol, studied also both in Germany and Paris, and for a short time was lecturer in materia medica in Oxford. He was made a fellow of the Royal Society in 1906, and served on the council of the Chemical Society in 1902–7. He was married in 1903 and leaves a widow and five daughters. In 1906, when forty-six years old, he astonished everyone by winning by examination an open prize fellowship at Merton College, which he held up to 1930, and during it filled for a time the office of sub-warden.

In his younger days Marsh was an intrepid yachtsman, and in company with one of the three Lynam brothers used to take long voyages in their small yacht among the Hebrides and even out into the open Atlantic. Inquiring for him in 1901 at Oban, knowing his intention of attending the British Association meeting at Glasgow that year, I found the local waterman in considerable anxiety, as nothing had been heard of the yacht or its crew for many weeks. He loved the Scotch crofters and liked to get right away among them and to share their mode of life. Though to unsympathetic people he may not have troubled much to make himself agreeable, he was essentially very human and lovable, and those who worked with him and were admitted to his friendship will cherish his memory with deep affection and loyalty. FREDERICK SODDY.

Captain R. S. Rattray, C.B.E.

We record with deep regret the death of Captain R. S. Rattray, distinguished as an anthropologist and authority on the native peoples of West Africa, who was killed in an accident while gliding at Farmoor, near Oxford, on May 14, at the age of fifty-six years. Captain Rattray was acting as pilot of the Oxford University and City Gliding Club, which he himself had founded only a week before.

Robert Sutherland Rattray was son of the late Mr. A. Rattray of the Indian Civil Service, and grandson of the late Robert Haldane Rattray, Chief Justice of Bengal. He was educated at Stirling High School and Exeter College, Oxford, holding the diploma of his University in anthropology, and the degree of D.Sc. He was *Officier d'Académie* of France, and was called to the Bar by Gray's Inn in 1914. In the South African War he served as a trooper, receiving the Queen's medal with five clasps. In 1902 he entered the service of the African Lakes Corporation, British Central Africa, serving until 1907, when he entered the Colonial Civil Service on the Gold Coast. He became an assistant district commissioner in 1911, and thereafter held various administrative appointments, until in 1920 he was acting senior assistant Colonial Secretary and clerk to the Legislative Council. During the Great War he served in Togoland, being district political officer during the Anglo-French occupation in 1914–17. For his services he received the M.B.E. and was advanced to C.B.E. in 1929.

In 1924 Rattray was made head of the recently formed Anthropological Department in Ashanti. It is in connexion with Ashanti that Rattray's name will longest be remembered. He had already made some notable contributions to the study of the customs and folk-lore of West Africa, when soon after his appointment as Government anthropologist he published his "Ashanti" (1924). This was the first of a series of volumes, in which he made a comprehensive and detailed study of Ashanti social organization and law, art and religion. Much interest was aroused by his unravelling of the story of the Golden Stool of the rulers of Ashanti, which, long familiar to the British public, had been a mystery completely misunderstood, even by many whose position demanded more accurate information. This matter was certainly not without interest—great interest indeed—for the anthropologist, but the overwhelming value of Rattray's studies for his fellow workers lay in his accurate observation, his clear, precise statement, and his restrained, but illuminating, power of interpreting his facts in relation to their cultural environment. To a wider public, the volume containing his study of Ashanti art is made a standard work of reference by the inclusion of a contribution from Vernon Blake discussing the place of African art in relation to the principles of æsthetics.

One of Rattray's duties not long before his retirement was to make a survey of tribes of the hinterland brought under British control by mandate, but as little known to anthropological science as they were to the administration. This survey was made with a view to the introduction of some measure of indirect rule ; and a record of the observations then made was published by him in his book "The Tribes of the Ashanti Hinterland" (1932). Its essential completeness, when considered in relation to the rapidity with which the work had to be carried through, is a lasting memorial of Rattray's quickness of observation and grasp of detail. On his retirement Rattray was a frequent lecturer on anthropological topics at Oxford and elsewhere ; and it may be noted that he was then one of the first to point out that indirect rule is not a complete panacea for the difficulties of native rule, not the least of these,

(*Continued on page* 929.)

NATURE

SUPPLEMENT

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LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 928.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Physical Sciences

Reversibility of the Equations of Classical Dynamics

IN a recent series of papers, one of us has derived the equation of motion[1] of a free particle in the presence of the expanding universe by *a priori* methods, and constructed an associated dynamics. The observers' clocks were supposed so graduated[2] that the expansion appeared *uniform*, and the resulting scale of time was called the t-scale. But the equations of motion reduced to their classical form[3] only if observers' clocks were regraduated from t to τ where

$$\tau = t_0 \log (t/t_0) + t_0,$$

and all derived measures correspondingly changed. Accordingly, the 'uniform time' of mechanics was identified as τ-time. In this measure of time, the universe appears as a stationary, non-expanding system, and the red-shift is shown[4] to be attributable to an acceleration of atomic absorption- or emission-frequency with time in τ-measure, so that the light, emitted long ago by a distant nebula, appears relatively displaced to the red. In a joint paper about to appear in *Zeitschrift für Astrophysik*, we have analysed generally all monotonic graduations of our temporal experience, that is, all possible modes of clock-graduation, and shown that of these there is just one, τ-measure, which reduces the members of any 'linear equivalence' to relative rest. This again we have identified as the time of mechanics.

The object of the present communication is to point out that this identification can be at once confirmed from Mach's principle and the well-known fact of the reversibility of the classical mechanical equations—the fact that they are unaltered in form on replacing $d\tau$ by $-d\tau$. For, by Mach's principle, the equations of motion of a free particle express the relation of the particle-in-motion to the general distribution of matter and motion in the universe. Suppose we reverse the velocity of a free particle. Then it can only reverse its trajectory if the motion of all the other particles in the universe is reversed at the same time, and this will not actually occur unless these other particles are on the whole relatively *stationary*, when the reversal of *their* relative motion makes no difference. Accordingly, the equations of motion of a free particle may be expected to be unaltered in form on reversing the differential of time only when the scale of clock-graduation is so chosen that the fundamental particles appear as relatively stationary. Since the equations used in ordinary mechanics *are* unaltered in form by this transformation, it follows that the scale of clock-graduation they imply is the τ-scale, namely, that for which the universe is stationary, that is, non-expanding. In confirmation, it is at once found that the equations of motion in any other scale, in particular the well-discussed t-scale equation,

$$\frac{dV}{dt} = -(P - Vt)\frac{Y}{X},$$

are altered in form on reversing V and dt.

Since a red-shift is observed to exist, and since the universe is non-expanding in the ordinary mechanical or τ-scale, it follows at once that as regards the emission or absorption of radiation atoms cannot keep the τ-scale. Closer discussion has shown that the frequency of the photon emitted must be constant on the t-scale[5].

These considerations throw a flood of light on what used to be regarded as a grave difficulty: How can the secular increase of entropy be reconciled with the reversibility of the Hamiltonian equations ? It now appears that the reversibility of the Hamiltonian equations is a peculiar property due to the particular choice of the scale of time in which the universe is relatively stationary. In general, for an arbitrary choice of clock-graduations, the dynamical equations are not reversible. Reversibility of equations of motion is therefore to be considered as irrelevant to the onward march of entropy, which simply expresses the tendency towards a state of greater probability independent of the scale of clock-graduation adopted.

Eddington has directed attention[6] to three time-direction sign-posts: (1) our consciousness of the temporal sequence; (2) the expansion of the universe; (3) the increase of entropy. We now see that by suitable choice of clock-graduation the second is abolished and replaced by a statement about the acceleration of 'atomic clocks'. The first is basic and given, and is so used in our analysis. The third is not therefore 'the barb on time's arrow'—time's arrow is already barbed in the statement of the before-and-after relation in the observer's experience; the increase of entropy must therefore be a theorem, or consequence of the existence of the temporal sequence.

It is perhaps scarcely necessary to add that when in the above we use the term "relatively stationary", we are not appealing either to material measuring rods or to the indefinable 'rigid' length-measure. We mean simply that the light-time difference for a to-and-fro signal, measured on the appropriately graduated clock, is a constant.

E. A. MILNE.
Wadham College, Oxford.

G. J. WHITROW.
Christ Church, Oxford.
April 28.

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[2] Whitrow, G. J., *Quart J. Math.* (*Oxford*), 6, 249 (1935).

[3] Milne, E. A., *Proc. Roy. Soc*, A, 158, 327 (1937). There are certain departures from the Einstein mechanics for speeds *v* approaching *c*.

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A New Boundary Condition and the Geodesic Postulate

Einstein and Rosen[1] have admitted that the geodesic postulate is an extraneous one and that the field-equations of gravitation must give both matter and motion independently of such a postulate. It has not been rigorously proved yet that the geodesic postulate is implicit in the field-equations[2]. A new boundary condition is stated here, couched in invariant terms; it is found to be satisfied by the Schwarzschild solution, and the content of the geodesic postulate that a test-particle describes a geodesic is shown to be implied by this condition. No extraneous postulate is necessary to account for the motion if the new boundary condition is accepted.

The inner and outer fields of an isolated spherical mass are given by the line-elements,

$$ds^2 = -\sec^2 x\, dr^2 - r^2(d\theta^2 + \sin^2\theta\, d\varphi^2) + (A - B\cos x)^2 dt^2, \quad . \quad . \quad . \quad (1)$$

where $R \sin x = r$ and

$$ds^2 = -\left(1 - \frac{2m}{r} - \frac{\lambda r^2}{3}\right)^{-1} dr^2 - r^2(d\theta^2 + \sin^2\theta\, d\varphi^2) + \left(1 - \frac{2m}{r} - \frac{\lambda r^2}{3}\right) dt^2 \quad . \quad . \quad . \quad (2)$$

The boundary conditions that are satisfied at the common surface, $r = r_0$, are two, as usually stated: (i) the pressure $p = 0$ and (ii) $g_{\mu\nu} = g'_{\mu\nu}$, the dash indicating the external field. The boundary conditions in the corresponding problem of Newtonian gravitation suggest that there is one more condition satisfied by (1) and (2) at $r = r_0$; and that is found to be that the laws of mechanics, namely,

$$(T^{\nu}_{\mu})_{\nu} = 0, \qquad (3)$$

hold good whether we use the three-index symbols for $g_{\mu\nu}$ or for $g'_{\mu\nu}$ at the common surface. In other words, this boundary condition is $(T^{\nu}_{\mu})_{\nu} = (T^{\nu}_{\mu})'_{\nu} = 0$. In the one-body problem considered above, this merely demands $\Gamma^{4}_{r4} = \Gamma'^{4}_{r4}$ ($r = 1, 2, 3, 4$), which condition is found to be satisfied at the boundary..

For a perfect fluid for which the condition of continuity holds good in the form $[(p+\rho)v^i]_i = 0$, if, at the boundary, the pressure-gradient is supposed to be negligible compared to the density, (3) reduce to the equations of geodesics[4],

$$(v^{\mu})_{\nu} v^{\nu} = 0. \qquad (4)$$

By the new boundary condition, (4) become geodesics not only of the inner but of the outer field also. Thus at the surface a fluid runs in geodesics of the external field. A particular case of this general result for a finite fluid mass is provided by a test-particle which, if treated as of negligible dimensions, traces a geodesic.

V. V. NARLIKAR.

Benares Hindu University.
April 2.

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[2] Becquerel, "Le Principe de Relativité", pp 209–214 (1922). The proofs given here are not rigorous. Evidently they are not accepted by Einstein and Rosen.

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Distortion of Mountain Strata, Isostasy, and Glacial Periods

THE connexion of the distorted mountain strata with isostasy has been examined in NATURE of April 2, p. 603. The foundation of the argument was that the strata were originally deposited horizontally at the bottom of the sea. It is, however, necessary to go further back, for they must have been lifted to a great height before isostatic influences could begin to operate. There is here a problem of flow in a medium of extremely viscous type, namely, the outer region of the earth beneath, which can scarcely be avoided. If anywhere the horizontal drift beneath is from both sides towards the same centre the lighter material above it will be pushed up as is required, and in part also pushed down, but the resulting displacement need not at first be isostatically distributed. So also at ocean deeps the underlying drift away from the centre may carry along the more solid upper strata, thinning them out: anyhow a problem presents itself there. Moreover, in all internal motions the drift relative to the surface is necessarily tangential. The analogy of the sideway shrinking up of a flat roll of cloth has been employed.

The process here described would be remote in time. It can scarcely be going on now to any sensible degree, *unless isostatic conditions prevail*; for it would gradually alter the period of the earth's rotation, which is known for astronomical reasons to have been extremely steady for some thousands of years. This consideration also excludes any hypothesis of great accumulation of ice in the Arctic regions; for it would lower the general level of the oceans and a change of level of more than a few centimetres is not permitted. So too the land must have not altered its *mean* level more than this in historic times. But in times beyond historical record this restriction does not apply. (These considerations favour the Darwin theory of the origin of coral reefs.)

This astronomical limit appears to be fundamental for geophysics. It asserts that change of level of the ocean of one centimetre is not permitted, unless the day was exceptionally longer in the glacial periods : if the water were removed to this depth and piled up uniformly on ice-caps within 5° or 350 miles of the poles, the resulting thickness would be only about 130 cm. or 50 inches, and if within 10° only 12 inches. Within such narrow limits are accumulations of ice now restricted. Sir George Simpson (NATURE, April 2) advances the view that recent ice ages may be due largely to change of temperatures of the Atlantic produced by drift of ice in it down into temperate latitudes ; and here question arises as to the permanent source of supply of the ice. A different mode of origin which has found some favour with the writer is the temporary diversion of ocean currents on a large scale by ice piling up in the narrower parts of their channels and so blocking the flow. Both causes might operate. But the recent glacial period on the central Indian plains appears to be a more intractable proposition.

JOSEPH LARMOR.

Holywood,
Co. Down,
Northern Ireland.
April 12.

Maxwell's Equations and the "Flux-Cutting" Principle

IN NATURE of February 5, Dr. C. V. Drysdale attempts a simplification of Maxwell's electrodynamic equations, on the grounds that these in their original form are difficult to comprehend and to apply, and not completely fundamental. As regards the latter criticism, it must be admitted that Maxwell rarely leaves much scope for improvement in his mathematical statements of physical laws, and so far as the complexity is concerned, many years' lecturing experience have convinced me that the average electrical engineering student of pass degree standard finds little difficulty in understanding and appreciating the concise and elegant expression of the laws of induction, which he has had ample opportunity of testing experimentally in his laboratory work, and usually finds the wider applications, to transmission, skin effect, and metallic reflexion, both easy and interesting.

A closer examination of Dr. Drysdale's argument leaves my opinion of Maxwell's achievement unshaken.

The first modification is introduced rather abruptly with the words : "if we write $j\frac{\partial E}{\partial x}$ for curl E in the equation $-$ curl $E = \dot{B}$ . . ." It is not easy to see any justification for this suggestion. It is true that the components of the vector curl E may be obtained by applying the differential operator $\mathbf{i}\frac{\partial}{\partial x} + \mathbf{j}\frac{\partial}{\partial y} + \mathbf{k}\frac{\partial}{\partial z}$ in a vectorial manner to the vector E, where **i**, **j** and **k** are the unit vectors along the axes X, Y and Z, respectively, that is, by developing the determinant $\begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ E_x & E_y & E_z \end{vmatrix}$. But here the scalar products $\mathbf{i}\times\mathbf{i}=\mathbf{j}\times\mathbf{j}=\mathbf{k}\times\mathbf{k}=1$, and the vector products $\mathbf{i}\wedge\mathbf{i}=\mathbf{j}\wedge\mathbf{j}=\mathbf{k}\wedge\mathbf{k}=0$, whereas Dr. Drysdale later asserts that $\mathbf{j}^2= -1$, and thus confuses the unit vector **j** with the electrical engineer's phase rotating operator and tempts the reader to suspect that the relation $E=jVB$ expresses a quadrature phase difference between E and B.

The next step is equally sweeping and illegitimate : it consists in "writing" $\frac{\partial B}{\partial t} = \frac{\partial B}{\partial x}\frac{dx}{dt}$.

It is now obvious, however, that the original equations have been reduced by making some very special assumptions, namely, that $E_x=E_y=0$, and $B_x=B_t=0$, leaving

$$\frac{\partial E_z}{\partial x} = \mu\frac{\partial H_y}{\partial t} \text{ and } \frac{\partial H_y}{\partial x} = \varepsilon\frac{\partial E_z}{\partial t},$$

and by this specialization a set of equations has been obtained which *ipso facto* is less general, that is, less completely fundamental, than the original system.

It is, of course, easy to obtain a simple wave equation from the above two equations, and the solution and discussion would seem fairly simple, but Dr. Drysdale prefers to introduce a magnet which is moved transversely through a non-conducting medium with a velocity V, inducing an E.M.F. $E= -j\mu VH$, this E.M.F. in turn inducing a magnetic force $H^1=\varepsilon\mu V^2H$, etc. It is asserted that thus an electromagnetic wave is generated, though it is not easy to trace any connexion with wave motion in the ordinary sense. It is further pointed out that, as the velocity increases, the fields will increase, unless H is diminished to $H-H^1=(1-\varepsilon\mu V^2)H$, and it is concluded that when $1-\varepsilon\mu V^2=0$, H is also 0. This is tantamount to a statement, that when one factor in a product is 0, the other factor is also 0.

The extension of this argument to the case of semiconductors shows an equal disregard for elementary rules of ordinary, partial and total differentiation and leads to yet another curious equation,

$$\frac{d^2E^1}{dt^2} = V^2\frac{\partial^2E^1}{\partial t^2}.$$

Dr. Drysdale's main contention is that flux-cutting is more fundamentally correct, as an E.M.F. inducing agent, than flux variation, but it is well to remember that when the dynamo designer speaks of a conductor, he is at the moment concentrating his attention on one side only of a complete armature coil—if the other side were not there, his dynamo would scarcely be a success. It is, of course, the flux variation through the armature *coil* which generates the E.M.F. Dr. Drysdale himself admits that, in the case of a transformer, the flux variation principle is correct (and even "more convenient"), and the attempt at saving the flux-cutting principle, by invoking some mysterious and incomprehensible "cutting" by a stationary coil, can scarcely be taken seriously.

Yet Dr. Drysdale claims to have rendered Maxwell's equations more completely fundamental and more intelligible, and urges that his representation "should be adopted". It might well be asked—by whom ? If text-book writers were to adopt this kind of argument, it could only add to the confusion.

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No one has a greater admiration for Maxwell's magnificent achievements than I have, and so far from wishing to decry them, my main object has been to help to restore them to their rightful place as the greatest scientific generalization we have seen. But there has been a decided tendency to neglect them of late, and I am convinced that this has been due to the complexity of the mathematical processes associated with Maxwell's equations, which has obscured their simple physical basis and conclusions. Dr. Wilcken is to be congratulated on being able to make them easily intelligible to students, but quite recently a professor of physics at a leading London college told me frankly that he had never been able to understand Maxwell's electromagnetic theory of light, and I have found that considerable confusion exists among all with whom I have discussed it. The simplified treatment has given me a much clearer realization of the physical processes involved and has convinced me that Maxwell's conclusions were entirely sound although his equations were not completely fundamental.

Dr. Wilcken commences by objecting to my "abrupt" substitution of $j\frac{\delta}{\delta x}$ for Maxwell's curl function, and suggests that it was introduced as a quasimathematical device to give colour to a preconceived bias in favour of the flux-cutting principle. I admit and am sorry for the abruptness, but my article was a highly condensed epitome of a long unpublished paper and was intended merely to give an outline of the theory in the shortest possible space. According to my recollection and notes, the inspiration for the modified (apparently I must not say "simplified") equations arose from wrestling with the array of differential equations in Drude's "Theory of Optics"; and becoming tired of the effort I decided on examining the problem of electromagnetic wave propagation from first principles. The most simple way of doing so was to consider a forced electromagnetic disturbance created by moving a magnet with wedge-shaped gap with velocity V in a direction transverse to its magnetic field B and in a plane containing the normals to its plane faces; and it was easy to see that in this case curl $E = \frac{\delta E}{\delta x}$ as regards magnitude and that $\dot{B}\left(=\frac{dB}{dt} = \frac{\delta B}{\delta t} + \frac{\delta B}{\delta x}\frac{dx}{dt} + \frac{\delta B}{\delta y}\frac{dy}{dt} + \frac{\delta B}{\delta z}\frac{dz}{dt}\right) = \frac{\delta B}{\delta x}\frac{dx}{dt} = V\frac{\delta B}{\delta x}$; so that Maxwell's third equation-curl $E = \dot{B}$, becomes $-\frac{\delta E}{\delta x} = V\frac{\delta B}{\delta x}$, or $E = -VB$, if $E = 0$ when $V = 0$. Similar treatment of Maxwell's fourth equation, curl $H = 4\pi\dot{D}$, of course gave $\frac{\delta H}{\delta x} = 4\pi V\frac{\delta D}{\delta x}$, or $H = 4\pi VD = VJ$ if $H = 0$ when $D = 0$, and $J = 4\pi D$. As x disappears in the integration, the equations $E = -VB$ and $H = VJ$ are independent of the direction of propagation.

Up to this point, I had not considered the flux-cutting principle, but the correspondence of the equation $E = -VB$ with the dynamo designer's or flux-cutting formula of course struck me, and as I had long ago come to the conclusion that Faraday's rotating disk experiment showed that the induced E.M.F. was due to the cutting of the magnetic flux, it was apparent immediately that the equation $E = -VB$ was not a mere transformation of Maxwell's third equation but an expression of an independent experimental fact. Similarly Rowland's demonstration that a magnetic field was induced by the rotation of two oppositely charged disks or the cutting of an electrostatic field afforded experimental verification of the formula $H = VJ$. The two equations $E = -VB$ and $H = VJ$ may therefore be regarded simply as direct expressions of the results of Faraday's and Rowland's rotating disk experiments, and my original derivation of them by transformation of the Maxwellian equations, which I quite admit was not general, is of no importance except as showing a connexion between them. The equations $E = -[VB]$ and $H = [VJ]$ are completely general, and I hope to show that they are more fundamental.

As Dr. Wilcken does not like my employment of the quadrantal versor $\mathbf{j} = \sqrt{-1}$ to indicate the directions of the induced forces, on the grounds that it leads to confusion with its use in alternating current theory and with vector analysis, there is no objection to writing the four equations for an isotropic dielectric as $J = \varepsilon E$, $B = \mu H$, $E = VB$, and $H = VJ$, and leaving the directions to be determined by the ordinary rules. I fail to see, however, why students who are familiar with the use of $\mathbf{j}$ for alternating current vectors should be confused by its application to any other vectors.

I dissent entirely from Dr. Wilcken's remarks concerning the flux-cutting principle, but to deal with them and his complete misapprehension of my method of explaining the generation and propagation of an electromagnetic wave would take too much space for a note; and I propose shortly to submit a further article, which I hope will make the flux-cutting principle and its application quite clear and indisputable.

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Why do we have Winter Heating?

The layman will answer: "To make the room warmer." The student of thermodynamics will perhaps so express it: "To import the lacking (inner, thermal) energy." If so, then the layman's answer is right, the scientist's wrong.

We suppose, to correspond to the actual state of affairs, that the pressure of the air in a room always equals that of the external air. In the usual notation, the (inner, thermal) energy is, per unit mass,

$$u = c_v T.$$

(An additive constant may be neglected.) Then the energy content is, per unit of volume,

$$u^1 = c_v \rho T,$$

or, taking into account the equation of state,

$$p/\rho = RT,$$

we have

$$u^1 = c_v p/R.$$

For air at atmospheric pressure,

$$u^1 = 0 \cdot 0604 \text{ cal. cm}^{-3} = 60 \cdot 4 \text{ Cal. m.}^3$$

The energy content of the room is thus independent of the temperature, solely determined by the state of the barometer. The whole of the energy imported by the heating escapes through the pores of the walls of the room to the outside air.

I fetch a bottle of claret from the cold cellar and put it to be tempered in the warm room. It becomes warmer, but the increased energy content is not borrowed from the air of the room but is brought in from outside.

Then why do we have heating? For the same reason that life on the earth needs the radiation of the sun. But this does not exist on the incident energy, for the latter apart from a negligible amount is re-radiated, just as a man, in spite of continual absorption of nourishment, maintains a constant body-weight. Our conditions of existence require a determinate degree of temperature, and for the maintenance of this there is needed not addition of energy but addition of entropy.

As a student, I read with advantage a small book by F. Wald entitled "The Mistress of the World and her Shadow". These meant energy and entropy. In the course of advancing knowledge the two seem to me to have exchanged places. In the huge manufactory of natural processes, the principle of entropy occupies the position of manager, for it dictates the manner and method of the whole business, whilst the principle of energy merely does the book-keeping, balancing credits and debits.

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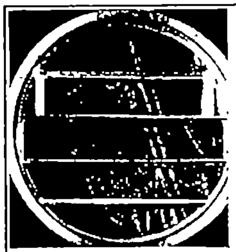
Secondary Effects of the Hard and Soft Components of Cosmic Rays

It has been shown in a previous paper[1] that the major part of the electron showers produced in a lead plate are formed by a 'cascade process' in accordance with the shower theory proposed by Bhabha and Heitler[2] and Carlson and Oppenheimer[3]. Our experiments have been made with an automatic cloud chamber. Four lead plates of 3 cm. thickness are placed inside the chamber in a distance of 5 cm. A cloud chamber divided up in this way offers good opportunity of studying the way in which the showers are generally produced.

Fig. 1 shows a typical 'cascade process'. In later experiments two counters were used to detect the passage of the particles through the cloud chamber. One was placed above and the other below the chamber in such a position that any ray passing straight through both must also go through the chamber and the four lead plates. The intention was to study the production of secondaries when the primaries pass the lead plates and to make statistical investigations of their frequency in the various sections. Figs. 2 and 3 show some track photographs made in this way. Secondary, not ionizing, light quanta are here seen to have produced ionizing particles near the main ray.

A statistical examination of results, obtained without screening the chamber, gives the following result. Out of every 100 particles (hard plus soft radiation) passing the chamber, 30 were without visible secondary effect. 26 tracks were found in section I, 35 in II, 44 in III, and 45 in IV, the sections being numbered from above. The cloud chamber was then screened with an iron filter of 33 cm. in order to absorb the soft radiation. In this way it was possible to ascertain whether the hard radiation gave the same statistical results as the hard plus soft radiation. The following result was obtained: Out of every 100 particles of the hard radiation, 41 give no visible effect. 18 tracks were found in section I, 21 in II, 22 in III and 23 in IV. Thus the hard radiation gives considerably less secondaries than the hard plus soft radiation. Assuming now that the 30 particles without visible secondary effect in the first experiment all belong to the hard component, we shall find, in agreement with experiments, that the soft component amounts to about 27 per cent of the total radiation at the earth's surface.

1



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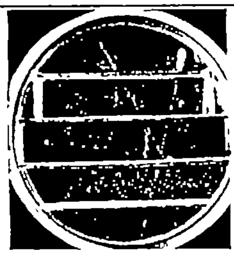

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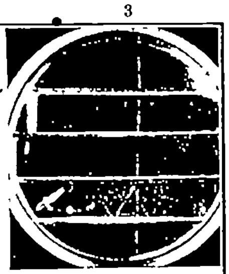

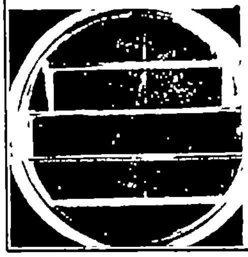

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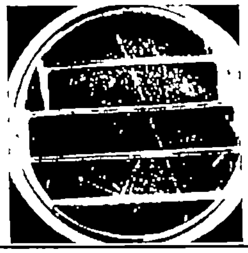

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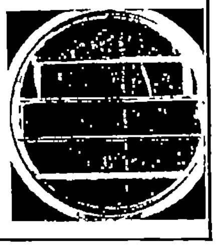

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In order by these calculations to get a correct value of this distribution factor, we are furthermore forced to assume that the quantities of hard particles being transformed into soft particles in the filter are negligible. On this assumption, we can now calculate the statistical distribution of secondaries for soft rays alone. We will find that practically all the soft rays give visible secondary effects, and as distinct from the hard rays the number of secondaries increases rapidly from one section to the other in the downwards direction. The number of secondaries stated in this way seems to be in good agreement with the electron absorption theory of Bhabha and Heitler.

The theory has been proposed that the hard rays are electrons having an energy higher than some critical energy above which the quantum absorption theory is not valid. If this be correct, we shall have to assume that the iron filter will decrease the energy of some of the hard particles and in this way produce a new soft radiation component. Our experiments seem, however, to show that this cannot be the case, and consequently we shall have to conclude that the hard particles cannot be electrons.

As to the secondary effect of the hard rays, it might be mentioned that the secondaries most frequently form a branch of the main rays, as shown in Fig. 4. Secondaries—electron pairs and single rays—among which are found strongly ionizing nuclear particles, may, however, also appear at some distance from the main ray according to the effects shown in Figs. 5 and 6. Such cases show that the hard radiation also may be accompanied occasionally by hard light quanta, which are thus able to produce cascade processes. The processes producing these secondaries may be of various kinds, such as nuclear reactions and head-on collisions with subsequent production of light quanta and pairs of the fast secondaries.

A fuller account of these and further investigations will be published elsewhere.

B. TRUMPY.

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Bergen.
April 9.

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[1] Trumpy, B , *Det. Kgl. N.V.S Fork.*, **10**, nr. 37 (1937).

[2] Bhabha and Heitler, *Proc. Roy. Soc.*, A, **159**, 432 (1937).

[3] Carlson and Oppenheimer, *Phys. Rev.*, **51**, 220 (1937).

High-Altitude Cosmic Radiation Measurements near the Magnetic Axis-Pole

THE Wordie Expedition of 1937 to Baffin Bay[1] gave us an opportunity of making measurements of cosmic radiation at great heights in the atmosphere near the magnetic axis-pole. Free balloons were used, the method employed being that of Prof. E. Regener, to whom we are very much indebted for invaluable help. Our two most successful flights were made within 5° of the pole, one with an ionization chamber and one with a triple counter set giving coincidences for vertical rays. The result of the ionization chamber flight is shown in Fig. 1 and that of the counter flight in Fig. 2.

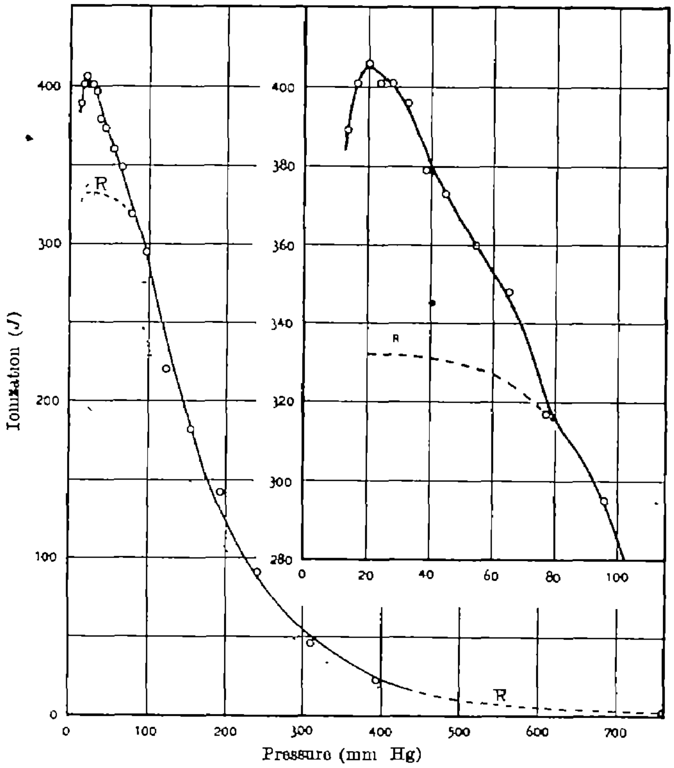

Fig. 1

IONIZATION CHAMBER MEASUREMENTS. .. ... ACTUAL RESULT λ 85°; - - - - - REGENER, λ 49°; ——— λ 85° CURVE INCREASED BY 20 PER CENT.

The ionization chamber was a steel sphere of wall thickness 0·5 mm. and collecting volume 3 litres. It was filled with argon at a pressure of about 6 atmospheres, and the collecting field was everywhere greater than 30 volts per cm. The electroscope was similar in construction to that of Neher[2], but in addition it was made to recharge itself automatically, after the manner of the ticking electroscope of Zeleny. The rate of leak of the electroscope was recorded, along with the pressure of the air and the temperature of the apparatus, on a moving photographic film. Relative values of the cosmic ray ionization are proportional to the rate of leak of the electroscope system and were found directly from the film record. Absolute values in ion pairs per c.c. per sec. in normal air were obtained by measuring the capacity of the electroscope system and converting the ionization in argon so found to that in air. The conversion factor 0·72 was used[3], after it had been checked by experiment with γ-rays. The probable error of the absolute magnitude of the ionization is greater than that of the relative values, except in the lower parts of the atmosphere, and may be taken as ± 5 per cent. The probable error of the pressure measurements is ± 1 mm. mercury, the lowest pressure reached being 12·5 mm. mercury.

The coincidence counter apparatus consisted of three Geiger-Muller alcohol-filled tubes[4] coupled through a conventional Rossi circuit to an 8-metre oscillator designed for the purpose by J. A. Ratcliffe. In order to actuate all three counters, a particle must traverse 0·3 mm. of brass and 4·25 mm. of pyrex. Each particle vertically directed within a cone of semi-angle 20° gave rise to a radio pulse which was received at ground-level by a commercial superheterodyne receiver, and the impulses were counted on a three-stage scale of a two vacuum tube counter. The air pressure was recorded by variation of the wave-length of transmission. This was checked by direct measurement of the height of the apparatus by means of theodolites, and in one flight, when the apparatus was recovered, by a recording meteorograph. The most valuable counter observations were made on this flight at magnetic latitude λ 88°.

The curve *R* in Fig. 1 is that of Regener[5] for λ 49°. It is to be expected that in the lower atmospheric levels the ionization curve near the pole should be identical with that of Regener, and when our curve is increased by 20 per cent, good agreement with Regener is in fact obtained for pressures above 90 mm. mercury. Our experimental points are shown on this adjusted curve. Similar agreement with Millikan and Neher[6] in λ 52° for pressures above 50 mm. (that is, for the whole range of their curve) can be obtained by increasing our results by 60 per cent. It is reasonable to conclude that these differences of absolute value are due chiefly to differences of the wall effect of the ionization chambers used.

The curve obtained near the magnetic pole, if the adjustment of the absolute results is valid, shows larger ionization near the top of the atmosphere than Regener's curve at λ 49°, and at 20 mm. mercury shows a well-defined maximum. It is not possible to say whether the radiation producing this increase reaches the earth at about λ 50° or nearer the pole. The available measurements of Millikan and Neher at λ 52° do not extend quite high enough to decide this point. We hope, however, soon to have flights in Great Britain with the same apparatus.

The coincidence counter results in Fig. 2 are compared with those of Pfotzer[7] taken at λ 49°. The curves are fitted at ground-level and are seen to agree closely at low pressures. At intermediate pressures Pfotzer's curve lies below ours. It should be noted, however, that Johnson[8] at approximately the same latitude as Pfotzer finds a similar deviation. If real, its origin is not clear.

The general conclusion reached by both types of measurement is that the radiation intensity at the pole is approximately equal to that at λ 50°. This is in agreement with the indications given by the results of Cosyns[9] between λ 47° and λ 51°. It is probable, consequently, that the radiation intensity at high altitudes, which increases markedly from the equator to λ 50°, remains thereafter constant to the pole. These experiments indicate, therefore, that cosmic rays of energy less than about 3×10^9 e.-volts either do not exist in space or are prevented from reaching the earth by an agency other than the terrestrial magnetic field. Janossy[10], on the basis of Cosyns's results, has shown that a solar magnetic field of reasonable magnitude will cut off rays of energy less than 3×10^9 e.-volts.

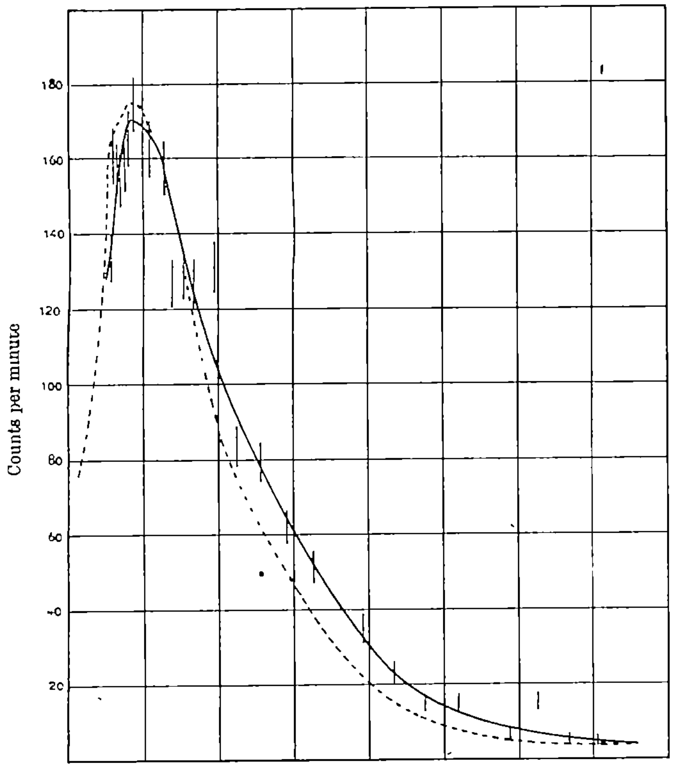

Fig. 2.

Coincidence counter measurements. ——— λ 88° ; – – – – Pfotzer, λ 49°.

We are deeply indebted to Mr. Wordie for providing the opportunity for this work, to all the members of the expedition and of the ship's crew for their help with the flights, and especially to Mr. I. M. Hunter for his work with the radio technique.

H. Carmichael.

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E. G. Dymond.

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April 11.

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[1] Nature, **140**, 1083 (1937).
[2] *Phys. Rev.*, **50**, 15 (1936).
[3] Cox, *Phys. Rev*, **45**, 503 (1934)
[4] Trost, *Z. Phys.*, **103**, 399 (1937).
[5] *Naturwiss.*, **25**, 1 (1937).
[6] *Phys. Rev.*, **46**, 641 (1934).
[7] *Z Phys*, **102**, 23 and **41** (1936).
[8] Swann, *J. Frank. Inst.*, **224**, 452 (1937)
[9] *Z. Phys.*, 104, 430 (1937).
[10] Nature, **137**, 616 (1935).

Transfer of Helium II on Glass

Kamerlingh Onnes[1] observed in 1922 that the surfaces of two volumes of liquid helium II, that is, helium below the λ point, in two concentric vessels adjusted themselves automatically to the same level. No further observations of this strange 'distillation' phenomenon appear to have been made in Leyden or elsewhere. Rollin[2], however, found that the loss from vessels containing liquid helium II is exceptionally high, and he attributed this to some effect connected with the formation of a thin layer of helium II on the inner walls of the connecting tube. This, he suggested, might be connected with the above-mentioned phenomenon. We have lately carried out experiments with various arrangements of vessels in order to reproduce the effect observed by Kamerlingh Onnes and to investigate it systematically.

In one very convenient apparatus we utilized a small glass beaker suspended on a thin glass fibre which could be lowered into a bath of liquid helium II or raised out of it. The heat influx was reduced to a minimum, 0·5 c.c. of liquid at 1·5° K. evaporating per hour. As it was found that light from an ordinary incandescent filament lamp was absorbed (probably on the glass wall) and disturbed the effect, our observations were carried out with a neon lamp. The following phenomena were observed:

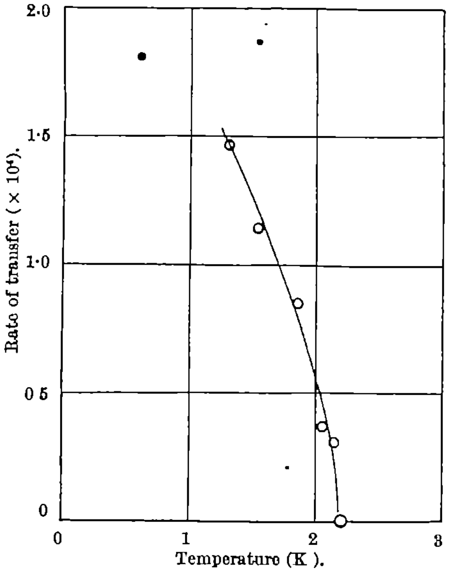
(*a*) When the empty beaker was lowered into the liquid, it filled up to the level of the bath although the rim of the beaker was everywhere above the level of the liquid.

(*b*) When the beaker was partly lifted out of the bath, the level of the liquid in the beaker fell at the same rate as it rose in (*a*), and the level of the bath rose until both had reached the same height.

(*c*) In order to establish whether the transfer took place by distillation through the gas phase or by transfer over the surface, the effect was examined of introducing 'wicks' of twisted copper wire which increased the surface leading from one level to the other. It was found that this increased the rate of transfer to several times the previous rate so long as, but only so long as, the wick reached into the liquid at the higher level.

(*d*) When the beaker (without a wick) was lifted completely out of the bath, it was found that the liquid vanished at the same rate as when it was still partly dipping into it. This was accounted for when it was observed that the liquid collected in drops at the bottom of the beaker and dripped into the bath.

(*e*) The rate of transfer did not appear to differ very greatly whether the beaker was almost full or nearly empty, the rate decreasing only by 20 per cent when the level had dropped from within 0·5 mm. of the rim to some 20 mm. from the rim.



(*f*) As shown in the accompanying figure, the rate of transfer increased rapidly with decreasing temperature. The rate is given in cubic centimetres of liquid per second per centimetre of glass surface cutting the surface of the liquid.

(*g*) If any of these phenomena occur above the λ point, the rate is so slow that they could not be observed in our experiments.

These experiments appear to show that the surface of a solid in contact with liquid helium II is covered with a helium film through which the liquid is transferred to the lowest available level. The rate of transfer on glass (it was found to be much higher on copper) appears to be of the order which one would expect if a monatomic layer were to move with the average kinetic velocity of the molecules. But the fact that the rate of transfer increases rapidly with falling temperature seems to indicate that the phenomenon depends not so much on the molecular velocity as on the viscosity, which decreases[3] as the temperature falls. Whether this is to be attributed to the obvious explanation that the de Broglie wavelength increases with falling temperature is a question which must be left until further experiments have enabled a more complete theory of the two phases of the liquid state of helium to be evolved.

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K. Mendelssohn.

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Oxford.
April 16.

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[1] Kamerlingh Onnes, H , *Comm. Leiden*, 159

[2] Rollin, B. V., Actes 7. Cong. int. du Froid, 1, 187 ; Prof. Simon informs us that a full account will be published shortly.

[3] Allen, J. F., and Misener, A D., Nature, 141, 75 (1938.)

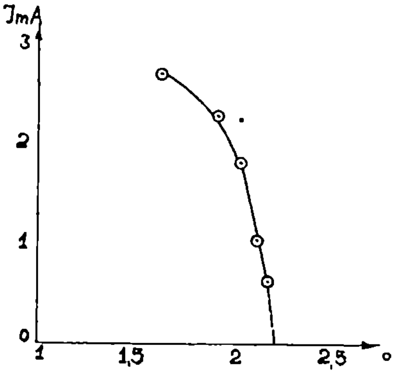
Experiments with Liquid Helium II

N. Kürti, B. V. Rollin and F. Simon[1] found that below the λ-point liquid helium slips over the surface of the tube lowered into it. They observed this phenomenon by increasing the flow of heat along the tube. We have made a more detailed investigation in order to obtain some quantitative characteristics of this phenomenon. We used the following method.

A glass tube 4 mm. in diameter, insulated by a vacuum vessel, is immersed in liquid helium with only its lower part surrounded by the liquid ; and the remainder is allowed to project above the level of the liquid helium bath. On the upper parts of the glass tube a copper tube is soldered, on to which a heating coil of constantin wire (0·1 mm.) and a resistance thermometer of phosphorbronze wire (0·1 mm.) are wound.

When the lower part of the tube is surrounded by liquid helium II, its upper part has the same temperature as the lower part, that is, the temperature of the liquid helium in the Dewar vessel. When heat was introduced electrically by means of the heating coil, almost no heating is observed (the temperature gradient in this case is approximately 2×10^{-4}° K.). At a fixed value of the current, intensive heating begins. The value of this limiting current depends on the height of the thermometer above the level of the liquid helium in the bath and also on its temperature ; it increases with decreasing height and with the decrease in temperature of the liquid helium. The dependence of the limiting currents upon the height is, however, very weak. In the accompanying graph, the values of the limiting current are plotted against the temperature. When the current in the heating coil is switched off, the upper part of the tube very rapidly (in a few seconds) acquires the same temperature as that of the lower part.

When the Dewar vessel is filled with liquid helium I, this phenomenon does not occur ; with the smallest values of current in the heating coil, the upper part of the tube is warmed, and on switching off the current the temperature equalizes very slowly (because of the heat conductivity of the tube and of the wire).



It appears that over the surface of the tube a fine film of liquid helium II is formed, which, owing to its abnormally high heat conductivity, equalizes the temperature of the upper and lower parts of the tube, even although the height of the thermometer above the level of the liquid is comparatively great (about 150 mm.). This film at the limiting value of the current evaporates, and only then does the heating begin. The phenomenon takes place even with a metallic tube.

From the values of the limiting current and that of the heat of evaporation of liquid helium, it is possible to estimate very roughly the thickness of the film. It appears to be of the order 10^{-5} cm. We obtained the same value when we determined the thickness from the value of the temperature gradient along the film, if we assume the heat conductivity of liquid helium to be 10^4 cal./gm.cm.sec., as found by Allen, Peierls and Zaki Uddin[2]; in their experiment the temperature gradient was of the same order as ours.

Kapitza recently supposed that the abnormally high thermoconductivity of helium II can be explained by the presence of strong convection currents in helium; it is evident, however, that with such extremely thin films as in our case (10^{-5} cm.) such convection currents could scarcely be formed.

At present, experiments on the direct determination of the film thickness are in preparation, and a detailed description of them will shortly be published.

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Transport Phenomena in Helium II

F. London[1] has recently proposed a new conception of helium II, according to which this liquid can be regarded as a degenerate Bose-Einstein gas, that is, as a system in which one fraction of the substance—say, n atoms per cm.^{3}—is distributed over the excited states in a way determined by the temperature, while the rest—$n_0 - n$ atoms per cm.^{3}—is 'condensed' in the lowest energy level. If T_0 denotes the temperature of degeneracy, the ratio n/n_0 is given by

$$n/n_0 = (T/T_0)^s \text{ for } T < T_0 \qquad (1)$$

For an ideal Bose-Einstein gas, according to London, $s = 3/2$, but for the real fluid one should rather insert $s = 5$ in order to fit Keesom's specific heat measurements.

The calculation of viscosity of a degenerate Bose-Einstein gas is in progress. A preliminary estimation shows that the atoms belonging to the lowest energy state do not take part in the dissipation of momentum. Thus, the viscosity of the system is entirely due to the atoms in excited states. This simple description allows us to account in a qualitative way for the well-known transport phenomena in helium II, though in the more exact treatment certain modifications have to be introduced, which are to be discussed in a detailed publication.

(1) Measurements of the damping of an oscillating cylinder will show the effect of atoms in excited states only. To a first approximation the viscosity, measured in this way, should be the same as the viscosity of helium gas at the same temperature. The value of the viscosity coefficient of helium gas at $T \sim T_0$ is $\mu \sim 10^{-5}$ c.g.s. units[6], while measurements in helium II just below the λ-point[2] give $\mu = 3 \times 10^{-5}$. Parallel measurements of the viscosity of helium II and helium gas in the corresponding range of temperature would provide us with an indication as to what extent the simple picture adopted here has to be refined.

(2) It is, however, not the viscosity coefficient μ which determines the flow velocity of helium II moving under the influence of a pressure gradient through a capillary. In this case, the fraction of substance consisting of atoms in the lowest energy state will perform—like a 'superfluid' liquid of viscosity $\mu \sim 0$—some sort of turbulent motion the flow velocity of which does not depend on the bore of the capillary. In addition, the atoms in excited states, behaving like a gas of pressure $\sim nkT$, will diffuse in a similar way to, say, molecules in a solution under the influence of a gradient of osmotic pressure. Thus, the total flow represents a rather complex combination of both these effects. It will largely depend on the ratio $(n_0 - n)/n$ and, therefore, on T, in agreement with experiment[3]. According to this interpretation, a temperature gradient should arise during the flow of helium II through a thin capillary.

(3) The so-called fountain phenomenon[4] of helium II is an inverse process to (2). If one maintains a temperature difference between the ends of a capillary, a gradient of density of excited atoms, n, and, thus, of pressure is produced. In consequence, (*a*) the excited atoms will diffuse towards the colder end, and (*b*) the super-fluid fraction of the liquid moves in the opposite direction. In the case of a wide tube, these currents must be equal and no resulting flow will be observed. If, however, the capillary is sufficiently narrow, the rate of the process (*a*) becomes reduced and the temperature gradient causes a surplus convection current opposite to heat flow. This picture can account for the great values of the heating current required to maintain a temperature difference at the ends of the capillary[5]. Simultaneous measurements of the heating current and the total convection of substance could provide us with information about the relative magnitude of the processes (*a*) and (*b*).

A detailed discussion of the problem will be given in the *Journal de Physique*. I am greatly indebted to Dr. F. London for the opportunity of seeing his paper before publication.

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Paris. April 16.

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A Simple Inexpensive Ultracentrifuge

In designing quantitative ultracentrifuges costing only a few pounds and available for measurements of sedimentation velocity and of sedimentation equilibrium, it is clearly best to adopt the simple modification of the air-driven spinning top of Henriot and Huguenard, in which the essential part of the system is immobilized by mechanical baffles[1]. This dispenses entirely with an optical system and depends upon direct analysis of the liquid after ultracentrifuging, using any suitable chemical, physical or biological method. Such opaque ultracentrifuges possess the further advantage over any transparent ultracentrifuge that the whole of the column of liquid from its upper surface outwards and from the very beginning of the sedimentation is available, without distortion, for exact measurement.

Cells which are ideally radial are made either from circular disks or from circular annular washers. Spacing pieces which leave the cell completely unobstructed are made from disks or washers of less width. The liquid, which may be aqueous or non-aqueous, is rendered so completely convectionless that the rotor may be stopped and dismantled for analysis without appreciable disturbance. The disks or washers may be made of any solid material that holds its form under the experimental conditions. We have found suitable such as can be cut from sheets of coin silver (10 per cent copper) a few thousandths of an inch in thickness.

Washers are suitable immobilizers for sedimentation equilibrium in any system, as described by McBain and Tostado in the accurate determination of the sedimentation equilibrium of sucrose[2]. Since then, Tiselius, Pedersen and Svedberg[3] have communicated an analytical method applied to the contents of their ultracentrifuge, giving their formula for calculating sedimentation velocity.

We now communicate measurements of sedimentation velocity of egg albumin with the disk method[4] in a 37 mm. rotor driven at 120,000 r.p.m. by air of 60 lb. pressure per sq. in. Each of fifteen attempts has been successful. In the last five the ultracentrifuge was held at constant known temperature to within 0·1° C. by the simple device of passing the driving air through a copper coil in a thermostat. Any desired temperature may be selected and held constant to within 0·01° C.

It is obvious that the same result should be arrived at whether the amount of protein leaving the immobilized liquid or arriving in the outer liquid is determined. About 2·2 c.c. of liquid is employed.

The results are expressed as sedimentation velocity in water at 20°. Analysis of the outer liquid gave $s_{20} = 3{\cdot}68$, $3{\cdot}69$, $3{\cdot}40$, $3{\cdot}59$, and $3{\cdot}64 \times 10^{-13}$, respectively; mean $3{\cdot}60 \times 10^{-13}$. Analysis of the inner liquid gave $s_{20} = 3{\cdot}35$, $3{\cdot}61$, $3{\cdot}42$, $3{\cdot}89 \times 10^{-13}$, respectively; mean $3{\cdot}57 \times 10^{-13}$. Svedberg's most recent result[5] is $3{\cdot}55 \times 10^{-13}$.

Similar results have been obtained with the same material by A. H. Lewis using an improved form of the McBain-O'Sullivan transparent ultracentrifuge[1]. Incidentally, these observations show that there is no wall effect upon velocity of sedimentation or diffusion where the spaces are as small as 0·01 mm., as would indeed be expected from hydrodynamic theory. The protein particles or molecules are 20,000 times smaller than the capillary spaces.

Polydisperse systems require that runs be made at several speeds for different times. There is also the advantage that analysis for every constituent may be carried out independently.

Complete details are being communicated elsewhere; the simple equipment was shown at the National Colloid Symposium, Cambridge, Massachusetts, on June 9–11 last year.

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April 11.

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Properties of Variable-Width Sound Film as an Optical Diffraction Grating

IN a recent letter in NATURE[1], D. Brown described an ingenious and simple method of obtaining acoustic spectra, namely, by using a strip of 'variable-density' sound film as a diffraction grating for light. If the transparency of the film is modulated by one frequency only, the spectrum obtained will only contain the orders zero and plus and minus one. Higher orders do not occur. If the transparency is modulated by a complicated sound, the place and intensity of the different lines in the spectrum will give immediate visual information on the spectral composition of this sound.

It may be interesting to describe shortly the behaviour of 'variable-width' sound film as an optical diffraction grating.

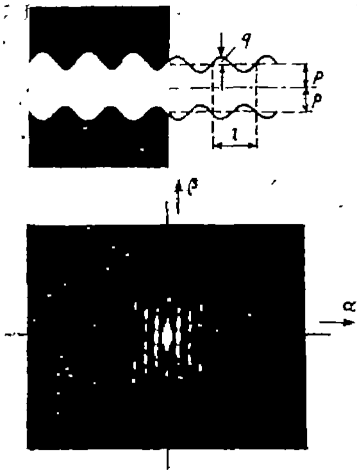

FIG. 1.

The diffraction pattern of a single frequency obtained with a point source of monochromatic light ($\lambda = 5461$ A.) is shown in Fig. 1. The point of symmetry corresponds with the direct image of the light source, the vertical line through it with the order zero, the first vertical line on each side with the order one. It is clearly seen that now higher orders are also present. Visually as many as twenty orders could easily be perceived.

The intensity of the light along a vertical line of order n, apart from an immaterial constant, is given by:

$$\frac{1}{\beta^2} \cdot \sin^2\left(\frac{2\pi\beta p}{\lambda} + \frac{n\pi}{2}\right) . J_n^2\left(\frac{2\pi\beta q}{\lambda}\right) \quad . \quad . \quad . \quad (1);$$

where $2p$ is width of zero track; q is maximum amplitude of modulation on both sides; l is length of period; λ is wave-length of the light; J_n is a Bessel function of order n; β is angle of diffraction in vertical direction; $\alpha = n\lambda/l$ = angle of diffraction in horizontal direction.

It can be easily derived from (1) that the intensity along the α-axis ($\beta = 0$) is identical with the intensity obtained with variable-density film, if the same percentage modulation is used. Thus all orders higher than one vanish, as can be seen in Fig. 1.

The intensity along a line of order n is mainly given by a Bessel function of that order. A Bessel function of order n remains practically zero for low values of the argument and reaches its first maximum for a value of the argument equal to approximately $n + 1$. This accounts for the peculiar cross-like shape of the diffraction pattern. The legs of the cross can be shown to stand perpendicularly to the maximum gradient of the sound track. The intensity is furthermore alternatively given by a sine for even and a cosine for odd orders. This explains the set of equidistant zeros, which may be called p-zeros. An alteration of the modulation q only affects the q-zeros determined by a Bessel function and thus only alters the shape of the cross. Alteration of the width of the zero track $2p$ only affects the distance of the p-zeros determined by a sine or cosine.

The formula (1) given here is the formula for bilateral modulation. If unilateral modulation is used, the trigonometric factor vanishes for all orders but zero, so that the intensity for these orders is given by a Bessel function divided by its argument.

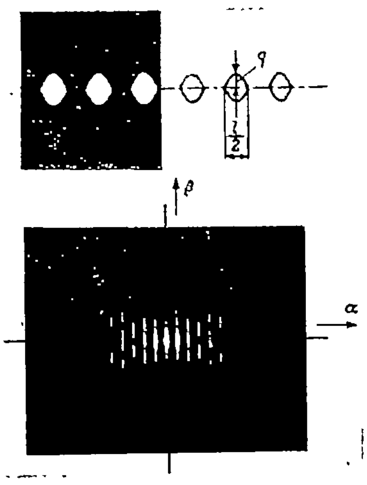

FIG. 2.

If more frequencies are present in the sound, the intensity along the α-axis is again identical with the intensity obtained by variable-density film and thus provides a visual Fourier analysis of the sound.

An interesting example is shown in Fig. 2. The width of the track is $q \sin 2\pi x/l$ from 0 to $l/2$ and zero from $l/2$ to l. In sound film practice this corresponds to zero value of the zero track. The Fourier spectrum only contains the orders 0, 1, 2, 4, 6, 8 . . . Higher odd harmonics should not be present. Fig. 2 confirms this expectation : along the α-axis only even higher harmonics are present.

For odd orders the intensity is given by

$$\frac{1}{\beta^2} \cdot J^2_{2n+1}\left(\frac{2\pi\beta q}{\lambda}\right) \quad . \quad . \quad . \quad . \quad (2);$$

and thus, but for the trigonometric factor, identical with (1). For even orders, however, the intensity is given by

$$\frac{1}{\beta^2} \cdot \Omega^2_{2n}\left(\frac{2\pi\beta q}{\lambda}\right) \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where Ω_{2n} stands for a Weber-Lommel function of order $2n$. For small values of the argument, Weber-Lommel functions of even order can be represented by the first power of the argument. The intensity along the α-axis is therefore different from zero. For higher values of the argument the behaviour of Weber-Lommel functions is very much like that of Bessel functions, appreciable intensities not being reached for values of the argument lower than the order. The observed zeros are in very good agreement with the calculated ones.

The original idea of Brown has hereby been greatly extended. Whereas the behaviour of variable-density film can be deduced immediately from the theory of optical gratings, this is not the case for variable-width film. It would seem that to the two well-known types of optical gratings, modulation of the amplitude and modulation of the phase of the incident light, a third new type, modulation of the width of the grating, is added.

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Specific Heat of Carbon Dioxide at Low Temperatures

A NEW Raman line with $\Delta\nu = 58$ cm.$^{-1}$ was observed by us[1] in the Raman spectrum of solid carbon dioxide at − 80° C. Since the heat capacities of solid carbon dioxide at low temperatures are known[2], it may be of interest to examine whether these values agree with those obtained from a corresponding Debye function. If the value of $\Delta\nu$ of the observed new line be taken as 63 cm.$^{-1}$, in view of the fact that this value increases slightly at low temperatures in other cases, the value of $h\nu/k$ is 90·3°. If the line be due to lattice oscillation, the values of C_v should be given by the corresponding Debye function with three degrees of freedom, because the crystal being cubic, ν has the same value for the three degrees of freedom. The calculated values are given in the second column of the accompanying table, and the observed values of C_p are given in the last column. It can be seen that the former are much greater than the latter at low temperatures. This shows that the new line is not due to a lattice oscillation involving translational motions of the molecules.

T	C_v for D.F., $\theta = 90·3$	C_v for two E.F., $\theta = 90·3$	C_v for one E.F., $\theta = 90·3$ and D.F., $\theta = 168·8$	C_p observed
19·4	2·46	0·836	1·08	1·08
22·0	2·91	1·144	1·49	1·46
25·4	3·41	1·524	2·04	2·06
31·8	4·11	2·11	3·04	3·28
37·8	4·55	2·518	3·85	4·38
44·2	4·88	2·838	4·58	5·46

Again, if the new line be assumed to have its origin in angular oscillations postulated by Pauling[3], its contribution to the heat capacity would be equal to that of two Einstein functions corresponding to two degrees of freedom perpendicular to the axis of the molecule. These values, given in the third column of the table, when compared to the observed values of C_p, show that the contribution of some other Debye function, which has to be taken into consideration, becomes superfluous. Hence the new line cannot be due to these angular oscillations.

The contributions to C_v of one Einstein function with $\theta = 90·3°$ and of a Debye function with three degrees of freedom and with $\theta' = 168·8°$ agree fairly with the observed values of C_p, as can be seen from the last two columns of the table. The observed values of C_p at higher temperatures are higher than the calculated values of C_v, probably because the value of $C_p - C_v$, and also the contribution due to angular oscillations, become appreciable. The observed heat capacities therefore show that, besides the lattice oscillations, another oscillation responsible for the origin of the new line takes place at low temperatures, the nature of the oscillation being such that its contribution to C_v is that of the corresponding Einstein function. It appears that this oscillation takes place in pairs of carbon dioxide molecules, the molecules in each pair being connected to each other by a weak electronic bond.

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[2] "International Critical Tables", **5**, 86.

[3] Pauling, L, *Phys Rev.*, **36**, 430 (1930).

Structure of the Methane Molecule

AN explanation of the complex rotational fine structure of the 1306 cm.$^{-1}$ fundamental vibrational band of methane[1] has been found which is based on a tetrahedrally symmetrical model for the molecule. The cause of the splitting of the rotational lines is a Coriolis coupling between the rotational levels of this threefold degenerate mode of vibration ν_4 and the rotational levels of the infra-red inactive twofold degenerate vibration ν_2 at 1536 cm.$^{-1}$, which lies 230 cm.$^{-1}$ above it. The perturbation is appreciable in spite of the distance between the pairs of levels concerned, because the Coriolis coupling term in question is essentially a first-order term in the Hamiltonian. A general expression for this term in methane was given by one of us in a previous paper[2]. It involves the components of vibrational angular momentum obtained by combining the displacements of ν_4 with the momenta of ν_2 and *vice versa*[3]. It is to be noted that since the two vibrations belong to different symmetry types, the perturbation affects only the rotational levels and leaves the origin of the ν_4 band unaltered.

The perturbation, which produces a splitting as well as a displacement of the rotational levels, has been calculated up to the tenth rotational quantum number. From these perturbed levels a theoretical spectrum has been derived which agrees very well with the observed spectrum, even though we have not taken into account any change in the moment of inertia or any centrifugal expansion of the molecule. These latter effects are therefore probably small. It should be pointed out that theoretical intensities which take into account correctly the nuclear spin weights of the equivalent hydrogen nuclei have not been given before. We have made use of the recent work of Maue[4] to calculate these, and the theoretical intensities agree well with experiment (for example, $R(1)$ and $R(5)$ weak).

It is to be noted that when, as in the low-frequency fundamental of methane, the perturbation comes from above, the levels are all pushed down. This produces, since the perturbation increases with the rotational quantum number, a converging R branch, a diverging P branch and a broad Q branch which extends well into the P branch, thus producing the effects of an apparent increase in the moment of inertia. A perturbation from below would, however, produce just the opposite effect, namely, a divergence in the R branch, a convergence in the P branch and a Q branch extending into the R branch. The fundamental ν_4 of germane (GeH_4) does indeed appear to have this structure[5], and we have here just the required conditions to produce this effect, for the perturbing vibration ν_2 lies below ν_4 (Steward and Nielsen[5] give $\nu_4 = 934$ cm.$^{-1}$, $\nu_2 = 820$ cm.$^{-1}$) (In silane (SiH_4), on the other hand, the Q branch would appear to extend into the P branch[6] and this is in agreement with the assignment of the frequencies ($\nu_4 = 910$, $\nu_2 = 978$) given by Stitt and Yost[7] which makes the perturbation come from above. We would like to believe that the apparent additional Q branch found near 978 cm.$^{-1}$ in the 910 cm.$^{-1}$ band of silane comes from activity being imparted to ν_2 by the perturbation.)

Similar perturbations may be expected in the spectra of all polyatomic molecules possessing a threefold or higher axis of symmetry, for such molecules can have degenerate modes of vibration with a vibrational angular momentum, and if the conditions are fulfilled there may be a large Coriolis coupling between the rotational levels of different bands. Thus, for example, these new effects may be looked for in the perpendicular bands of the methyl halides and ammonia and possibly in the deformation bands of linear molecules.

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April 13.

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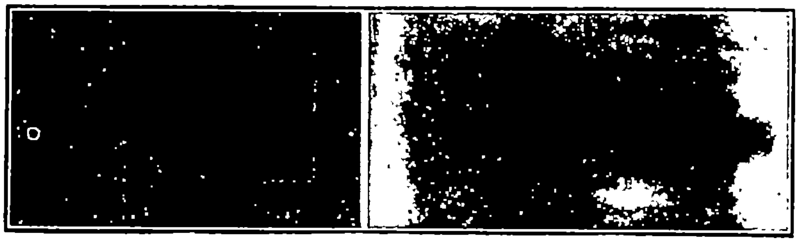
[6] Steward and Nielsen, *Phys. Rev*, **47**, 828 (1935)

[7] *J Chem. Phys*, **4**, 82 (1936).

Photographic Action of Artificial Radio-Elements

IN the literature concerning artificial radioactivity, we find no indication of attempts to show the photographic action of radio-elements. Accordingly we decided to carry out a few experiments, the results of which are given below.



(a) (b)

Fig. 1.

It is known that iridium irradiated with neutrons slowed down in paraffin shows a strong activity of period 19 hours. We placed an activated sheet of iridium directly on the emulsion of a photographic plate (Gevaert Super-Press 2,000). After 21 hours, development showed a neat photographic blackening (Fig. 1*a*). Similar attempts were repeated, arranging on the plate two similar iridium sheets, one irradiated, the other not so. The blackening was found only under the irradiated sheet. In subsequent attempts, the sheet was separated from the emulsion by interposing thin aluminium screens arranged in steps of increasing thicknesses : a blackening was found again, the intensity of which changes with the interposed thickness.

One of us (J. G.), having obtained a strong source of radio-phosphorus [1], an exposure of this kind of 48 hours was made with radio-phosphorus ; it gave the result shown in Fig. 1*b*. The copper rod covered with radio-phosphorus was about 1 mm. distant from the emulsion.

These first attempts show undoubtedly the photographic action of artificially produced radio-elements.

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[1] Govaerts, J , Nature, 141, 871 (1938).

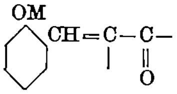
Specificity of the Salicylaldehyde Reaction of Csonka-Straub

A short time ago, Prof. A. E. Braunstein[1] discussed the specificity of the salicylaldehyde reaction proposed by Csonka for the determination of acetone and by Straub for the determination of pyruvic acid, and suggested that a positive reaction is obtained with all compounds containing a CH_3CO group linked directly to a hydrogen or carbon atom, and that the reaction is negative with carbonyl compounds which do not contain the aforementioned grouping. The mechanism responsible for this range of specificity was stated to involve the possibility or otherwise of enolization ensuing in a strongly alkaline medium, leading to the formation of an enolate the colour of which was attributed to a cumulated double bond system.

On this view, ethyl acetoacetate, which gives a positive reaction, must condense through its methyl group and not through its reactive methylene group—a most unlikely occurrence (compare the formation of salicylacetylacetone from salicylaldehyde and acetylacetone). Positive results have been obtained in the salicylaldehyde test with diethyl ketone, propionaldehyde, cyclohexanone and methyl cyclohexanone, all of which on Prof. Braunstein's hypothesis should have given negative results. Prof. Braunstein describes the colours obtained in the test as yellow. While this is true of very dilute solutions, with more concentrated solutions the colours obtained are varying depths of red, changing with dilution through orange to golden-yellow. The limit of detection is attained when the red tint fails to deepen appreciably the lemon-yellow colour given by salicylaldehyde in alkaline solution. Employing a relatively concentrated acetone solution (a few drops in 5 ml. water) in the test, there separate out on prolonged standing dark red prisms with a green metallic lustre, using sodium hydroxide, or glistening bright red leaflets using potassium hydroxide. These have been shown to be the simple alkali salts of salicylacetone (sodium content 12·3 per cent). In very dilute solutions, where there is a large excess of salicylaldehyde, it is, of course, probable that disalicylacetone is also formed.

Similarly, benzalacetone yields a dark red sodium salt giving sodium 8·7 per cent. Acetophenone gives vermilion-coloured needles which on acidifying yield salicylacetophenone. The positive results given in the test by cyclohexanone and 1-methylcyclohexanone are supported by the observations of Borsche and Geyer[2] that the condensation products from salicylaldehyde and cyclohexanone and 4-methylcyclohexanone respectively give red solutions in alkali.

The mechanism of the colour reaction thus involves condensation of the salicylaldehyde with a methylene group in the α-position to an unsaturated group such as carbonyl (CO) and the formation of a simple alkali salt of the resulting compound. The chromophoric grouping is therefore



where M is Na or K. The function of the carbonyl group is to activate the adjacent methylene group. Positive results have been obtained with a 3 per cent solution of cyanacetic acid, in which the methylene group is activated by the unsaturated —C≡N group. Negative results have been obtained with fluorene, the methylene group of which possesses a certain amount of activity, no condensation taking place in this instance.

The range of specificity of the salicylaldehyde reaction is thus by no means so narrow as stated by Prof. Braunstein and the enolization mechanism is untenable. The test is more sensitive for acetone than for any of the other substances examined, which included pyruvic acid, ethyl acetoacetate, acetophenone, benzalacetone, acetaldehyde, propionaldehyde, methyl ethyl ketone, diethyl ketone, cyclohexanone, methylcyclohexanone and cyanacetic acid.

It is hoped to publish full details of the investigation elsewhere in due course.

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April 16.

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[1] Braunstein, Nature, 140, 427 (1937).

[2] Borsche and Geyer, *Annalen*, 393, 49 (1912).

A New Method of Resolving a Racemic Compound

Since the introduction of Tswett's technique of chromatographic adsorption, this process has been applied successfully to the separation of many isomeric or closely related substances, including the chlorophylls and the components of natural carotene. A few attempts have also been made to employ it for the resolution of racemic compounds by use of an optically active adsorbent, but without positive results.

After examining a number of cases, we have now succeeded in effecting a partial resolution of inactive *p*-phenylene-*bis*-iminocamphor, $C_{10}H_{16}{:}N.C_6H_4.N{:}C_{10}H_{16}$, in the following manner. A weak solution of the compound in petroleum-benzene mixture (8 : 1) was allowed to flow down a tube filled with solid lactose, when the compound was adsorbed forming a broad pale yellow band in the upper part of the tube. The adsorption band was then 'developed' by washing it with the same solvent mixture until the faintly coloured layer practically filled the tube. On pushing the lactose column out of the tube, dividing it into four quarters and recovering the adsorbed material from the top and bottom fourths, respectively, by extraction with chloroform, a partial resolution was found to have occurred. *d-p*-Phenylene-*bis*-iminocamphor is more strongly adsorbed on lactose than its lævorotatory isomeride, and the product recovered from the upper fourth gave after purification from a trace of lactose, $[\alpha]_D + 90°$ (in chloroform): the product from the lower fourth had $[\alpha]_D - 50°$, both values remaining unchanged after further crystallization. As pure active *p*-phenylene-*bis*-iminocamphor has $[\alpha]_D \pm 1{,}500°$, the above process represents a separation of the dextro form in about one sixteenth of its maximum optical purity. Experiments are in progress with the object of increasing this degree of separation. When completed, the details will be published elsewhere.

As is well known, the success of chromatographic adsorption methods rests largely upon the correct choice of solvent and adsorbing medium. The facts recorded above thus open the way to further investigations which may lead to the discovery of cases in which resolution is more readily achieved. The method has the advantage that it is not dependent upon the presence in the asymmetric molecule of a carboxyl, amino or other chemically reactive grouping.

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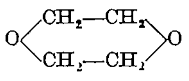
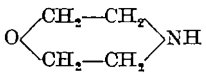
Dipole Moment and Structure of Morpholine

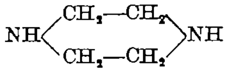
WE have determined the dipole moment of morpholine* in benzene solution at 20° and have obtained a value of 1·48 (Debye units are used throughout). The result is of interest as the structure of morpholine (II) can be compared with those of dioxan (I) and piperazine (III).



I



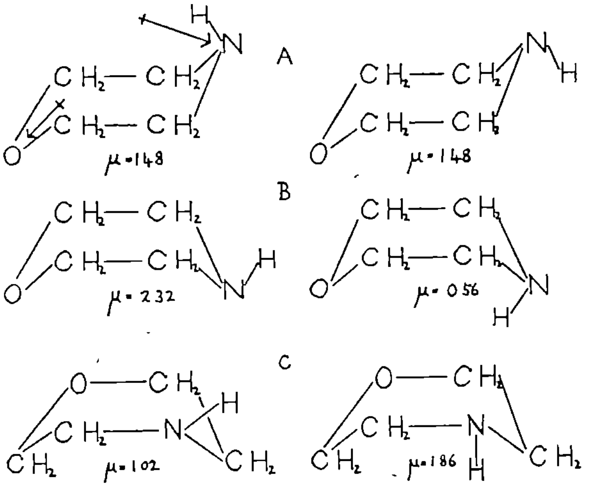
II



III

There are three possible configurations of the six-membered dioxan ring[1]. The Sachse *Z*-form would have zero moment, while the moment of the symmetrical *U*-form would be approximately 2, and that of the unsymmetrical *U*-form would be approximately 1. The experimental value of the moment of dioxan is 0·4–0·5, both in benzene solution and in the vapour state[1,2]. Kubo[1] concludes that dioxan exists in the *Z*-form, but there may be a small amount of either of the *U*-forms present.

In the case of morpholine, there are two possible *Z*-forms and two symmetrical *U*- and two unsymmetrical *U*-forms, because in each case there are two positions which the hydrogen atom attached to the nitrogen can take up with respect to the rest of the molecule. We have calculated the moments of the six forms using atomic distances and angles from recent work on electron diffraction[3]. The moment of ether (average value 1·18) has been used for the $\mathrm{O}\langle^{\mathrm{C}}_{\mathrm{C}}$ group moment and that of diethylamine[4] (1·13) for the $\mathrm{HN}\langle^{\mathrm{C}}_{\mathrm{C}}$ moment. The direction of the latter moment was calculated from those of ammonia and triethylamine, and was found to make an angle of 80° with the CNC plane. The moments of the six forms, that is, the *Z*-forms (*A*), the symmetrical *U*-forms (*B*), and the unsymmetrical *U*-forms (*C*) are shown in the accompanying diagram.



The experimental value of 1·48 agrees with either of the two *Z*-forms, and from the results for dioxan it seems that this is the most probable interpretation. The possibility of small amounts of the four *U*-forms cannot be entirely excluded.

Piperazine, for which a moment of 1·47 has been found in benzene solution by Martin and Partington[5], is an analogous compound for which there is a larger number of possible configurations. Assuming a *Z*-form of ring for this compound, and that all positions of the hydrogen atoms are equally probable, calculation gives a value of 1·52, in good agreement with experiment.

The complete results will shortly be published.

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April 27.

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* Specimen kindly given to us by the General Metallurgical and Chemicals, Ltd.

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[2] Hunter and Partington, *J. Chem. Soc.*, 87 (1933); Smyth and Walls, *J. Amer. Chem. Soc.*, **53**, 2115 (1931).

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Biological Sciences

Halteres of Flies as Gyroscopic Organs of Equilibrium

IN insects belonging to the group Diptera the second pair of wings is modified into a pair of dumb-bell shaped organs, called halteres or balancers, which consist of a thickened base bearing numerous sense organs, a shaft, and a swollen blood-filled end (Fig. 1, A). During flight the halteres are vibrated rapidly through an arc of about 90° in the vertical plane with a frequency which is almost certainly identical with that of the wing beat. In *Calliphora*, *Lucilia* or *Phormia* this is about 200 times per second.

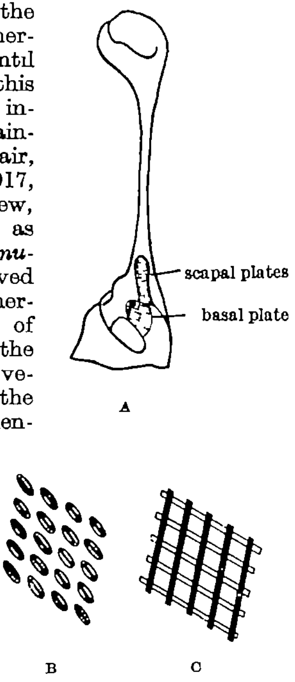

Fig. 1.

It has been known for a long time that without halteres the insect cannot fly, but otherwise behaves normally. Until about twenty years ago, this was attributed to the inability of the animal to maintain its equilibrium in the air, but v. Buddenbrock (1917, 1919[1,2]) rejected this view, and regarded the halteres as "stimulation organs" (*Stimulations-organe*) which served to stimulate the central nervous system into a state of activity indispensable for the execution of the flight movements. We have come to the conclusion that v. Buddenbrock's conception of a purely stimulatory function for the halteres is wrong and that the old balancer theory is in principle correct. The following are the main points of the experimental evidence :

(1) In flies deprived of their halteres, flight can always be induced through the so-called flight reflex, that is, by lifting the fly off the ground and suspending it freely in the air[3]. Certain species (*Phormia terra-novae R.-D.*, *Lucilia sericata* Mg.) fly under these conditions for as long as normal flies.

(2) It is confirmed that immediately after removal of the halteres the flies do not take to flight spontaneously and cannot be startled as readily as normal flies. But they become almost indistinguishable from normal individuals in this respect when tested one day after the operation. This suggests that the temporary loss of spontaneity is caused by a shock effect.

(3) The amplitude and frequency of the wing beat after the operation are identical with those of normal flies.

(4) Flies without halteres show a complete loss of control in the air and often fall on their backs, whereas those which are merely fatigued or have had their wings clipped fly downwards steadily and alight perfectly.

(5) This loss of control is particularly marked with regard to rotations about a vertical axis. Flies suspended freely from a piece of thread in the normal position spin irregularly round this axis.

(6) The loss of equilibrium in a fly without halteres can be almost eliminated by fixing a piece of cotton to the tip of the abdomen. This stabilizes the flight and largely compensates for the loss of equilibrium otherwise observed.

The mechanism by which the haltere acts as an equilibrium organ can be deduced from a study of the anatomical arrangement of the sense organs at its base. The most numerous type of organ present is the campaniform sensillum, the mode of action of which has recently been described by one of us (Pringle, 1937[4]) from experiments on the cockroach. On the legs of that insect the sensilla were found to be sensitive to the shearing strains set up in the exoskeleton by muscular activity, and a theory was developed to relate this behaviour to the structure of the sensillum.

The arrangement of the sense organs of the haltere base has been described accurately by Pflugstaedt (1912[5]). On the basal plate the sensilla, each of which consists essentially of an oval hole in the exoskeleton bridged over the top by a thin membrane, lie in regular rows and show a definite orientation in a direction which is diagonal to the length of the haltere (Fig. 1, B). The cuticle of this plate is so pierced with sensilla that its mechanical properties can differ little from those of a trellis (Fig. 1, C), which is relatively strong or weak in shear according as the resulting lines of compression and extension lie parallel to or diagonal to its component strips.

In flight the vertical vibration of the halteres will produce forces in the skeleton of its hollow base, and these will normally be of the type to which the basal plate is most resistant. Further, the sensilla of the plate, owing to their diagonal orientation, should be insensitive to such forces (Pringle, 1937[4]). If, however, while the halteres are in rapid movement, the whole body of the insect is rotated in any plane not that of the haltere vibration, lateral shearing forces will be set up in the cuticle of the base due to the gyroscopic action of the end knob ; and to these the basal plate should be least resistant and its sensilla most sensitive. The secondary forces due to the rotation will alternate at a frequency related to that of the haltere beat, and the sensilla will be excited at each cycle.

The haltere may thus be regarded as an alternating gyroscope, and the two organs, which are inclined backwards on each side at an angle of about 60° to the long axis of the body, could act together as an efficient equilibrium organ for fore-and-aft and directional stability. The experimental work shows that it is particularly in these planes of movement that balance is impaired by haltere removal.

The substance of this communication will be further discussed in separate papers dealing with its different aspects.

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April 5.

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Salinity Tolerance and *p*H Range of *Culex fatigans*

IN a paper on the biology of *Culex fatigans* Wied. in the Belgian Congo, Drs. Wanson and Nicolay[1] state that "at Banana the larval cycle is accomplished normally in concentrations of up to 30 grams of chloride per litre". Taking this figure as representing the total chlorides present, the salinity, $(S^\circ/_{oo})$, expressed as total weight of salts in grams per 1000 gm. of sea water, would be in the vicinity of 33·5. Hamlyn-Harris[2] states that in Queensland this mosquito rarely breeds in brackish water. No other references to *Culex fatigans* Wied. breeding in saline waters have been found, and it is generally regarded as a typical freshwater mosquito.

In a recent series of experiments carried out at Sydney, laboratory cultures of *C. fatigans* were reared in various dilutions of sea water, using tap water as a control.

The general technique of breeding was similar to that previously described by me[3].

It was found that larvæ would not develop normally in water with a salinity greater than 10 gm. per 1000. Where the salinity was very gradually raised during larval development, about 60 per cent of adults emerged from $S^\circ/_{oo}$ 11, about 15 per cent from $S^\circ/_{oo}$ 12, and none from $S^\circ/_{oo}$ 16. When first stage larvæ were transferred directly from $S^\circ/_{oo}$ 0 to $S^\circ/_{oo}$ 12, all died within a few days. Fourth stage larvæ transferred directly from $S^\circ/_{oo}$ 0 to $S^\circ/_{oo}$ 12 gave approximately 1 per cent of adults, and no adults emerged from large series transferred to $S^\circ/_{oo}$ 13·5.

All control series gave 100 per cent adults. Pupæ, on the other hand, transferred from $S^\circ/_{oo}$ 0 to $S^\circ/_{oo}$ 70 gave 100 per cent adults, while from $S^\circ/_{oo}$ 105, 85 per cent adults emerged. It will be seen from this that the pupæ are extremely resistant to high osmotic pressure in the surrounding medium.

With regard to the hydrogen ion concentration, the *p*H was lowered by the addition of dilute acetic acid to tap water, and it was found that 100 per cent of adults would develop from larvæ bred in water the *p*H range of which varied from 3·6 to 4·2. Similarly, by the addition of dilute sodium hydroxide, adults developed normally from larvæ kept in water which varied between *p*H 9·0 and 10·6. It may therefore be concluded that the hydrogen ion concentration in itself has no effect on the development *C. fatigans* within the limits of *p*H 4·2 and *p*H 9.

A detailed account of the experiments on salinity and hydrogen ion concentration will be published shortly.

In view of the importance of *C. fatigans* as a pest species and as a vector of disease, it would be interesting to know whether any other workers have records of it breeding in salt water. Possibly a salt water race of this species occurs on the coast of the Belgian Congo.

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April 1.

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Cytology of Metamorphosis in the Culicinæ

PROF. C. A. Berger[1] has apparently overlooked the work of Holt[2], who also investigated the larval gut of *Culex pipiens* during metamorphosis, and described multiple chromosome complexes of 9, 12, 18, 24, 36, 48 and 72 chromosomes. Holt's results do not agree with Berger's conclusion that there is a correlation between chromosome number and cell size in this case, and her illustrations show conclusively that any such correlation is fortuitous. Holt also describes the so-called 'prophase synapsis' of the sister chromosomes of the complex, which pair in three groups ($n = 3$), but she says that the cells with the largest multiples contain vacuoles and show signs of degeneration, and that these cells ultimately degenerate, and are absorbed by the newly formed imaginal cells.

Actually, this synapsis is somatic pairing[3], which was most strikingly shown in Diptera, and especially in *Culex*, by Metz[4], and was first found by Stevens[5]. It is due to attraction between homologous chromosomes, which results in close approximation, but any appearance of fusion is due, Metz showed, to faulty fixation. The chromosomes are not closely coiled round each other, and therefore those torsion stresses which are essential in the production of chromatid breakage and chiasma-formation[3] are not present, and reduction by the ordinary mechanism of meiosis is impossible. Holt believes that the close somatic pairing of the multiple chromosome complexes finishes before the end of prophase, and mitosis is normal. Even were it to persist to metaphase, it would not lead to regular reductional separation, as is demonstrated by the work of Ribbands[6] on the hybrid *Lilium* × *testaceum*, where position correlation of univalents at diakinesis usually leads to their parallel secondary pairing at prometaphase, but nevertheless the distribution of the univalents towards the opposite poles at full metaphase is random.

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May 7.

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[6] Ribbands, C. R , *J Genet*, **35**, 1 (1937).

Bionomics of a Cattle Louse

In the course of a study of the life-histories and bionomics of cattle lice, I have found that the species *Solenopotes capillatus*, End., hitherto considered to be rare in Great Britain, is more common than has been supposed. I found the species first on dairy shorthorn cattle (cows, heifers and calves) at the Cooper Field Research Station, Little Gaddesden, Herts, and further investigations in the neighbourhood revealed the presence of this louse on three other farms. It thus appears that there is a high incidence of *S. capillatus* in Hertfordshire.

While engaged on field work in Scotland in April of this year, I was able to find these lice on cattle at three out of a total of seven farms, where I made examinations. This, I believe, is the first record of the occurrence of *S. capillatus* in Scotland. The localities of the three farms were Strathyre, Perthshire, and Bentpath and Langholm, Dumfriesshire.

These records prove to be more interesting when it is added that examinations conducted on thirteen farms disclosed the presence of *Bovicola bovis* on eleven, *Hœmatopinus eurysternus* on eight, *Linognathus vituli* on five and *Solenopotes capillatus* on seven. The species of sucking lice were confined to nine only of the thirteen farms, which fact signifies a relatively high incidence of *S. capillatus*. With a single exception, the infested cattle were all dairy shorthorns, and the parasites were found on both sexes of all ages, that is, bulls, cows, heifers, bullocks and calves.

The original record and description of *S. capillatus* was made by Enderlein[1] in Germany. Bishopp[2] recorded the species in the United States, where this louse appears to be widely distributed. The earliest record of the occurrence of the species in England (Cornwall) appears to be that of Noel Pillers[3]. Australian records are those of O'Connor[4] (Perth, W. Australia) and McCulloch and Noble[5] (New South Wales). Freund[6], who redescribed this insect in Germany, gives a detailed description of the external anatomy, comparing his observations with those of Bishopp.

The available evidence suggests that *S. capillatus* is widely distributed, and is possibly more important than has been supposed, and, further, that this louse should be included with the other three well-known species attacking cattle, when considering control measures.

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Succession in Birthcoat Kemp Follicles

Dr. A. B. Wildman[1], communicating the findings of the late Prof. J. E. Duerden, has recently written about the nature of the successors of birthcoat kemp in the merino, pointing out especially that an original kemp is sometimes followed, in the same follicle, by a fine non-medullated fibre.

In dissections of Romney skin taken about ten weeks after birth, a hair-cone has been found below a club-hair birthcoat kemp. In 1931 at this College, Miss Anthea Hefford showed, among other facts about sweat glands, that the follicle of a birthcoat kemp always possessed a sweat gland, but not so the newly developed follicle of a fibre added to the fleece in the early months after birth. At ten weeks, follicles with sweat glands were found with the tip of a new fibre just protruding from the wide mouth of the follicle. New fibres, similarly short, in follicles lacking sweat glands, were closely gripped by the sheath surrounding the emerging tip. At three months, non-medullated fibres, an inch or a half or so shorter than the long persistent birthcoat fibres, were found in follicles with sweat glands attached. The freedom from medulla of the successors of birthcoat kemps is brought home on examining in the benzol tray specimens from certain covered lambs in which the shed birthcoat kemps stand out at the tip of the staple, while below there is no medulla at all, or just a touch of it in the apical ends of fibres far fewer than the birthcoat kemps.

Differences in the nature of the successors (G_2) of birthcoat kemps (G_1) have been studied, especially on the middle of the back at the level of the attachment of the last rib[2]. For simplicity attention may be focused upon the successors of the largest birthcoat kemps, the halo-hairs, in fibre type arrays containing sickle-fibres, although a parallel story could be related for the 'plateau array', which, typically, lacks sickle-fibres. Amongst the immediate successors (G_2) of halo-hairs the presence of a big proportion of kemps is correlated with the shedding of a substantial majority, usually threequarters or more, of the large-ended sickle-fibres. Reasons have been published for attributing the shedding of kemp to vigour on the part of the follicle.

When there is little G_2 kemp, it has been concluded that the hairiness (medullation) of the persistent successors can, in some measure, be correlated with degree of freedom of shedding of the large-ended sickle-fibres, but that the medullation of these successors tends also to reflect that of large persistent birthcoat fibres, the curly-tip fibres.

Following the G_2 'crop' of kemp there may be another, or even two more crops of secondary kemps grown before the first shearing at some fourteen months. Such later kemp has been found in any abundance only in lambs in which the fibre type array is 'saddle', or a near approach to that array. Such an array is indicative of a mild pre-natal check. In the 'valley array' the pre-natal check is intense. In this array there is much G_2 kemp if halo-hairs are abundant and the large-ended sickle-fibres shed freely, but there is little later kemp (G_3 and G_4). The consequences of a pre-natal event are reaped, it is thus concluded, at the age of nine months.

Preliminary breeding experiments point to genetic factors being of importance in determining the above differences in the 'kemp history' of the fleece of the first year.

Not only does theoretical trichology have practical significance in wool production, but also that somewhat large domesticated animal, the sheep, grows good material for pure zoology.

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New Zealand. April 1.

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[1] Nature, **140**, 893–94 (Nov. 20, 1937).

[2] *N Z. J. Agric*, **48** (June 1934)

Acclimatization in Relation to Livestock Improvement

THE problem of the acclimatization of breeds of livestock exported from one country to another is interesting. Certain breeds quickly adapt themselves to certain environmental conditions far removed from those under which they were reared. But, generally speaking, the importation of domesticated breeds into countries of different climatic and soil conditions is regarded as a somewhat risky enterprise. The genetic constitution of the modern breeds has so changed during the last hundred years that many of them depend entirely upon human assistance, and have lost, to a great degree, the ability to live under natural conditions. If this happens in a country, it may be advisable to import foreign breeds of strong constitution which are better adapted than the local breeds, weakened through the continued use of false standards of selection over many generations.

An example of this is to be seen in the Zoological Garden at Warsaw. The European wild deer (*Cervus Elaphus*), from the forests which surround that city, when kept in the open paddocks at the Zoo during the winter, are very susceptible to colds, and usually succumb to pneumonia. On the other hand, the spotted wild deer, imported from India, running in similar paddocks and receiving similar treatment, show signs of robust health and maintain good condition throughout the winter. This observation is confirmed by others and appears to hold good for other Mammalia imported to Warsaw from the tropics.

Accordingly, one is forced to the conclusion that the genotype of the European deer has been weakened. These wild deer of Europe are kept under abnormal conditions. Not only is natural selection removed, but also, since the sportsmen shoot the best males, it is the least thrifty specimens that produce the next generation. These wild deer have to be artificially fed during the winter.

Accordingly, consideration of the problem of acclimatization of domesticated animals in European conditions must include the weakened condition of domesticated strains. It appears to me that this emphasizes the need for skilful selection on the part of the breeder of these domesticated strains, and that this is a more important factor in economical production than suitable environmental conditions. But, of course, the progressive breeder will make his choice of the right breed in its right environment.

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Cracow. April 12.

Sources of Calcium for Shell of *Ostrea virginica*

THE letter by Robertson and Pantin on "Tube Formation in *Pomatoceros triqueter* (L)"[1] points to the sea water as the source of the calcium required for the building of tubes. It is of interest that a similar condition apparently obtains in the case of *Ostrea virginica*. My observations in 1932–33[2] on the growth of oysters in Long Island Sound show that the deposition of the shell material continues throughout the winter even when other activities of the organism are reduced to the minimum. The weight of the shell increased when the temperature of the water dropped below 4° C. and the oysters were in a state of hibernation, unable to take in any food. During the same period the weight of the tissues remained constant. In view of the fact that there is no storage of calcium in the body of the oyster, an inference can be made that calcium and other salts required for the building of shells are taken in directly from the sea water.

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[1] NATURE, **141**, 648 (April 9, 1938).

[2] "The Biochemistry of the Invertebrates of the Sea", by Paul S. Galtsoff, *Ecological Monographs*, **4**, 481–490 (October 1934).

Toxicity of Mercury Vapour to Insects

Christensen, Krogh and Nielsen[1] have referred to the highly toxic effects of mercury vapour in a closed experimental chamber, and recorded the effects on mammals of this vapour arising from droplets of mercury spilled accidentally on the chamber floor. Previously Krogh[2] found a very high mortality among insect embryos on which he was carrying out respiration experiments. He attributed this to the toxic action of mercury vapour from minute drops of mercury which were always left in the tap-borings of his air sampling tubes. He states that it was known from unpublished observations of the Copenhagen physiological laboratories that mercury vapour was highly toxic to insect eggs. Burkholder[3], who cited Krogh's paper, found that eggs of the grasshopper, *Melanoplus differentialis* Thomas, died in a glass respirometer which had been calibrated with mercury although the mercury had been removed prior to the experiment.

Whilst carrying out toxicity tests on eggs of the bed-bug, *Cimex lectularius* L., in a fumigation apparatus containing mercury, I observed a high mortality amongst the controls. At 23° C. all the control eggs were killed in less than twelve hours. I traced this to the effect of mercury vapour, and found that other stages of the bug were only affected after several days' exposure. I also found that eggs of the flour beetle, *Tribolium confusum* Duv., were all killed within less than twenty-four hours, whereas other stages of this insect were unaffected by exposures of one week.

As mercury is extensively used in biological apparatus and the literature concerning its toxicity is very scattered, a note on the subject may be useful to other workers. The literature cited here does not pretend to be exhaustive, as observations on this phenomenon made by physiologists are not necessarily indicated by the title of the paper in which they are mentioned or noticed by abstractors.

Kunhi Kannan[4] first directed attention to the custom of Indian peasants of protecting stored pulses from pests by placing a drop of mercury in an excavated soap-nut in the receptacle used for storing. Though the practice had nearly died out, he investigated it and his results showed the value of what had long been regarded as a superstition. He pointed out that the action of the mercury vapour was only on the eggs of the insects concerned. Larson[5], acting on a suggestion of Kunhi Kannan's, found that both eggs and young larvæ of *Bruchus quadrimaculatus* F. were killed by exposure to mercury vapour. Dutt and Puri[6] confirmed the statement that it was insect eggs that were particularly affected, finding it true of several species of stored products pests and other insects. A dust containing metallic mercury as the toxic principle was found to be effective against pests of cereals by Cartwright[7].

On the other hand, Bovingdon[8] found no detectable difference in the results of fumigation experiments on adults of *Calandra* spp. and *Tribolium* spp., some of which were exposed to mercury vapour and others which were not. In the latter, the mercury vapour was trapped by passing the gas mixture containing it over gold foil.

There seems to be ample proof, however, that mercury vapour is highly toxic to insect eggs. Though other stages are not so seriously affected, it would probably be wisest to avoid the use of exposed mercury altogether in experimental work with insects and possibly other organisms.

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May 4.

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Blood Groups and Pigmentation

THE physical characters of the population of Rachrai (Rathlin Island, Northern Ireland) have already been described[1] and compared with those of the people of Sheffield[2].

A recent survey of the blood groups of the two peoples shows significant relationship between the stages of evolution of the blood group genes and those of the factors for hair and eye colour. Observations of blood grouping and of hair and eye colour were made on thirty males in Rachrai—there are some hundred and fifty on the island. The distributions of hair and eye colour conjointly agreed very closely indeed with those found at the first survey. One third were blue-eyed, one third had fair (blond) hair. One third were of the RR (or O) blood group, one third were B or AB. In Sheffield, one half were of the RR group, one tenth were B or AB; one half had fair hair, one quarter were blue-eyed. The Sheffield observations were made on more than three hundred individuals, both for blood and for hair and eye colour. Appropriate statistical tests showed that the populations differed significantly in the distributions of the characters named.

These observations agree with a formula of connexion between the proportions of fair hair (h), pure blue eyes (e), RR blood, and B (including AB) blood, namely:

$$\frac{e}{h} = P\frac{B}{RR},$$

where P is a parameter defined by the inequality: $1 < P < 3$. This formula is derived from a consideration of the genetic nature of the characters concerned, together with their reputed order of sequence in evolution. For Rachrai, P has the value 2·1; for Sheffield it is 2·4. The classification of eyes into blue and others, and of hair colours into fair and others, is based upon published studies upon the post-natal development of the Sheffield population[3, 4], in which such a classification was found to have significance.

An account of the work outlined above will be published in full.

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May 3.

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The Jump of Fleas

I CAN find nowhere any reference to an interesting peculiarity about the jump of fleas, though perhaps it may be common knowledge among those who train them to perform.

While I was studying in the Department of Entomology of the London School of Hygiene and Tropical Medicine, I observed a number of fleas jumping. They were contained in a petri dish and were watched under a large hand lens.

It casually occurred to me as I looked down on a stationary flea that its body was streamlined, but that the fat heavy end was its tail. Arguing from the flight of a dart, which will turn and fly point forward however it may have been thrown, I considered that a flea should travel tail first through the air.

It was an easy thing to check as fleas were all the while coming and going across my field of vision. I watched those that were landing and saw that they were in fact invariably facing the direction from which they had come.

Continuing, I noticed that a flea needs a space of about one to two inches in the air clear of obstructions for the process of turning its heavy end to the front, after jumping off. If it hits something during this part of the leap, it lands sideways and usually falls over. But if not interrupted, the leap carries the insect so that the first parts of its body to touch anything are the two back legs, which are carried in a convenient position ready for landing tail first.

If the landing place proved uncongenial, I suppose nothing could get away more quickly than a flea, already facing as it is the way it wishes to return.

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April 20.

Fertile Haploid Sectors by Partial Merogony in Mozaics of *Drosophila pseudo-obscura*

A STRAIN of *D. pseudo-obscura* gives a high proportion of mozaic offspring. In the majority of those obtained, only the X-chromosomes of the parents were marked and the phænotype of the mozaics consisted of a regular area showing the expected constitution and an exceptional area (usually less than half) in which the recessive genes of the paternal X were expressed. Of the fifty obtained in the first experiments forty-six were female with no suggestion of male tissue. The fact that they were completely normal as to sex suggested that the exceptional area was haploid in constitution, the complex, $1X:1A$, being known to be female. In addition, the exceptional tissue showed the greatly reduced size of bristles, eye-facets and wing-cells characteristic of haploid tissue. To test this hypothesis, a series of matings was made in which the autosomes as well as the X-chromosomes were differently marked in the two parents. Six more mozaics, all female, were obtained, and in each of these the genome of the father only was manifested in the exceptional region. This result suggests that the basis of mozaicism in these flies is some peculiarity following fertilization which permits of a division of the sperm nucleus before the fusion with the egg-nucleus becomes complete, so that a group of haploid cells is formed bearing the paternal genome which eventually form part of the adult fly. (There is also evidence that two separate sperms occasionally take part in development and also that two female pronuclei are sometimes involved, but the mozaics resulting from these contingencies are extremely rare, and are not here considered.)

The importance of these 'merogonic' mozaics lies in the opportunity they may give of studying the maturation processes of haploid germ-cells where the possibility of normal conjugation is absent. That maturation does take place under these conditions is strongly suggested by the breeding results of one of the few mozaics obtained, in which the haploid tissue formed half the abdomen. Her progeny included six patroclinous sterile sons. These were almost certainly not the result of either primary or secondary non-disjunction since our other work on non-disjunctional forms of this species shows that such males are produced in this way only with the greatest rarity. From their occurrence it is therefore inferred that the haploid germ-cells had undergone meiosis, which had resulted in the formation of some gametes containing all the autosomes but no X-chromosome. Such no-X eggs if fertilized by X-sperm would give patroclinous sons lacking a Y and therefore sterile. Moreover, these would form the only class recognizable as to their origin from the haploid or diploid tissue since, when the X as well as the autosomes was included in such gametes at maturation, they could only give rise to offspring of regular phænotype. The exceptional sons therefore probably represent about a quarter of the actual number of gametes capable of producing viable zygotes that had been elaborated from the haploid tissue of this mozaic. As in the case of triploids, there were probably many more gametes, anuploid as to their main autosomes, and hence giving inviable zygotes.

If these conclusions are substantiated by cytological observation on future cases, it will be clear that conjugation itself, or the presence of a chromosome complex capable of conjugation, though indispensable in the diploid germ-cell as a means of orderly segregation, is not, as such, a necessary step in the process of maturation. The lack of it could not therefore be plausibly invoked as an explanation of the failure of maturation to be initiated or to reach completion in species hybrids.

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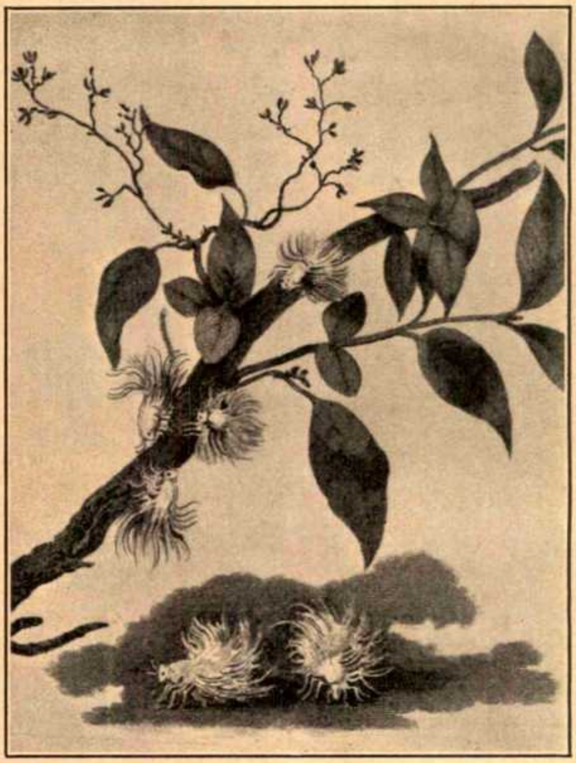
Staunton on the Wax Insect of China

SIR G. STAUNTON in his travels, "Embassy to China", published in 1797 in three volumes, describes, in vol. 1 on p. 352, a wax-producing insect that he observed in Cochin-China and not in China proper. He says, "These insects, each not much exceeding the size of the domestic fly, were of a curious structure, having pectinate appendages rising in a curve, bending towards the head, not unlike the form of the tail feathers of the common fowl, but in the opposite direction. Every part of the insect was . . . completely covered with a white powder. The particular stem, frequented by these insects, was entirely whitened by a powder . . . strewed upon it by them. The annexed engraving will convey some idea of what is here very imperfectly described. The powder was supposed to form the white wax of the East". He says further it is mixed with oils and moulded into candles.



Blanchard, in his "Coccides utiles", 1883, cites Staunton's work in his bibliography pertaining to the real Chinese wax insect, *Ericerus pela*. The engraving of Staunton, reproduced herewith, leaves no room for mistaking his insect for a scale insect, and it is surprising how Blanchard was led into such an error. Through the kindness of the British Consul-General in Chung King, I have been able to obtain some of the Chinese wax insects, which are entirely unlike the species illustrated by Staunton. It seems to me that the insect illustrated by him is probably a Cicad of the family Flatidæ, and what he saw may have been the larvæ of this unknown Cicad.

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Chromosome Numbers in Sugarcane × Bamboo Hybrids

THE sugarcane × bamboo hybrids recently produced at this station (Venkatraman, 1937), provide material for the study of the phylogenetic relationship of the genus *Saccharum* with other grasses. The gap covered by this cross is considerably wider than in the case of the *Saccharum* × *Sorghum* hybrids[1,2], or the *Saccharum* × *Erianthus* hybrids effected in Java[3].

The female parents employed were the two Java canes: *P.O.J.* 213—an interspecific hybrid between *S. officinarum* (Black Cheribon, $2n = 80$) and *S. barberi* (Chunnee, $2n = 82$); and *P.O.J.* 2725—a rather complicated hybrid cane between a number of 'noble' types and the *S. spontaneum* (*Glagah*) of Java. The male parent was *Bambusa arundinacea* Willd., a species which is common in South India.

Root tips of *P.O.J.* 213 showed 124 chromosomes at metaphase, somatic pairing of homologous chromosomes being very apparent. Bremer has reported 62 bivalents at the reduction division of pollen mother cell of this plant. He gives $2n = 106$–107 as the chromosome number of *P.O.J.* 2725[4]. Reduction division is somewhat irregular in this cane, and like a number of other hybrid sugarcanes, it has been known to produce both diploid and haploid gametes. Pollen sterility is very high in both the canes. As the ovules, however, are fertile, these canes have been used a great deal as female parents in the breeding programme at Coimbatore. 72 chromosomes were counted in the root tips of *Bambusa arundinacea*. Root tips of five of the hybrids between *P.O.J.* 213 and *Bambusa arundinacea* showed 96–100 chromosomes and one plant of the cross *P.O.J* 2725 × *Bambusa arundinacea* examined had 90 chromosome. These numbers represent approximately the sum of the haploid numbers of the two parents.

All the *Saccharum* × bamboo hybrids so far examined differ from the *Saccharum* × *Sorghum* hybrids in the fact that whereas the chromosome numbers of the latter indicate that viable embryos are formed from fertilization of both haploid and diploid gamates[5], in the former only those derived from fertilization of haploid gametes were found to be viable. They also differ from the *Saccharum* × *Imperata* hybrids (Janaki Ammal, unpublished), where viability is limited to such embryos as are derived from the fertilization of diploid gametes only.

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Pedocalic Tendencies in Soils of Southern England

THE late Dr. C. F. Marbut proposed the division of the soils of the world into two primary groups, namely, pedocals and pedalfers. Pedocals are soils developed under climates which are too dry to maintain a continuous downward movement of water to the water table. They therefore contain a horizon of accumulation of calcium carbonate (and sometimes other salts also) in the soil profile, usually in the *B* horizon. Pedalfers are soils developed under more humid climates. They are completely leached and contain no horizon of calcium carbonate accumulation. Thus the steppe and desert soils of the semi-arid and arid regions are distinguished from the podsolic and lateritic soils of the humid temperate and humid tropical climates. It has been generally accepted that the climate of Great Britain is too wet for pedocals to develop. Under free drainage conditions, therefore, horizons of secondary calcium carbonate accumulation should not occur.

Observations on the brown forest soils of Rumania, developed from calcareous lœss, were made by me, through the courtesy of Dr. Cernescu of Bucharest, in the spring of 1937. These showed calcium carbonate concretions at the base of the *B* horizon, although brown forest soils should belong to the pedalfer group. This anomalous position led me to make detailed observations of the soils in Berkshire developed from porous calcareous parent materials, since it was thought that the deposition of secondary calcium carbonate might be a function of the calcareous nature of the parent material.

Consequently, pits were dug on the Malmstone (Upper Greensand) and Calcareous Grit formations. The Malmstone soil, developed under mixed broad-leafed woodland and free drainage conditions, revealed small soft calcium carbonate concretions at a depth of 3 ft. 9 in. at the base of the *B* horizon and in the top of the *C* horizon. The soil on the Calcareous Grit, developed under very free drainage conditions, under a stand of Scots pine at least a hundred years old, revealed secondary deposition of calcium carbonate on the upper surface and in the cracks of bands of shattered rock. These occurred at a depth of 15 in. and again at 37 in.

Analytical data showed that the Malmstone profile was weakly podsolized, since some alumina had been lost from the surface horizons. Iron oxide was apparently stable, although exceptionally low in amount. The Calcareous Grit profile showed lateritic tendencies, since there was considerable loss of silica from the soil horizons. The silica-sesquioxide ratio is about 2·0 in the soil horizons and about 3·0 in the parent material. It is suggested in this connexion that all red-brown soils developed from calcareous parent material may show loss of silica from the soil horizons.

Observations on shallow downland soils near Wantage, developed from Upper Chalk, revealed secondary deposition of calcium carbonate at a depth of 6–8 in., the horizon being about 3 in. deep. The profile was calcareous to the surface, high in organic matter, with a good crumb structure, and showing the typical profile of an English rendzina. Chalk rock fragments occurred throughout the profile, but whereas these are normally humus-stained and therefore dark brown in colour in the soil, the secondary calcium carbonate, which was structureless, showed up as a white layer. This layer was very intermittent, frequently entirely absent, and in places only represented by isolated spots. I consider, however, that this profile strongly resembles the Continental *tshernosem* (steppe soil). Its shallowness is, of course, the result of erosion. In some localities the surface horizon may be completely leached of calcium carbonate and may be slightly acid in reaction, but it does not lose its steppe-like character.

Further observations have revealed secondary calcium carbonate in the parent material of Coral Rag, but not in the soil horizons derived from it. A striking example of secondary deposition of calcium carbonate was also observed in the glauconitic greensand of the Upper Greensand formation. In the upper layers of the parent material were numerous concretions of soft calcium carbonate, up to half an inch in diameter, which showed a ringlike structure in cross section. Evidently deposition had taken place around some non-calcareous material. Large amounts of calcium carbonate were also deposited in old root channels and round dead roots, showing up as a very striking white network in the greenish-grey parent material.

I suggest that secondary deposition of calcium carbonate will always occur in southern England when the parent material is calcareous. This calcium carbonate may lie within the soil itself or below it, at a variable depth in the otherwise unaltered parent material. The intermittent nature of the calcium carbonate accumulative horizon is considered to be caused by differences in moisture movements within the soil, due to small differences in the micro-relief, texture, etc. Calcium carbonate is deposited on upper rock surfaces, in cracks in the rock, in old root channels, and in the form of concretions. It is observed that these concretions are often deposited at the depth to which calcium carbonate is leached from the soil; this was also the case with most of the Rumanian soils examined.

It is of interest to note that Dr. C. F. Shaw, chief of the Californian Soil Survey, when on a visit to Great Britain for the Third International Soil Congress in 1935, observed what he described as an "apparent zone of lime accumulation" in a chalk profile in Kent. He goes on to say that this profile showed essentially the characteristics of the soils of an arid region, and ends up by asking "is there a region of arid soils in England?"

Since in England secondary deposition of calcium carbonate has not been observed in soils developed from non-calcareous parent material, I prefer to regard the phenomena in this country as a function of the calcareous nature of the parent material.

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April 12.

Adaptation Energy

ANIMALS continuously exposed to a uniform damaging stimulus (a drug, exposure to cold, excessive muscular exercise, etc.) at first display the symptoms of the 'alarm reaction'[1] and later pass into a resistant phase; sooner or later, however, the power of resistance is exhausted and the symptoms reappear. It has now been found that this third stage of the general adaptation syndrome may be reached more regularly and more promptly by withholding food.

Sixty female rats, two months old, were adapted to a temperature of 1° C., another group of sixty similar rats was treated with 0·2 c.c. of 4 per cent formaldehyde thrice daily, subcutaneously, while a third similar group was forced to run for 15 minutes thrice daily in 12-inch wheel cages rotated at 18–12 revolutions per minute. Six animals of each group were killed after 1, 6, 12, 24 hours and 2, 4, 6, 10, 17 and 22 days respectively. In another series of exactly parallel experiments, the rats were fasted for the last twenty-four hours before they were killed. It was found that fasting intensified the alarm reaction symptoms in the groups killed during the first forty-eight hours of treatment, but did not visibly affect those killed between the second and the tenth day. The rats killed after 17 or 22 days, and fasted, showed a return of alarm reaction symptoms; pronounced thymus and pancreas atrophy, adrenals brown and enlarged, multiple gastric ulcers and hypoglycæmia; while their non-fasted controls showed adrenals rich in lipids, less marked thymus and almost no pancreas atrophy and no gastric ulcers.

The eventual reappearance of such symptoms gives further support to the conception[2] that for adaptation the organism is dependent upon a special hitherto unrecognized type of energy. The present experiments show that while fasting is harmful during the stage of the alarm reaction when adaptation energy is not yet mobilized, and at the onset of the stage of exhaustion when adaptation energy is depleted; yet the animal in the resistant stage learns to perform adaptive functions more economically and with less dependence on the caloric energy derived from food.

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[1] Selye, Hans, NATURE, 138, 32 (1936); *Brit. J. Exper. Pathol.*, 17, 234 (1936); *Endocrinology*, 21, 169 (1937); *Arch. Internat de Pharmacodynamie et de Ther.*, 55, 431 (1937).

[2] Selye, Hans, *J. Path. and Bact.*, in the press.

The Piltdown Bone Implement

I IMAGINE that few archæologists who have made a study of palæolithic cultures, will dispute the Abbé Breuil's recent conclusion[1] that bone was much more extensively used in the earlier of these cultures than has been generally supposed. But his claim that the Piltdown bone implement owes its shaping to gnawing "by carnivores or rodents", is not, I think, likely to receive much support. The pointed end, and the butt-end, of this specimen are formed by a considerable number of facets which have every appearance of being produced by man. Some of these facets exhibit what may be termed a 'stepped' fracture, and this, I fear, has caused Breuil to conclude that animal's teeth have given rise to them.

In the experimental shaping of bone with sharp-edged flints and other stones which I carried out years ago, I found that this stepped fracture appeared frequently. A similar type of fracture is shown by certain flints, broken by some form of natural tension, in various deposits. Personally, I regard the Piltdown specimen as affording remarkably clear evidence of having been shaped by man—but I would be much interested to see the bones referred to by Breuil which have been gnawed by carnivores or rodents, and are said to mislead archæologists into believing that these bones are artefacts. I must confess that I am unfamiliar with such specimens.

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[1] NATURE, 141, 651 (April 9, 1938).

Chemical Identification of Œstrone in Human Male Urine

Laqueur, Dingemanse, Hart and de Jongh[1] first reported in 1927 that œstrogenically active substances could be obtained from the urine of healthy men. The necessity arose shortly afterwards of identifying these active substances chemically. The small amounts in which these active substances occur in adult male urine has so far made this impossible. Dorfman, Gallagher and Koch[2] tried to solve the problem in 1935 by means of comparative biological studies, but such investigations merely produced indications as to the nature of the œstrogenically active substance.

On the average, adult male urine was found to contain 70 international units per litre. If one assumes a biological activity equal to that of œstrone, this represents a substance content of 7 gamma per litre. This figure makes it perfectly clear that the chemical identification of the œstrogenically active substance in male urine can only be brought to a satisfactory conclusion when large amounts of urine can be worked up. Through the intervention of the N. V. Organon-Oss, for which we take this opportunity of expressing our thanks, it has been possible for us to work up 17,000 litres of male urine. The various stages in the process are briefly described in the scheme below. Tests of the œstrogenic activity of the various fractions on castrated mice served as a guide for judging the success of the separation.

In this way we succeeded in obtaining 6 mgm. of a single crystalline substance. This proved to be identical with œstrone.

	Crystals from male urine	Œstrone
Melting point .	256–260°	257–261°
Mixed melting point ..	No depression	
Optical rotation $[\alpha]_D$ ..	+153°	+160°
Physiological activity ..	$0\cdot1\gamma=1$ I.U.	$0\cdot1\gamma=1$ I.U.

In the melting point determination practically the same crystalline form was observed as with œstrone. The identity with œstrone of one œstrogenically active substance isolated from male urine is definitely established by the above results.

Œstrone, however, is only partly responsible for the œstrogenic activity of male urine. The extract obtained according to the scheme below can be separated into ketonic and non-ketonic fractions. Only a third to a half of the œstrogenic activity passes into the ketonic fraction. We are at present occupied with the chemical identification of the non-ketonic œstrogenic fraction.

PROCESS SCHEME

Urine: extraction of the hydrolysed urine by the usual method and separation of the comb growth promoting substances.

Benzene solution: evaporated to dryness and the residue partitioned between 70 per cent alcohol and light petroleum.

Alcoholic solution: extracted with benzene after dilution with water.

Benzene solution: washed with soda solution, then with sulphuric acid and extracted with 5 per cent sodium hydroxide solution.

Alkali solution: neutralization of the alkali until practically neutral and extraction with benzene.

Benzene solution: evaporated, the residue dissolved in ether, and extracted with 0·1 *N*-sodium hydroxide solution.

Ethereal solution: treated with Girard's reagent.

Ketonic fraction: submitted to several repeated fractional sublimations in a high vacuum at less than 0·0001 mm. mercury.

125–130° Fraction: recrystallized from methyl alcohol.

Œstrone.

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April 7.

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[1] *Klin. Wochenschr.*, 6, 1859 (1927).

[2] *Endocrinology*, 19, 33 (1935).

Points from Foregoing Letters

ON the basis of the theory of several 'time-scales', and from the fact that the equations of motion for a particle are unaltered in form when the direction of the trajectory of a particle is reversed, Prof. E. A. Milne and C. J. Whitrow conclude that all the other particles in the universe are relatively stationary, and consequently the universe is non-expanding.

Prof. V. V. Narlikar proposes a new boundary condition. It is in the tensor form and it is satisfied in the one-body problem as solved by Schwarzschild. He deduces from the condition a general result about the motion of a fluid at its surface and shows that this result implies the content of the geodesic postulate.

A discussion of isostasy leads Sir Joseph Larmor to the view that large accumulations of ice at the poles are not possible without an appreciable slowing down of the earth's daily rotation.

Prof. R. Emden points out that the energy content of the air in a room is independent of temperature and concludes that the reason why we heat our rooms in winter is not to add energy but 'entropy'.

A statistical investigation of the number of secondary cosmic rays produced in an iron-screened and unscreened Wilson cloud chamber, divided into five sections by four parallel lead plates 3 cm. thick, is described by Prof. B. Trumpy. From the results obtained he concludes that the soft components of the cosmic rays amount to about 27 per cent at the earth's surface, and that the hard components cannot be electrons.

Graphs showing the intensity of cosmic radiation at various heights near the pole of the earth's magnetic axis as compared with latitude 49° are supplied by Dr. H. Carmichael and E. G. Dymond. The results obtained both with ionization chamber and coincidence counters show that the radiation intensity is about the same, and indicate that cosmic rays of less than 3,000 M.e.v. do not exist in space, or are prevented from reaching the earth by some agency such as a solar magnetic field.

J. G. Daunt and Dr. K. Mendelssohn describe experiments indicating that the surface of a solid in contact with helium II is covered with a helium film through which the liquid is transferred to the lowest available level, the rate of transfer increasing the lower the temperature. From the amount of electrical energy which has to be supplied as current, before any apparent heating is observed in the upper part of a tube immersed in liquid helium II, A. K. Kikoin and B. G. Lasarew estimate that the thickness of the film is about 10^{-5} cm.

Dr. L. Tisza discusses a possible interpretation of the behaviour of helium II on the assumption that its viscosity is due only to the atoms in the 'excited' state, while the remaining atoms, 'condensed' in the lowest energy level, take no part in the dissipation of momentum. He concludes that a temperature gradient should arise during the flow of helium II through a capillary.

By means of a simple ultracentrifuge which dispenses with an optical system and costs only a few pounds, Prof. J. W. McBain and F. A. Leyda have been able to obtain, for the sedimentation velocity of egg albumen, values agreeing with those obtained by means of the expensive Svedberg ultracentrifuge.

Dr. J. F. Schouten describes the behaviour of a strip of variable-width sound film, such as is widely used in sound film practice, as an optical diffraction grating. The two-dimensional diffraction pattern obtained by modulating a pure tone is reproduced. Contrary to the spectrum of variable-density sound film, the spectrum of variable-width sound film contains all higher orders. The intensity along an order is mainly given by a Bessel function of that order.

From comparison of the observed heat capacities of solid carbon dioxide with those calculated from a new line observed in the Raman spectrum of that substance, S. C. Sirkar and Jagannath Gupta conclude that besides the lattice oscillations, another oscillation responsible for the origin of the new line takes place at low temperatures.

The complex rotational fine structure of the low-frequency fundamental vibrational band of methane is stated by Drs. H. A. Jahn and W. H. J. Childs to be due to a new type of perturbation involving a Coriolis coupling between this fundamental and another inactive fundamental of the molecule. A theoretical spectrum has been found which agrees well with the experimental measurements. It is pointed out that similar perturbations are to be expected in the spectra of other polyatomic molecules having a threefold or higher axis of symmetry.

Dr. T. Thomson states that positive results in the salicylaldehyde reaction of Csonka-Straub are not confined to substances possessing a methylcarbonyl (CH_3CO) group, and that therefore the enolization mechanism of the reaction propounded a short time ago by Prof. Braunstein is untenable. The reaction mechanism would appear to involve condensation through an activated methylene group and the formation of a simple alkali salt of the resulting compound.

A partial separation of an optically inactive compound (*p*-phenylene-*bis*-iminocamphor) into its optically active components, by adsorption on lactose in a Tswett column, has been observed by G. M. Henderson and Dr. H. Gordon Rule.

Prof. J. R. Partington and D. I. Coomber have obtained a value of 1·48 Debye units for the dipole moment of morpholine. The results agree with those calculated for a Sachse *Z*-form of heterocyclic ring for this compound, but the possibility of small amounts of the Sachse *U*-form cannot be excluded. The results are in agreement with those for dioxan and piperazine.

Diagrams of the structure of the 'halteres' or balancers (second pair of wings which in some insects are modified into dumb-bell shaped organs) are submitted by G. Fraenkel and J. W. S. Pringle, who disagree with Buddenbrock's conception of them as stimulation organs. The basal plate of the haltere has the structure of a trellis the resistance of which to shear is dependent upon direction, and the authors regard this, together with the end knob, as an alternating gyroscope, which gives the insect in flight fore-and-aft directional stability. They describe experiments to support this view.

Experiments carried out at Sydney by A. R. Woodhill show that *Culex fatigans* Wied. will not develop normally in water containing more than 10 gm. of salts per litre, unlike the previously reported case by Drs. Wanson and Nicolay, who reported normal development in water containing 30 gm.

C. R. Ribbands directs attention to the work of Holt, who investigated the larval gut of the mosquito during metamorphosis, and whose results do not agree with Prof. Berger's conclusion that there is a correlation between chromosome numbers and cell size.

H. J. Craufurd-Benson records the occurrence of *Solenopotes capillatus*, End. on cattle in England and Scotland, and suggests that this louse possesses a greater economic importance than has been suspected.

Dr. F. W. Dry describes various types of fibres which may succeed the coarse birth-coat hairs in Romney lambs. The immediate successors contain a large selection of kemp (coarse fibres) and after these there may be one or even more crops of secondary kemp before the first shearing when the lambs are fourteen months.

Prof. R. Prawochenski reports that the spotted wild deer imported from India, wintering in open paddocks at the Warsaw zoo, are more resistant to pneumonia than the European wild deer from the forests surrounding that city. He considers that the latter strain has been weakened by domestication and false standards of selection.

A significant relation between blood groups (as determined by serological reaction) and colour of the hair and eyes is indicated by observations made by M. A. MacConaill upon 30 Rachrai (Rathlin Island, Northern Ireland) inhabitants, and upon some 300 inhabitants of Sheffield.

Breeding experiments on the fruit fly *Drosophila pseudo-obscura* are described by Prof. F. A. E. Crew and Rowena Lamy which indicate that the basis of mozaicism structure in these flies is some peculiarity following fertilization which permits of a division of the sperm nucleus before the fusion with the egg-nucleus becomes complete. As a result, part of the adult fly has a 'haploid' constitution (with only half the usual number of chromosomes in the cell-nucleus). The authors state that the presence of a chromosome complex capable of conjugation is not a necessary step in the process of maturation.

E. K. Janaki Ammal shows that hybrids obtained by crossing Java sugarcane (female) with bamboo show that only the offspring derived from parent cells containing the basic (haploid) number of chromosomes survive. In this they differ from *Saccharum* × *Sorghum* hybrids, which give viable hybrids also from diploid parent cells (containing twice the basic haploid number of chromosomes).

The occurrence of secondarily deposited calcium carbonate concretions in or below the surface soil in Berkshire (Upper Greensand and Calcareous Grit formations) is reported by Dr. F. F. Kay. Such concretions are typical of 'pedocals' (soils developed under dry climatic conditions) hitherto not reported from England.

perhaps, arising from the feelings of a section among the natives themselves.

Rattray, while still an officer in the Service, was one of the first to fly to West Africa; and on his retirement, flying divided his interest with anthropology. He became one of the pioneers of gliding. It was his ambition that the club which he founded at Oxford should eventually become a friendly rival of the similar club at Cambridge; but this ambition is now left for others.

We regret to announce the following deaths:

Prof. A. E. Boycott, F.R.S., emeritus professor of pathology in the University of London, on May 12, aged sixty-one years.

Dr. W. Eagle Clarke, honorary supervisor of the Bird Collection and formerly keeper of the Natural History Department, Royal Scottish Museum, Edinburgh, on May 10, aged eighty-five years.

News and Views

Prof. Hans Geiger

The Council of the Physical Society has this year awarded the fifteenth Duddell Medal to Prof. Hans Geiger, of the University of Tubingen. The medal is awarded to "persons who have contributed to the advancement of knowledge by the invention or design of scientific instruments, or by the discovery of materials used in their construction". Geiger's connexion with Great Britain goes back to the days, early in this century, when he went to Manchester to study radioactivity under the direction of Lord Rutherford, and it will also be remembered that one of the early results of this happy partnership was the demonstration of the possibility of detecting a single α-particle by its electrical effect. The method in its original form was somewhat tedious and troublesome, but the invention of the 'point' or Geiger counter made possible much more rapid counting, the counting of β- as well as of α-particles and, in its more recent form, introduced by Geiger himself, even the differentiation of the effects produced by α- and β-particles. These early researches and inventions laid the foundations on which have been built the more modern elaborate and less exacting automatic methods of counting used in this field.

Geiger has also contributed notably to our knowledge of radioactive phenomena. In particular may be mentioned the experiments of Geiger and Nuttall, repeated later with greater accuracy by Geiger himself, to determine the ranges of the α-particles from various radioactive products. These experiments led to the formulation of the well-known rule connecting velocity and range, which gives a means of calculating velocities from known ranges with remarkable accuracy. But of outstanding importance are the experiments made in Manchester by Geiger and Marsden on the scattering of a beam of α-particles by thin sheets of matter. They recorded the striking observation that some of the α-particles in a beam directed on to a sheet of matter are deflected through very large angles and may even emerge on the side of incidence of the beam of α-rays. To explain the effect, Rutherford postulated the existence of large-angle scattering as the result of occasional single encounters with atoms. This led to the formulation of Rutherford's nuclear theory of atomic structure, with all its subsequent remarkable developments and far-reaching reactions on atomic theory.

Prof. E. Schrödinger and the University of Graz

Since the recent incorporation of Austria into Germany, little precise knowledge has been available as to the result of the change upon the position of some distinguished Austrian men of science. Upon inquiry we are informed that Prof. E. Schrödinger will continue to occupy the chair of theoretical physics in the University of Graz. The *Tagespost*, Graz, of March 30, publishes a letter from Prof. Schrödinger to the Senate of the University, in which he explains that he has not hitherto taken the active part expected of him in the National Socialist movement but is now glad to be reconciled to it. The last paragraph of his letter reads as follows: "Well-wishing friends who overestimate my importance consider it right that the repentant confession which I made to them should be made in public. I too belong to those who seize the outstretched hand of peace, because, sitting at my writing-desk, I have misjudged up to the last the real will and the true destiny of my land. I make this confession readily and joyfully. I believe it is spoken out of the hearts of many, and I hope in doing this to serve my country."

Dr. R. P. Linstead

Dr. R. P. Linstead, whose appointment to succeed Prof. G. M. Bennett in the chair of chemistry in the University of Sheffield, is announced on p. 943 is a distinguished younger worker in organic chemistry. Dr. Linstead is thirty-five years of age. He received his training at the City and Guilds College, Finsbury (1919–20), and at the Imperial College of Science and Technology, London (1920–25), graduating with first-class honours in chemistry in 1923. For a time he carried out research work in organic chemistry at the Imperial College, being awarded degree of Ph.D. (London) in 1926, and of D.Sc. (London) in 1929.

He received the Harrison Memorial Prize (awarded by the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry and the Pharmaceutical Society) and the Meldola Medal (awarded by the Institute of Chemistry), both of which are given for research carried out by a worker less than thirty years of age. His main researches have been carried out in the field of organic chemistry, but have not been entirely confined to this field. He has published seventy-four original papers in the *Journal of the Chemical Society*, of which sixty-five are essentially on organic chemical topics. He is joint author with Prof. J. F. Thorpe of the seventh edition of Cain and Thorpe's "Synthetic Dyestuffs", and has written a number of articles for the "Dictionary of Applied Chemistry".

Mr. A. J. H. Edwards

MR. A. J. H. EDWARDS has been appointed director of the Scottish National Museum of Antiquities in succession to Dr. J. G. Callendar, who died on March 19. Mr. Edwards is the son of the late Capt. John Edwards of Dundee, one of the last of the well-known arctic whalers. He was educated at Robert Gordon's College, Aberdeen, and joined the staff of the Natural History Department of the Royal Scottish Museum in 1906. In 1912 he was appointed assistant keeper of the National Museum of Antiquities, and in 1913 went to Germany to study the preservation of antiquities with Prof. Rathgon, principal chemist to the German Government Museums. During the Great War he served in Malta, Salonika, Egypt and Palestine in the ranks and as an officer on the General List. He returned to the Museum of Antiquities in 1919 and also continued studies abroad. Mr. Edwards has visited the large museums in Norway, Sweden, Denmark and France and has contributed from time to time articles on archæological subjects which have been published in the *Proceedings of the Society of Antiquaries of Scotland* and other journals.

The Herbert Jackson Prize

THE London Midland and Scottish Railway announces that the first award of the Herbert Jackson Medal and Prize has been made to Mr. A. S. Davison, of the Crewe Chemical Laboratory, for a paper on the "Chemical and Biological Examination of Water Supplies". This medal has been struck by the Company in memory of the late Sir Herbert Jackson, and is to be awarded annually to a member of the Company's research staff for the best written account of an investigation carried out in the Company's laboratories during the year. Sir Herbert Jackson was an original member of the L.M.S. Advisory Committee on Scientific Research, on which he served from 1930 until his untimely death in 1936. He played an invaluable part in guiding the earlier work of the Committee, and above all, in encouraging the many members of the Company's scientific staff with whom he came into contact, and the directors felt that it would be appropriate to perpetuate his memory by the foundation of an annual prize for the encouragement of scientific research.

Sunspot, Magnetic Storm and Aurora on May 11

ON May 10·4 a large sunspot, crossing the sun's disk between May 4 and 17, reached the central meridian. The sunspot had originated on the sun's invisible hemisphere, and it seemed of possible significance that the longitude of the spot, 189°, differed little more than 10° from that of the large and spectroscopically active spot associated with the great magnetic storm of April 16 (NATURE, April 23, p. 721). On May 11 at 15^h 52^m U.T. a magnetic disturbance began, and this developed within a few hours into a "great" magnetic storm which, reaching a maximum towards 0^h (May 12), was accompanied by a display of the aurora borealis. At Greenwich the aurora was first seen by chance at 23^h 48^m U.T. by two of the astronomical observers, though from other reports it must have appeared some minutes before this time. The aurora, which was bright and of a deepish red colour, was described as having the form of a fan-shaped bundle of rays the apex of which extended to about 10° south of the zenith; at 0^h 10^m only faint streamers were visible. Since there was bright moonlight at the time, this aurora must have been intrinsically a very bright one, and doubtless other features would have been seen had the sky been dark. The records from the Greenwich magnetic station at Abinger, kindly communicated by the Astronomer Royal, give the following (provisional) ranges: in Declination, 80′; in Horizontal Force, 960 γ; and in Vertical Force, 420 γ. There was considerable ionospheric disturbance affecting long-distance short-wave radio transmission during the period of magnetic disturbance.

THIS magnetic storm, as pointed out by Greenwich, adds yet another member to a recognizable group of storms indicating a "magnetically" active region of the sun, extending over about 120° of longitude, which has been in operation since the beginning of 1937. If for each of the thirty-five magnetic storms recorded since then at Abinger, the longitude of the sun's central meridian at the time of the respective commencements be tabulated, it is found that in twenty-four cases (nearly 70 per cent) the solar longitudes lie between 60° and 180°; the remaining eleven storms are spread over the remaining 240° of longitude. It may also be noted that the seven "great" storms occurring during the last fifteen months correspond to solar longitudes 120° to 180°. Paradoxical though it may appear from the well-established statistical relationship between large sunspots and large magnetic storms, the distribution in longitude of large sunspots (in area greater than or equal to 500 millionths of the sun's hemisphere) over the epoch January 1937–May 1938 does not, however, favour these particular longitudes, but is more or less a random distribution. It is, of course, impossible to say how much longer this "magnetically" active region of the sun will continue to be associated with terrestrial magnetic storms, but the return of these longitudes to the sun's central meridian centred about June 8 will be observed with interest.

Discovery of a Near New Star

Dr. Otto Struve, Yerkes Observatory, reports the discovery of a new star to which the name Wolf 424 has been assigned. It is described as of the twelfth visual magnitude, and its spectrum is of the very late *M*-type. As is well known, it is possible to determine stellar distances to a fair degree of accuracy from their spectral type. The examination of the spectra of stars of known distances shows that the intensities of certain lines in their spectra vary with the true luminosity of the stars. Conversely, by studying lines in the spectra of stars, the real light output can be estimated, and this, combined with the star's apparent brightness, furnishes the necessary data for determining the distance. In the case of the new star, this method has been applied, and the spectroscopic parallax so found shows that it is probably closer to us than α Centauri. It should be pointed out, however, that there is considerable doubt about the true distance, for various reasons. Very great accuracy in determining the intensities of the lines is essential, and in addition, if, as is possible, the star is a very close unresolved binary, this would vitiate the results to some extent. There is no doubt about the star being fairly close to us, for which reason its trigonometrical parallax can be determined in about six months and its distance found by this independent method. Until this has been done, it is advisable to suspend judgment regarding Dr. Struve's conjecture that it may be the nearest star.

Recovery of Comet Gale (1927 vi)

Mr. L. E. Cunningham, at Harvard, recovered this comet in the following position: 1938 May $1^{d}\ 5^{h}\ 51{\cdot}6^{m}$ U.T.; R.A. $17^{h}\ 23{\cdot}4^{m}$; S. Decl. 13° 4′; mag. 10. It is described as diffuse without central condensation or nucleus, and there is no report of a tail. Dr. A. C. D. Crommelin has deduced the following elements:

T	1938 June 18·47 U.T.	
ϖ	208·87°	1950·0
Ω	67 50	
i	11·62	
e	0·76085	
P	10·9966	

On May 18 the moon passed near the comet. As the object is moving rapidly southward it will be difficult for observers in the northern hemisphere to see it. The following ephemeris may prove useful for those who are favourably placed for observing it:

		R.A. 1950·0		S. Decl.		
1938 May	22·0	19^{h}	4^{m}	24°	41′	8·7
	30·0	19	55	30	6	8 4
June	7·0	20	53	34	46	8 2
	15 0	21	51	37	48	8·2

Dr. R. T. A. Innes has published a long paper on this comet and found a period of 4088·8 days. He predicted perihelion passage on 1938 August 24 and also a close approach to Jupiter in August 1917 (*Mem. Brit. Astro. Assoc.*, 30, Fifth Report of the Comet Section). As the period is now known with considerable accuracy, it will be possible to examine the closeness of the approach to Jupiter in 1917.

The Evolution of Electrical Power

Dr. A. P. M. Fleming gave a Faraday lecture on "The Evolution of Electrical Power" to the Institution of Electrical Engineers on May 12. Applications of electrical power are to be found in every branch of our modern communal life, and yet few of those who make use of them have any real appreciation of the discoveries in which the modern system of electrical power had its origin, of the part which scientific research has played in making modern developments possible and of the direction in which new scientific discoveries may cause its continuous evolution to proceed. Few men have entered with success, comparable to Faraday's, into such a diversity of fields of investigation. We may well marvel that with only simple self-constructed apparatus available, he was able to formulate laws and lay down principles which have stood the test of time. Since Faraday invented the first electrical generator, numerous types of electrical generators have been developed; but the principle underlying them all is the same.

Dr. Fleming directed attention to the continuous increase in the voltages now used, to the change over from direct current to alternating current generation, to the increase in running speeds and to the enormous increase in the power output provided by single machines. These changes are linked with contemporary developments—to the introduction and improvement of the steam turbine prime mover, and to the rapid growth of central generating stations and their associated transmission and distribution networks. The electromagnetic method is not the only means of converting natural sources of energy into electrical form. The extent to which recent discoveries in the physical sciences, such as those of controlled atomic disintegration, cannot yet be forecast, but it is certain that much that is purely scientific to-day will form the basis of new industrial developments to-morrow. The spirit of Faraday is still at work, but now it works through many brains and with many hands so that who can say where it will lead?

Expedition to Greenland and the Canadian Arctic

In his Friday evening discourse at the Royal Institution on May 13, Mr. J. M. Wordie described "An Expedition to North-West Greenland and the Canadian Arctic". The objects of the expedition were in part geological, in part archæological, but in the main to investigate cosmic ray intensity near the north geomagnetic pole by means of free floating balloons. The expedition sailed from Leith at the end of June, 1937. The cosmic ray observations were undertaken at various points in West and North-West Greenland, and six flights altogether were made. Two different types of apparatus were in use, one designed by Mr. E. G. Dymond which consisted of a triple-coincidence Geiger counter set with wireless transmission of the counts and the barometric pressure, the other constructed by Dr. H. Carmichael consisting of a miniature ionization chamber with electroscope and a small camera which photographed the latter at work and at the same time recorded the temperature and atmospheric pressure. [Some of the results obtained are described by Mr. Dymond and Dr. Carmichael on p. 910 of this issue.] The greatest height reached from which a successful record was obtained was a little above 17 miles. In addition pilot balloons for testing the upper air currents were flown on twenty-eight occasions to heights in many cases of nearly 20 miles. From Thule in North-West Greenland the ship proceeded through Smith Sound to Kane Basin, and archæological investigations were made at a long abandoned Eskimo site at Buchanan Bay, Ellesmere Land, and continued in Jones Sound on North Devon Island. On the return journey the ship touched at North-East Baffin Land, which was found to be a region of long fjords which penetrate a glaciated mountain country south-westwards into hill country of low relief.

Exploring as a Career

As a rule the explorer has turned to that work as the result of chance. An adventurous spirit, often combined with financial resources, has been the introduction to exploration. Comparatively rarely, at least in Great Britain, has the explorer had the scientific training that is necessary for adequate results to be obtained from his work. A pamphlet issued by the Institute for Research, Chicago, entitled "Exploring as a Career" discusses at length the training, opportunities and possible scope of the prospective explorer. Much stress is rightly laid on personal qualities and accomplishments which an explorer should show. Though somewhat naïve in parts, the pamphlet on the whole covers the ground and incidentally directs attention to the great amount of work still awaiting true scientific investigation. A criticism that might be offered is that while a training in science is deemed essential, there is a tendency to advocate too superficial and general a course of study including even the study of public speaking, rather than a more intensive devotion to one or more branches of science which would equip the would-be explorer with the capacity to undertake specific investigations and devise new methods of research.

Native Africa and the Cinema

AN interesting experiment in the instruction of the Bantu peoples in their tribal history and traditions has been undertaken, involving the co-operation of the administration and the people themselves. Major L. A. Notcutt, director of the Bantu Educational Cinema Experiment, has made a film dealing with the history, traditions and customs of the Wasamba, who live in the mountainous region behind Tanga in Tanganyika Territory. The members of the tribe, who took part in the film, it is stated in *The Times* of May 13, were directed by Mr. L. Vickers-Haviland, District Officer of the Wasamba tribe: while the tribal authorities agreed to contribute £40 towards expenses out of the amount the tribe receives for its treasury out of taxation for the pay of native courts, officials and other tribal expenses. The subject chosen by the members of the tribe themselves was the life of Mbega, a chief who lived some three hundred years ago, and was responsible for the foundation of the tribe as it exists to-day. The film shows his life in a series of major and minor incidents, beginning with the refusal of his father, an Arab, to allow him to be killed in accordance with the custom which prescribed that children who cut the upper teeth first, and consequently were believed to be evil, should be killed. Later incidents deal with his life as a hunter and wanderer, and the story closes with his consolidation of a number of tribes, of which he becomes the supreme chief. The natives, the producer states, took the greatest interest in ensuring accuracy of detail, and definitely elected for a film of an educational rather than a 'comic' character. The main work of the Bantu Experiment is to produce films of African life for educational purposes. It is promoted by the Department of Industrial and Social Research, and has received financial assistance from the Carnegie Trustees, the Union Government of South Africa and the Governments of the two Rhodesias.

Exhibition of Antiquities from British Honduras

A COLLECTION of antiquities from the Bay Islands, British Honduras, is on view at 10 Grosvenor Place, London, S.W.1, until May 31. The collection was formed by Lord Moyne during the summer of 1937, when a brief visit was paid to the islands and more than three thousand objects, mostly of stone and pottery, were obtained from sites known to the present inhabitants. Very few traces of burials or of skeletal material were found; nor was there any other evidence to suggest that the great majority of the specimens were of a funerary character. The shallow overlying soil showed no evidence of stratification. In a note on the collection, Mr. R. W. Feacham and Mr. H. J. Braunholtz (*Man*, May 1938) point out that the objects of stone and pottery exhibited show a remarkable range of development in form and design, and that the collection as a whole is, therefore, of the greatest interest, not only archæologically, but also from the point of view of the evolution of design. Some of the specimens have features typical of the Archaic pre-Aztec culture of the Valley of Mexico, while others have characteristics indicating a period of development extending from the end of the first millennium of our era to the close of the sixteenth century, not long before the original inhabitants were exterminated by Spanish colonists. Although the absence of stratification, and of evidence of the associations of different articles one with another, makes chronological sequence and cultural grouping uncertain, the size of the collection and the period of time covered makes it possible to verify and demonstrate the development of design convincingly by providing all the links in the chain without gap. Stylistically the evidence points to strong influence at various times from such widely separated regions as Panama, Costa Rica, Honduras and Mexico. The islands may have served as a trading station in pre-Columbian times, as the Pearl Islands did on the Pacific coast, whereby influences from various quarters would have been received and redistributed.

Accessions to the British Museum (Bloomsbury)

Among recent accessions to the collections of the British Museum (Bloomsbury), reported at the May meeting of the Trustees, is a notable addition to British antiquities. Mr. F. J. Durbin has presented to the Museum the collection of finds made some ten years ago by the late Mr. W. O. Klein when excavating the Romano-British temple at Worth, near Sandwich. It was then found that the Roman temple, built of stone and erected in the second half of the first century A.D., was situated on the site of a prehistoric British shrine of Early Iron Age date, not less than one, and probably four or five centuries earlier. Among the finds were British and Roman brooches, bronze votive offerings in the form of shields, iron and bone implements in large numbers, and a considerable quantity of pottery, ranging from the Iron Age to the Roman occupation. Among antiquities from the East reported at the same time were a fantastic bronze animal figure from Iraq of the older Babylonian period (about 2000 B.C.), and a painted terra-cotta figure of a horseman, which is said to come from Luristan in Persia, and in date is thought to fall between the eighth and fourth centuries B.C. Archæologists who are concerned with western Asia will also be interested in the announcement that a diary kept by Gertrude Lowthian Bell, apparently in Arabia in 1911, has been presented to the Department of Manuscripts by her sister, Lady Richmond. The bequest to the Museum by the late Mr. T. W. Gann of jade objects, pottery and other antiquities from Central America, acquired in the course of his journeys of exploration, has now been received. The jade objects, in accordance with his desire, will be kept together as a unitary collection.

Film Demonstration of Money Movements

In view of the recent discussions on "Science and Society" in our columns, many readers will be interested to learn that Prof. M. Polanyi, professor of physical chemistry in the University of Manchester, has produced a short film entitled "An Outline of the Working of Money". The film, which runs for 25 minutes and, except in the opening section, is in diagrammatic form, is divided into five parts. It deals in turn with the circular flow of money, the actions of saving and spending, the functions of the banks, depreciation and the role of the capital goods industries, and finally the interaction of these forces affecting the working of the economic system. In the preparation of the film, simplification of ideas has of course been necessary, but it presents a most interesting venture—so far as we are aware, the first venture—in the application of methods of visual presentation to economic theory. The film was first shown to members of the Manchester Statistical Society in March, and the Society has now published the full script of the film. The film itself, which is at present only available in a silent version, was made by Science Films Limited.

A Psycho-Technical Laboratory

In *The Engineer* of May 13 is an illustrated account of the new Psycho-Technical Laboratory recently erected at Viroflay, near Versailles, for testing candidates for employment on the French State Railways. The laboratory, which is under the direction of Prof. Laugier and his assistant Mlle. Weinberg, is stated to be the most complete of its kind in France. The equipment includes two machines for neuro-muscular tests, an electro-cardiograph, an apparatus for vigilant attention tests, a sound-proof cabin for hearing tests, and an apparatus for testing the candidate's response to visual signals. The room in which the electro-cardiograph is installed is completely darkened. The heartbeats of the candidate having been recorded on a moving band of photographic paper, a powerful light is flashed into the candidate's eyes and a loud and raucous motor-horn sounded, the test being designed to determine the heart's reaction to these sudden stimuli. Tests have been carried out for some years under temporary conditions, but they were not regarded seriously by the railway administration. It being observed that candidates rejected by Prof. Laugier prove less efficient and more prone to accident, has, however, led to the erection of the laboratory.

The Institution of Electrical Engineers

The report presented at the annual general meeting on May 12 to the Institution of Electrical Engineers, shows that it is in a very flourishing condition. The membership has increased from 13,561 to 18,252 during the last ten years. The use of the Institution's premises has been granted, without charge, to a number of kindred societies in connexion with their meetings and 188 such meetings have been held during the past year. It has been arranged that as soon as a member of any class has completed fifty years of membership he will automatically cease to be asked any further subscriptions. The Council has decided that facilities to attend Institution meetings and to use the reference library should, as a gesture of good will, be offered to Chinese electrical engineering apprentices and students who, under arrangements made by the Federation of British Industries, have been given opportunities for engineering experience in Great Britain with the object of improving and fostering relations with China. The Council is also giving more active support to the Engineer's 'German Circle'. The lectures given by this Circle are in German and are by eminent German-speaking engineers. On each occasion, they will be followed by a short discussion in German. Those present can thus further their knowledge of technical German.

The following award of premiums for papers read during the session 1937–38, or accepted for publication have been awarded by the Institution of Electrical Engineers: Institution Premium to A. D. Blumlein, C. O. Browne, N. E. Davis and E. Green; Ayrton Premium to the late H. W. Clothier and B. H. Leeson and H. Leyburn; Fahie Premium to F. G. Tyack; John Hopkinson Premium to Dr. W. G. Thompson; Paris Exhibition (1881) Premium to J. S. Pickles; Overseas Premiums to Dr. V. K. Zworykin, Dr. G. A. Morton and L. E. Flory; and to Prof. B. L. Goodlet; Extra Premiums to E. T. Norris, D. J. Bolton, A. H. Davis, O. W. Humphreys, C. E. Fairburn, W. Maurice, J. N. Waite; Wireless Section Premiums to T. C. Macnamara and D. C. Birkinshaw; J. Bell, J. W. Davies and B. S. Gossling; A. J. Gill and Dr. S. Whitehead; Meter and Instrument Section Premiums to K. J. R. Wilkinson, T. A. Ledward, C. W. Hughes; Transmission Section Premiums to Dr. J. L. Miller and Dr. J. M. Thomson (Sebastian de Ferranti Premium), Dr. S. Whitehead and Mr. E. E. Hutchings.

Centralized Control of Public Lighting

In a paper read to the Institution of Electrical Engineers on May 11 by H. Purslove Barker, a full account is given of the new methods of the centralized control of public lighting and off-peak loads, by superimposed ripples. Although clock-switches have to-day reached a high pitch of mechanical perfection, they are only suitable for services where the switching routine is prearranged and invariable. There are very few applications of this kind of switching where the time of the day is the only element which should regulate the operation of a switch. For example, in street lighting the correct time to switch on and off may be determined by the incidence of fog, war or other emergency. By the aid of a central transmitter it is now possible to transmit signals by ripples of current in the distributing and feeding mains, so that one signal acting on a relay turns street lights on, another controls off-peak loads and so on. The system can operate, from a central position, an unlimited number of inexpensive relays. It appears probable that in many areas very restricted lighting will be permitted during war-time, provided that it can be instantaneously extinguished. A centralized ripple control system is now used in Paris for operating warning syrens over a large area. The same ripple that is used to start warning syrens can also be employed to call air-raid wardens in their homes by the aid of a portable relay comprising a bell which can be plugged into any socket in the network. This system of control may prove useful for many purposes in the future.

Recommendations for Seed Potatoes

Potato growers when considering the purchase of seed for next year's planting should obtain the leaflet on seed potatoes which the National Institute of Agricultural Botany, Cambridge, issues free of charge. Despite the encouragement given to potato breeding by the Ministry of Agriculture, and Scottish and Irish Departments of Agriculture for many years, more than 90 per cent of the potato acreage in Great Britain is still planted with varieties which have been on the market for more than twenty years. In most cases, newer varieties could be introduced with considerable benefit, and it is suggested that growers who are naturally reluctant to discard varieties with which they are familiar should at least try small quantities of the newer kinds so that they can test for themselves the value of the recommendations made. In the first-early class, Arran Pilot and Doon Early are suggested, while Gladstone, Redskin and Arran Signet are the recommendations for second-early or main crop potatoes. For late main crop, Dunbar Standard and Arran Cairn both produce white kidney tubers of excellent quality. A number of the older varieties are susceptible to wart disease and possess such faults as poor shape, indifferent cooking quality and proneness to second growth, but these new varieties are immune from wart disease and are only recommended after careful trial. The certificates issued by the Ministry of Agriculture and Scottish and Irish Departments of Agriculture for growing crops of potatoes, are a reliable guide to the standard of health of the purchased seed, and growers should become familiar with the different grades, that they may understand the nature of the guarantee supplied.

Commonwealth Fund Fellowships Awards

The Committee of Award of the Commonwealth Fund fellowships has made the following appointments, among others, to fellowships tenable by British graduates in American universities for the two years beginning September 1938. These fellowships are offered by the Commonwealth Fund of New York, of which Mr. Edward S. Harkness is president: Dr. G. H. Benham, University College, London, to the University of Wisconsin, in biochemistry; Dr. Bernard Cannon, University of Liverpool, to Princeton University in mathematics; A. G. Cowan, University of Glasgow, to Brookings Institution, Washington, in economics; M. W. H. Davies, University College of North Wales, Bangor, to the Massachusetts Institute of Technology, in engineering; K. J. Laidler, Trinity College, Oxford, to Princeton University, in chemistry; E. H. Lee, Gonville and Caius College, Cambridge, to Stanford University, in engineering; M. W. Lister, Oriel College, Oxford, to Harvard University, in chemistry; J. M. Meek, University of Liverpool, to the University of California, in engineering; H. B. Parry, Queens' College, Cambridge, University of Edinburgh, and Royal Veterinary College, London, to the University of Wisconsin, in veterinary science; E. R. Roberts, Imperial College of Science and Technology, London, to the University of Minnesota, in agriculture; H. B. Whittington, University of Birmingham, to Yale University, in geology; P. V. Youle, University of Sheffield, to the University of California, in physical chemistry.

The following have been appointed to fellowships tenable by candidates from the British Dominions: A. M. Acock, University of Cape Town, and Brasenose College, Oxford, to the University of California, in botany; J. S. de Wet, University of Cape Town, Balliol College, Oxford, and St. John's College, Cambridge, to the Institute for Advanced Study, Princeton, in mathematics. The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: J. G. Crawford, University of Sydney, of the Rural Bank of New South Wales, Government of New South Wales, to Brookings Institution and Government agencies, Washington, D.C., in economics;

F. G. Forman, University of Western Australia, of the Department of Mines, Government of Western Australia, to Harvard University, in geology; L. A. Hurst, University of Cape Town, of the Department of the Interior, Government of South Africa, to the New York State Psychiatric Institute, in medicine; C. S. Plank, University of New Zealand, of the Post and Telegraph Department, Government of New Zealand, to the American Telephone and Telegraph Company, and associated companies, in engineering; Dr. V. A. Wager, Transvaal University College, and University of the Witwatersrand, of the Department of Agriculture, Government of South Africa, to the University of California, in agriculture. The following have been appointed to fellowships tenable by candidates holding appointments in the Home civil service: A. B. Cohen, Trinity College, Cambridge, of the Colonial Office; H. G. Gee, University College, and London School of Economics, University of London, of the Ministry of Labour; Robert Macdonald, University of Glasgow and Lincoln College, Oxford, of the Scottish Education Department.

Announcements

AT the general monthly meeting on May 9, Prof. W. L. Bragg was elected professor of natural philosophy in the Royal Institution, in succession to the late Lord Rutherford. Prof. Bragg, who is the son of Sir William Bragg, the Fullerian professor of chemistry and director of the Royal Institution, was recently appointed Cavendish professor of experimental physics in the University of Cambridge. He is thus the fourth Cavendish professor, following Lord Rayleigh, Sir Joseph Thomson and Lord Rutherford, who has also held the London professorship. At the same meeting Sir J. J. Thomson was re-elected honorary professor of natural philosophy and Sir James Jeans was re-elected professor of astronomy.

PROF. F. VERZÁR, professor of physiology in the University of Basel, will deliver a series of lectures on absorption in the intestine and the physiology of the adrenal cortex in the University of Oxford (Physiology Theatre, University Museum) on May 23, 24, 27, 30 and 31. Further information can be obtained from Prof. J. H. Burn, Department of Pharmacology, Oxford.

THE following appointments and promotions have recently been made in the Colonial Service: G. H. Addison, assistant curator of gardens, Straits Settlements; A. G. Bailey (agricultural officer), education officer, Kenya; R. M. Gambles (veterinary officer, Cyprus), veterinary research officer, Palestine.

AT the annual general meeting of the Institution of Civil Engineers held on May 10, Mr. W. J. E. Binnie was elected president for 1938–39 and will succeed Mr. S. B. Donkin on November 1. On the report of the judges (the president of the Institution of Civil Engineers and the president of the Royal Institute of British Architects), the Council has awarded a Charles Hawksley Prize of the value of £150 to Mr. Louis Matheson for his design of a multistoried public garage.

THE *Renaissance Française* has opened a subscription for a bust of the late Dr. Emile Roux by the sculptor Armand Bloch, to be presented to the Pasteur Institute of Paris of which Roux was director for many years.

THE eighth international congress for occupational diseases and accidents will be held at Frankfort-on-Main on September 26–30. Further information can be obtained from Ministerialrat Dr. Bauer, Unter den Linden 13, Berlin, 8.

THE fourth annual congress of medical electroradiologists will be held in the physics amphitheatre of the Paris Faculty of Medicine on October 5–8, under the presidency of Dr. Delherm. The chief subject for discussion will be neutrons and artificial radio-elements—their biological applications and therapeutic possibilities. Further information can be obtained from Dr. Morel-Kahn, 45 rue Scheffer, Paris.

THE first two volumes of Pavlov's works will be published by the Soviet Government this year in Russian, English, French and German. The first volume will contain his articles and speeches on social and political subjects and his works on circulation of the blood, and the second his observations on the physiology of digestion.

ACCORDING to statistics recently published by the Health Department of Palestine for 1936, the estimated population of Palestine at the end of June, 1936, was 1,269,952, of whom 781,789 were Arabs, 370,471 Jews and 106,473 Christians. The birth-rate was 53·14 per 1,000 among Mohammedans, 36·34 among Christians and 29 among Jews. The death-rate was 19·98 per 1,000 among Mohammedans, 12·63 among Christians and 8·83 among Jews.

VOL. 22 (1938) of the *Comptes Rendus* of the Carlsberg Laboratory is a jubilee volume in honour of the seventieth birthday of Prof. Sørensen, a portrait of whom is prefixed to it. Many papers (occupying in all 570 pages) by several well-known authorities cover a wide range of subjects, mostly of biochemical interest.

WE have received from Messers. Newton and Co., 72 Wigmore Street, W.1, their catalogue of the "Newton and Wigmore" British epidiascopes. Several types are listed, including inexpensive models for school use. The Newton projection microscope is another product supplied by the firm, the outfit ordinarily supplied being suitable for a ⅔in. objective. Messrs. Newton are also agents for the "Ampro" 16 mm. cinematograph projector, of which both sound and silent equipments are supplied.

Research Items

Classification of the Races of China

MR. CHUNGSEE H. LIU has attempted a classification of the races of China (*Zs. f. Rassenkunde*, 6, 2; 1937) in which he points out that the Chinese people are by no means a homogeneous unit as commonly supposed and examines critically the classifications of those anthropologists who have recognized this fact. Mongol, Mongoloid and Mongolian, are loose and unsatisfactory terms, and *Homo sinicus* is suggested to replace them. In the Chinese population as a whole, the physical characters are, in general terms: hair universally black, lank or coarse, straight, with almost circular cross-section; body and face hair very scanty; skin varying from yellowish to yellow-brown; eye colour light-brown; setting of eyes horizontal or oblique with epicanthic fold; cheek bones prominent, mesocephalic on the brachycephalic side; nose relatively flat with depressed nasal bones; mesorrhine; medium stature; slender or thick-set, hands and feet small. Within this general description, three types are recognized, which are distributed in accordance with the three great river-systems of China: (1) The Huangho type in the north, mainly found in the valley of the Huangho, the Liao Ho, and the Sungari River in Manchuria. This type is of high stature, dolichocephalic, leptorrhine, and of vigorous physique and robust feature. It is honest and frugal, slow but sure, chivalrous and conservative. The people speak the northern Chinese mandarin, and may be regarded as the archaic type of Chinese. (2) The Changkiang type, mostly confined to the Chang Kiang or Yangtze River valley in a favourable natural environment. This type is of medium stature, mesocephalic, mesorrhine, with light yellowish complexion. The people exhibit great literary power and ability. They speak southern Chinese mandarin with local dialects—the progressive type of the Chinese nation. (3) The Chukiang type in the Chu Kiang or Pearl River valley of southern China, with Fukien as an eastern corridor and Hainan Island beyond the sea. They are of shorter stature, brachycephalic, platyrrhine, of darker skin colour. Mentally this type is vivacious, and adventurous, quick in action and radical in thought. They speak various dialects of southern China.

Skeletal and other Remains from the Virgin Islands

REMAINS, skeletal and other, of the early inhabitants of the Virgin Islands, which had been discovered on Water Island, near St. Thomas, by Mr. A. H. Julien, were collected by Mr. J. S. Trevor in 1936. Burials of about twenty-one persons lay 2–3 ft. below the surface, in direct association with shells of the giant conch (*Strombus gigas*) and other gasteropods, small animal bones, probably those of the Indian coney (*Capromys brachyurus*), lumps of a red ochreous substance, stone implements and pottery. The skeletal remains are discussed by Dr. L. H. Dudley Buxton and the pottery by Prof. Gudmund Hatt of Copenhagen in *Man* of April 1938. As the skeletons had been reinterred, it was impossible to locate more than seven, but the occipital bone of an eighth individual was also found. These are represented by skulls, mostly incomplete, humeri, pelvic fragments, sacra, femora and calcanea, which are now in the Oxford collection. Measurements have been made by Dr. Buxton, who regards the material as too scanty to give anything but the most tentative results. In 1492, Dr. Charlotte Gower has concluded, there were at least three populations in the West Indies, possessing distinct cultures. These were the Caribs, the Ciboney and the Tains and/or Ygneri. Owing to the lack of any description of the physical characters of the aborigines for comparison, the present material admits of the addition of nothing substantial in the way of argument from the skulls. None of them displays artificial deformation, which is common in the Carib, but is said to be absent in the Ciboney. There is no high cephalic index, though the general tendency of the West Indian skulls is towards brachycephaly. High nasal indices and marked prognathism suggest negroid characteristics, but a secondary interment after the introduction of negro slaves seems unlikely. In his discussion of the pottery, Prof. Hatt affirms that the vessels are of pre-Columbian Indian origin. In form and ornament, the pottery resembles that found previously in St. Thomas and St. Croix. It is probably earlier than the Carib invasion and, therefore, Ignerian, that is, Arawak.

Vascular Anatomy as a Taxonomic Tool

THIS subject has received a very thorough treatment by P. A. Vestal (*Phil. J. Sci.*, 64, No. 3, November 1937) in connexion with the Hypericaceæ and Guttiferæ and allied families. The vascular characters that proved most significant were the dimensions of the vessels, the nature of their perforations and of the pittings upon their walls, the pitting and dimensions of fibre tracheids and the characters of the rays, particularly the uni-seriate rays. It is concluded that the groups studied fit very well with the taxonomic groups of Wettstein, the Parietales and Guttiferales, and that the anatomical evidence is more in favour of this author's treatment of these families or of their arrangement by Engler and Prantl than with their treatment by Hutchinson. The anatomical criteria found of value in this study agree very well with those of which the significance is underlined in a more general study of the same problem by L. Chalk (*Ann. Bot.*, N.S., 1, 409–428), but the latter author finds Hutchinson's arrangement of the Archichlamydeæ more in agreement with the evidence from anatomy than that of Engler.

Effects of Radiation on Polypore Fungi

THE results of a detailed investigation into the action of ultra-violet rays, X-rays, radium and sunlight upon three polypore fungi, formed the subject of the presidential address by Prof. S. R. Bose to the Botanical Society of India on January 6, 1938 (*J. Ind. Bot. Soc.*, 17, No. 1, 5; 1938). *Polyporus ostreiformis*, *Polystictus leoninus* and *Trametes cingulata* were the three species concerned, and the experiments were made with plate cultures upon malt extract agar. Ultra-violet rays and excessive direct sunlight diminished for a time the fertility of all three fungi, and in some cases even death ensued. Both hard and soft X-rays were studied; small doses gave slight injury, from which the organisms recovered quickly, whilst heavy doses totally suppressed sporophore formation. Conidia and chlamydospores, however, remained almost unaffected. No effect of X-rays in promoting saltations, or mutations in culture, was observed. Treatment of the three polypores with large doses of radium damaged the vegetative hyphæ and delayed the formation of fruit bodies, but subcultures recovered quickly. It is a notable fact that the three species mentioned will not fruit in darkness, so evidently they can tolerate, if not enjoy, the amounts of radiation present under natural conditions.

Action of Ammonia on Mercurous Chloride

ALTHOUGH the blackening resulting from the action of ammonia on mercurous chloride is now usually regarded as due to finely divided mercury, the nature of the other product has been the subject of discussion. H. R. Frecke and M. C. Sneed (*J. Amer. Chem. Soc.*, 60, 518; 1938) have shown that the course of the reaction is influenced by the concentration of aqueous ammonia (ammonium hydroxide) used, as well as by the time of reaction. The end-products with concentrated ammonia are a grey precipitate of the composition ($Hg + NH_2.HgCl$) and the water-soluble fusible compound $HgCl_2.2NH_3$. The latter on dilution partially decomposes into NH_2HgCl and ammonium chloride: $HgCl_2.2NH_3 \rightleftharpoons NH_2HgCl + NH_4Cl$, so that the total reaction would be: $Hg_2Cl_2 + 2NH_4OH = Hg + NH_2HgCl + NH_4Cl + 2H_2O$. In the case of dilute ammonium hydroxide, however, the speed of reaction is sufficiently slow to permit the identification of the intermediate products, namely, mercurous oxide (Hg_2O)—which does not amalgamate gold sheet—and ammonium chloride, which further react to produce metallic mercury and NH_2HgCl: $Hg_2O + NH_4Cl = NH_2HgCl + Hg + H_2O$. The authors consider that under ordinary conditions the reaction between mercurous chloride and ammonium hydroxide is best represented by the equation: $2Hg_2Cl_2 + 4NH_4OH = [Hg + Hg_2O + NH_2HgCl] + 3NH_4Cl + 3H_2O$.

Theory of Liquids

IN a series of papers published in Indian journals between 1934 and 1936 a theory of liquids was developed by Dr. T. S. Wheeler, who obtained formulæ for many liquid properties, such as surface tension, viscosity and heat of evaporation, in terms of interatomic forces of the Lennard-Jones type. A collected account of this work has now been published (*Trans. Nat. Inst. Sci. India*, 1, 333; 1938). The theory is based on simple physical ideas and uses only elementary mathematics. A liquid is regarded as composed of a number of force centres, each of which vibrates within a spherical space kept free from other molecules by its thermal motion, and the translational motion is assumed to be small compared with the vibrational motion. A number of formulæ have been derived relating certain properties of a liquid with one another, and when the Lennard-Jones force constants are substituted in them they give numerical results in fair agreement with experimental values. The method employs a number of simplifying assumptions such that the molecules of a liquid are uniformly distributed round any one, that within the free spherical volume in which each molecule moves there is no field of force, and that the formulæ of the kinetic theory of gases may be applied. There is no discussion of entropy or of free energy, on which alone calculations of vapour pressures can rigorously be based. None the less the paper gives a picture of a liquid which, while oversimplified, may help some workers on this subject to visualize liquid properties more easily.

Principles of Plant Design in Electrolysis

IN a paper on electrolysis discussed at a joint meeting of the Institutions of Electrical and Chemical Engineers on April 27, Dr. H. J. T. Ellingham concludes that although the principles on which the design and operation of plant for electrolysis depend are at least as simple and clear-cut as those for most other kinds of industrial process, their successful application requires close co-operation between the chemical engineer and the electrical engineer. This would ensure the co-ordination of the electrical and chemical factors in any particular problem in the most complete and appropriate manner. The paper sets out and correlates the relative electrochemical principles. Electrolytic processes may be carried out in order to obtain products such as metals, alkalis, oxygen and hydrogen, and various salts, which are to be marketed as such; but certain of these processes may also be worked as part of some other industry, as, for example, electroplating in the motor-car industry, alkali and chlorine in the manufacture of paper, and chlorates in the match industry. For many processes, electrolytic cells of various types have been patented, and units of standard size and output can be purchased from the respective manufacturers, for example, cells for the production of oxygen and hydrogen, or alkali and chlorine, and plant and chemicals for electroplating. Some electrolytic processes depend for their efficient operation on continuous working during day and night. These provide a very steady and continuous load for a power station. Many types of electrolytic operation are worked intermittently and a few, like oxygen and hydrogen, can be operated for irregular periods without much loss of efficiency. It would be advisable to arrange that these loads should be operated during 'off-peak' loads in conjunction with other intermittent electrical processes, so as to effect economies for both the chemical and electrical industries by securing a high load factor.

Spectrohelioscope with a Vibrating Slit Mechanism

MR. F. J. SELLERS, director of the Solar Section, British Astronomical Association, has described his own construction of a spectrohelioscope, involving certain departures from the standard type (*J. Brit. Astro. Assoc.*, 48, 6; April 1938). Mr. Sellers considered that oscillating slits would be more satisfactory than rotating prisms, and the spring-vibrating system is very simply operated by means of an electric contact-breaker, like an electric bell. The optical reversal occasioned by the collimating mirrors necessitates that the second slit should move in opposite phase to the first and remain parallel to it. A full description with a diagram is given of the various parts. Any amateur would be able to construct the various fittings required for the apparatus. It is interesting to notice that ordinary bell-battery dry cells operate the contact-breaker, and that these have been in use for eighteen months without serious signs of depreciation. Indeed, the whole apparatus has not given a moment's trouble since it was first tried in October 1936.

Roman Britain

RECENT study of Roman Britain has profited on the whole more perhaps than any other branch of archæological research in Great Britain by co-operation between the national administrative body, the Office of Works, with its statutory powers, the local authority, and the local archæological society, representing expert knowledge and instructed interest. A conspicuous example of the success of such co-operation is afforded by the excavation of the Forum of Roman Leicester, of which a part, the so-called Old Jewry Wall, was handed over to the custody of the Office of Works so long ago as 1920, but of which it became possible to ascertain the true character only after the site had been acquired by the Corporation in 1935 for public baths. Thanks to an enlightened, but economical, solution of the financial problem on the part of the authority, public and private funds were able to combine to carry out a thorough examination of the site in 1936 and 1937 under the direction of Miss Kathleen Kenyon, with the result that by a further public-spirited act on the part of the Corporation, Leicester now possesses one of the most striking and remarkable monuments of Roman Britain still surviving.

The character and history of the complex of which the Old Jewry Wall had been the only visible relic since the Middle Ages, though not completely revealed, especially in regard to some of the more interesting features, until the excavations of 1937, was apparent in the more important essentials when the work of 1936 was brought to a close. An account of the results of the first season's work has been published by Miss Kenyon recently (*Trans. Leicester Lit. Phil. Soc.*, 1936–37).

The earliest inhabitants of the portion of the site excavated in 1936 would appear to have been slightly Romanized Celts of the Belgic tribes; but as none of the pottery then found dated from before A.D. 40, it seemed likely that they had been attracted, whence is not known, by the legionary camp established here on the line of the Roman advance. In the following period, a town was laid out on Roman lines, some of the roads constructed passing over the pits of the first occupants. For the next fifty years or so, the houses along this road were built of wood with clay-filled walls and mainly occupied by the descendants of the original tribesmen. They were becoming gradually more Romanized. Then about A.D. 120 Leicester shared in the movement for setting up grandiose municipal buildings over Roman Britain. The area was cleared and the whole laid out as a basilica and forum in the usual Roman style and on a scale which compares with any in Britain. Though the later history is obscure, the site was undoubtedly occupied in the third and fourth centuries; but towards the close of the period, the neglected state of the roads points to the time when municipal organization was breaking down and trade and other civilized activities were failing. Thereafter, more especially with the Saxon occupation, the buildings served merely as quarries, the incorporation of the wall, which survived to modern times, in an early Saxon church probably being responsible for its preservation.

A further example of the valuable results which may accrue from such co-operation between public authorities and private bodies is afforded by recent work of the Letchworth Natural History and Antiquarian Society, for a report of which we are indebted to Mr. W. Percival Westell, honorary curator of the Letchworth Museum. The Hitchin Rural District Council in carrying out a housing scheme proposed to erect cottages partly on the site of the outer bailey of Great Wymondley Castle, near Hitchin. The scheme was approved by the Office of Works, provided that it were carried out under expert archæological supervision. This supervision was undertaken at the request of the Office of Works by the Letchworth Society. Unfortunately a drainage trench, which had yielded Romano-British pottery, had already been filled in before representatives of the Society arrived, nor could it be reopened; but a series of trenches was opened as near the line as possible. From these much interesting material was obtained. A large number of bases and sherds of Romano-British pottery was found, together with bones and teeth, tiles, nails and oyster shells. In one trench at a depth of 1 ft. 6 in. there was discovered a flint and rubble floor, measuring six feet in width and twenty-four feet in length, while at the south-west corner was a rubbish pit. An extension of the floor, but with much smaller flints, was found at right angles and at a depth of 2 ft. 6 in. This was 1 ft. 6 in. below the old turf level, which was plainly visible at a depth of 1 ft. below the present surface. In another trench was a circular layer of flints, within which was a rammed floor. This was without flints, and overlying it were many pieces of fired daub and cut pieces of wattle of elm wood. This would appear to be the site of a primitive oval thatched hut, probably for storage, and, it may be, pre-Roman. No pottery or other objects were found within the circle. The diameter of the circle of flints is 8 ft. The pottery found is of the first and second centuries A.D. and consists of coarse ware cooking pots, grey ware bowls, dishes and vases, and black ware. A few fragments only of Samian ware were found.

The activities of the Society in other parts of Hertfordshire have produced some interesting finds. At Baldock, an exceptionally rich region, two full-length skeletons, a quantity of pottery and building materials, as well as parts of British and Roman querns have been found. From South Road came a perfect large coarse ware brown urn, containing a heavy cremation with a Samian dish clamped at the side. This rested on the skeleton of a horse; and was found at a depth of three feet. A number of Romano-British finds are also recorded from Ashwell, Hitchin and Letchworth itself. The last named, the remains of four Romano-British pottery vessels, indicate that the rectangular pit-dwellings, such as recently were recorded at Hawthorn Hill, Letchworth, extended still farther to the north-west.

The excavation of the hill-fort known as The Caburn, near Lewes, which was described by Dr. A. E. Wilson before the Society of Antiquaries of London on February 10, was especially interesting for the evidence which it furnished of successive occupations. Pottery found in the old turf beneath the early rampart pointed to an occupation of an undefended village settlement dating at about 500 B.C. Then at about 250 B.C. the top of the hill was enclosed by a single rampart and ditch which are still visible as an inner work. At about 50 B.C. an extensive and ambitious scheme of refortification was undertaken, which included an outer rampart and ditch. This, however, seems not to have been completed. A complete rebuilding took place in the year, approximately, A.D. 50, when a full outer rampart and ditch were constructed. The site was then neglected for a thousand years, until in the eleventh century some refortification took place. The excavations have been carried out by Dr. Wilson on behalf of the Brighton and Hove Archæological Society, with the assistance of Dr. Cecil Curwen and Mr. G. P. Burstow.

An account with photographs of the recently discovered western postern for pedestrians of the Newport Arch at Lincoln is given by Mr. F. T. Baker in *Discovery* of February. This arch, famous for having been in uninterrupted use since its erection probably in the second century A.D., was the northern gateway of the Roman occupation. The surviving portion consists of the southern face of the main arch and an eastern postern; but the demolition last autumn of a building abutting on the western side of the arch brought to light the spring of an arch, which confirmed previous conjecture that there had also been a postern for pedestrians on the western side. It is evident that barrack rooms, or chambers for some such purpose surmounted the arch. The discovery of a portion of the Roman city wall in the course of the work indicates that this met the structure of the gate at approximately the centre, and not flush with the south or north face as previously thought. The exterior angle, possibly, may have been filled by a bastion.

The Rockefeller Foundation*

Barriers to International Aims

FROM the beginning of its activities twenty-five years ago the Rockefeller Foundation has been guided by the objective written into its charter: "The well-being of mankind *throughout the world*". In accordance with this purpose the aim of the trustees has been to maintain the work of the Foundation on an international plane without consideration of flags or political doctrines or creeds or sects. Particularly in a programme based on the advancement of knowledge it is imperative to disregard the geographical boundaries which arbitrarily and often unhappily divide the earth into a patchwork of senseless antagonisms. For in the last analysis knowledge cannot be nationalized. No successful embargoes can be maintained against the export or import of ideas. Whether new conceptions in atomic physics come from Copenhagen or from Cambridge, England; whether the cure for cancer is developed in New Haven or in Berlin; whether it is a Russian or an Italian or an American who takes the next step forward in mankind's struggle with virus diseases—we are all of us, under whatever flag, the joint beneficiaries of the intellectual property of the race. In all the clash of competing nationalisms there is here an underlying principle of unity: the single aim and language of science in the discovery of truth. It is this principle which challenges the twentieth century with the conception of civilization as a co-operative achievement and with the ideal of intellectual capital as an international possession.

A foundation, therefore, whose aim is to assist in pushing out the boundaries of knowledge must necessarily work wherever the best tools are to be found. In its search for high talent and promising opportunities it must assume that frontiers are not the forbidding barriers they pretend to be.

This ideal, which for more than two decades the Rockefeller Foundation has consistently attempted to follow, has in recent years encountered serious difficulties. And these difficulties are increasing. Objective scholarship is possible only where thought is free—and freedom can exist only where there is tolerance, only where there are no "Keep Out" signs against the inquisitive and questioning mind. Disinterested research cannot survive in an atmosphere of compulsion and repression. It withers under the efforts of Governments to impose uniform ideologies and to circumscribe in the interests of a dominant regime the area of intellectual liberty. Particularly in the broad range of subjects covered by the social sciences, and in the humanities as well, the world has recently witnessed in several countries the progressive disintegration of creative scholarship.

This phenomenon has naturally affected the programme of the Foundation. In some fields it is now profitless to go where we formerly went. We find ourselves stopped at some frontiers—not because the frontiers have any greater geographical significance than they had a few years ago, but because behind them the search for truth by eager and sceptical minds has been made impossible.

Some twenty years ago in a Central American city a revolution developed while the Foundation was engaged in a study of yellow fever control measures. Dr. Emmett Vaughn, who was in charge of the work, determined to continue his research. Every morning with a flag of truce he crawled through the barricades to collect his mosquitos on one side of the fighting line, and in the afternoon he crawled back again to gather up his specimens on the other side. He was molested by neither army. Both sides thought him somewhat crazy—a man who, when great issues of human destiny were being fought out, spent his time catching mosquitos. To-day in that Central American country the revolution has been largely forgotten, but Dr. Vaughn is remembered as the man who helped to stamp out an age-long pestilence.

The Rockefeller Foundations likes to think of this incident as an example of what its approach to the welfare of mankind should be. But occasionally aggressive action by the fighting lines makes impossible even the gathering of mosquitos!

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* From the Rockefeller Foundation: A Review for 1937. By Raymond B. Fosdick, President of the Foundation. (New York, 1938.)

Alchemy under James IV of Scotland *

JAMES IV of Scotland was one of the most intelligent princes in Europe at the beginning of the sixteenth century. He had an active and inquiring mind, and sought to extend his knowledge by observation and experiment. His interests included medicine and surgery, physiology, alchemy, and even psychology. Thus, in 1493, he tried to determine by a direct experiment the nature of that "primitive tongue" which Ben Jonson, at a later day and in jocular mood, supposed to be High Dutch. "The king gart [caused] tak ane dum woman and pat hir in Inchekeytht [island]", wrote Lindesay of Pitscottie, "and gaif hir tua young bairnes, and gart furnische them of meit, drink, fyre and candell, claithis [clothes], witht all uther kynd of necessaris, desyrand to knaw quhat langage thir bairnes wald speik quhene they came to lauchfull aige. Sum sayis they spak goode hebrew bot as to my self I knaw not."

James's excursions into alchemy were probably determined by his interest in medicine, because of the potent medicinal and rejuvenating virtues which were ascribed to the Philosopher's Stone. His chief associate in a prolonged series of alchemical experiments was a certain John Damian, an ingenious and personable Italian or Frenchman. Under Damian's inspiration and direction, James established Scotland's first research laboratory in Stirling Castle.

James provided his alchemist with an emolument and the necessary leisure for research by creating him Abbot of Tungland, in Galloway. The new ecclesiastical dignitary preferred the smells of his laboratory to the odour of sanctity, and feared the effect of the laboratory smoke upon his costly religious vestments.

The accounts of the Lord High Treasurer of Scotland from 1501 to 1513 throw some interesting light upon the nature and cost of the materials which Damian and his associates used in their attempts to prepare the *quinta essencia* (Philosopher's Stone, or Elixir of Life). Among them were gold, silver, quicksilver, aqua vitæ, saltpetre, sal ammoniac, litharge, salt and sugar. The prices of apparatus, the wages of the laboratory attendants, and even the cost of the alchemist's attire, are detailed in the Treasurer's records.

Three kinds of aqua vitæ, or whisky, are indicated by the adjectives "small", "ordinary" and "thrice-drawn". Although in the strange Scotland of James IV whisky must have been a rare drug reserved mainly for medicinal purposes, the Abbot of Tungland and his collaborators in the Great Work were able to secure and find uses for surprisingly large amounts.

Among occasional visitors to the Stirling laboratory was one Broun, a master "potingair of Sanctandrois". Skilled in the distillation of "waters" perfumed with essential oils, and also in the primitive sugar "potingry" of those times, this worthy apothecary was the unconscious prototype of the St. Andrews chemists of a later age.

The Abbot's attempts to achieve the Stone were interrupted in 1507, as a result of another of his spectacular activities. In the quaint language of Bishop Lesley: "This Abbott tuik in hand to flie with wingis; and to that effect he causet mak ane pair of wingis of fedderis". Equipped with these movable feathered wings, he took off from the lofty battlements of Stirling Castle for a flight to Paris; "bot shortlie he fell to the ground and brak his thee bane". Nothing daunted, the courageous experimenter ascribed his downfall "to that thair was sum hen fedderis in the wingis", which yearned and coveted the midden and not the skies: if the wings had been made entirely of eagles' feathers, they would have exerted a natural tendency to soar into the heavens!

The alchemical experiments in Stirling Castle were continued until 1513, when the interest of the Scottish crown in alchemy came to an untimely end with the death of James IV upon the tragic field of Flodden. A century and a half later this interest in science found a rebirth in two of James's distant descendants—Prince Rupert of Bavaria and King Charles II.

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* Abstract of a lecture delivered to the Society for the Study of Alchemy and Early Chemistry on May 11, at the British Academy, Burlington Gardens, London, W.1, by Prof. John Read, F.R.S.

Aeronautical Research in Australia

THE growth of civil aviation and the necessity for increased attention to Air Force requirements led the Australian Government last year, at the instance of the Council for Scientific and Industrial Research, to invite Mr. H. E. Wimperis, retiring director of research to the Air Ministry, to visit the Commonwealth to examine the existing situation with a view to the inauguration of aeronautical research. His report was presented in December last and its recommendations have been generally approved by Cabinet.

It was desired that such facilities as might be provided for aero-engine work should be extended to cover automobile engines: hence the first recommendation provides for an engineering research establishment at a suitable centre (almost certainly Melbourne), equipped for experimental work in wind tunnels, for engine tests for both aircraft and automobile use, and for physical tests of aircraft instruments and other apparatus. The laboratory will be administered by the Council for Scientific and Industrial Research, the programme of research, under a civilian superintendent, being supervised by an Australian Aeronautical Research Committee with an independent chairman. Its membership will include official representatives of the military and civil aviation departments, of meteorological services and radio communications, together with non-official members having special scientific and technical qualifications.

So far as practicable, use will be made of existing facilities at universities and in defence laboratories, the former being encouraged to undertake approved investigations in aeronautics for which they are fitted. It is proposed to create a chair and department of aeronautics (probably in the University of Sydney) to ensure a supply of trained personnel for military and civil aviation and for aeronautical construction. A readership in meteorology will also be established.

The Research Committee will form sub-committees to deal with aerodynamics; power plant; navigation and meteorology; materials; accidents; and air inventions. It will also be required to investigate the use of Australian-produced materials and processes in aircraft construction; and it will maintain a general information service.

On the automobile side it is proposed to set up an Industrial Research Committee to assist the Council with advice on a programme of research and to seek the co-operation of the industry in making provision for the carrying out of it.

It will be some considerable time before the projected laboratory is completed, but a start will be made in the current financial year. Provision is being sought for £143,000 to cover capital expenditure, and the estimated annual maintenance cost is put at £12,000.

Electrical Interference with Radio Reception

It has been well known for some years that a large proportion of electrical apparatus and plant, of both a commercial and domestic character, produces discontinuous electrical currents, which can result in interference with radio reception over a wide range of frequencies. In view of the widespread use of broadcast receivers in everyday life, it is very much in the public interest that all possible steps should be taken to mitigate the results of such interference. In Nature of August 1, 1936, reference was made to the work of a joint committee representative of all sections of the electrical and radio industries in the study of this problem. Following the report of this committee, a number of other committees have been at work under the auspices of the British Standards Institution compiling specifications of components which may be fitted to electrical ap-aratus and to radio receivers with the object of ducing the nuisance of interference to a minimum. ncurrently with the operation of these committees, e Post Office on one hand and the British Electrical d Allied Industries Research Association on the her, have been carrying out investigations on a mprehensive scale.

The results of such investigations were summarized a meeting of the Wireless Section of the Institution Electrical Engineers on April 6, when a paper was ad by Mr. A. J. Gill (of the Post Office) and Dr. S. hitehead (of the Electrical Research Association) nder the title "Electrical Interference with Radio ception". The paper described the method of essment of the interference to radio reception by ctrical equipment, and the degree to which such erference must be reduced to permit satisfactory vice. Various methods of measuring the inter-ence have been developed in different countries d the most reliable of these have been compared th the view of securing uniformity of interpretation the results.

With the aid of such apparatus, a study has been de of the interference produced under typically ctical conditions from such electrical sources as lley-buses, high-voltage overhead power lines, high-quency medical apparatus and surgical equipment, ctric lifts, telegraph and telephone plant, domestic pliances and the ignition systems of motor-cars. has been found that while in some cases the inter-nce is experienced by direct radiation from the ce, it is more common for the interfering voltages et up currents in the electrical supply network, from which the mains at the receiving station radiate locally to the receiving aerial. Following this appreciation of the nature and magnitude of the source of the interference, a detailed study has been made of methods of suppression to the level required to give satisfactory reception. Where possible, it is naturally best to suppress the interference at its source; but where this is either impracticable or unduly expensive, it is necessary to take steps to improve conditions at the receiver itself. Very effective methods of suppression have been worked out in some detail and some typical results of applying these are described in the paper. It is by the continued friendly co-operation between the electrical and radio industries that continued progress is to be anticipated as the methods of suppression and mitigation now available come into widespread use.

One of the methods adopted by the Post Office in dealing with this matter has been by co-operation with the ordinary broadcast listener in investigating complaints of interference brought to the notice of this Department. The number of such complaints brought to the attention of the Post Office has increased from some 10,000 in 1931 to nearly 50,000 in 1937. To deal with this problem, a full-time staff of about 250 are employed, and these have been trained by special courses of instruction. The equipment available to this staff comprises 110 motor-vans, each supplied with an interference locator, portable wireless receiving set, screened leads and a number of suppression components for demonstration purposes. The work of this staff has already produced a great amelioration in the conditions of broadcast reception. It is interesting to note that in some cases the broadcast listener is himself the cause of much of the interference of which he complains; for although it may not be usual in any one household to listen to broadcast programmes at the same time as the vacuum cleaner or electrically driven sewing machine is in use, these items may cause considerable interference to neighbouring listeners. Perhaps the time is not far distant when the man in the street may insist that all new domestic electrical appliances which he purchases will have been certified as 'interference free'.

The paper, to which reference was made above, concludes with an extensive bibliography, which indicates the large amount of scientific and technical work which has been devoted to this subject.

Science News a Century Ago

Magnetism at Low Temperatures

On May 17, 1838, Faraday wrote in his Diary: "Graham has lent me Thilorier's Carb. acid apparatus and I have been experimenting with it in cooling metals and ascertaining their relation to Magnetism. The metals were in pieces, kept a while in the mixture of Ether and C.A. with solid C.A. in it, and moved either by platina wires or by wooden tongs. The temperature according to Thilorier would be about 112° below 0° of Fahrenheit." With these arrangements, Faraday proceeded to test the magnetic properties of a large number of metals at the low temperature obtained, but without exception "these gave no deflection by a double astatic needle that was exceedingly sensible to the smallest particle of iron or nickel". The experiments were in continuance of some he had made in December 1835, and were the outcome of an idea he had at the time that all metals might acquire magnetic properties at low temperatures similar to those of iron. In 1835, the lowest temperature he had been able to reach was about − 70° Fahrenheit.

Thilorier had recently developed in France his apparatus for liquefying and afterwards solidifying carbon dioxide; and he had published his important observation of the value of a mixture of solid carbon dioxide and ether as a refrigerant. Faraday, interested in the attainment of low temperatures, was quick to see the advantages of the new method. He used the mixtures of carbon dioxide and ether afterwards in experiments on the liquefaction of gases; but it is interesting to notice that his first thought, on hearing that a temperature lower than any he had previously used could be obtained, was to test his theories of magnetism by it.

The "Graham" from whom the apparatus was borrowed was almost certainly Thomas Graham, the chemist.

Magnetic Observations at Greenwich

On May 21, 1838, at the Royal Observatory, Greenwich, as Airy records, "a magnet was suspended for the first time, Mr. Baily and Lieut. [afterwards Sir William] Denison being present". Airy had submitted a proposal for a magnetic observatory to the Admiralty two years before, and during the course of 1837–38 the observatory, a wooden building, had been erected in the form of a four-armed cross with equal arms, one axis being in the magnetic meridian. In 1840, the Magnetical and Meteorological Department was formed with James Glaisher, F.R.S. (1809–1903) as head. Glaisher held this position for thirty-four years. He was one of the first to adopt the photographic self-recording instruments of Charles Brookes (1804–79), and in 1850 he founded the Royal Meteorological Society, of which he was the secretary from 1850 until 1872. He was also well known for his balloon ascents for scientific purposes made during 1862–69 on behalf of the British Association Committee. On one of these, made on September 5, 1862, with Coxwell, he reached a height of seven miles.

Launch of the S.S. *British Queen*

At Limehouse, on May 24, 1838, Curling and Young, the shipbuilders, launched the Atlantic steamship *British Queen*, then the largest vessel of her kind in the world. She was constructed for th British and North American Steam Navigation Company. of which the American lawyer, Junius Smit (1780–1853), was the founder, and the famou African explorer, Macgregor Laird (1808–61), was th secretary. She was 275 ft. long from figurehead t taffrail, and 64 ft. wide over the paddle boxes. Afte her launch, she was sailed to the Clyde, where he engines of 500 horse-power were fitted by Rober Napier. She was one of the first vessels fitted wit surface condensers instead of jet condensers, and wa able to use fresh water in her boilers. Her first trans Atlantic voyage was made in July 1839, when sh crossed from Portsmouth to New York in 15½ days She returned to England in August, and during 183 made two more double passages. She made fiv double crossings in 1840 and one in 1841, after whic she was sold to the Belgian Government. She wa somewhat larger than her famous rival the *Grea Western*, which, however, proved a slightly faste vessel.

Supply of Rubber from India

On May 26, 1838, at a meeting of the Asiati Society, Dr. Royle, the secretary, read a pape entitled "On Caoutchouc or Indian Rubber". H stated that caoutchouc was known to the Peruvians and to the Chinese in early times. Condamine firs noticed it, in his voyage down the River Amazon i 1743, by the name *cachuchu*. Dr. Priestley afterward mentioned it as a rubber-out of pencil marks. D Royle said that, a few years before, about five ton were imported; now 500 tons are annually brough into London and Liverpool alone, and the quantit is daily increasing.

Caoutchouc is produced by numerous trees an shrubs of the natural families of the Euphorbiace Apocynaceæ, Asclepiadaceæ and Moraceæ in tropic parts of the globe, where high temperature is combined with moisture. It is imported from Para ar other places in South America, Vera Cruz, Sier Leone, Java, Penang and Singapore. It is also pr duced in India, being obtained from *Ficus elasti* a native of the forests of Silhet and Lower Assa It was of excellent quality, and feeling assur that the tree must be abundant and knowi that it could be easily grown in every part of In he (Dr. Royle) addressed letters on the subje to the societies and individuals in Calcutta. T replies proved that the supply of caoutchouc w inexhaustible.

A French Scientific Expedition

In its column of Miscellanea for May 26, 1838, t *Athenæum* said: "We have frequently had to repo the progress of the Bonite during her voyage rou the world in order to take out the consular agen of France to different colonies. The following is brief summary of the scientific labours of the office on board. The voyage was completed in 631 da during which the corvette only anchored 151 day it has therefore been a matter of surprise that much should have been done for zoology, for amo a considerable collection of rarities five have be added, which form types of new genera, and of whic there was either no vestige in museums or only i perfect specimens; and beside these there are ma new species. . . . The phosphorescence of the has been an object of continual research and organised beings which cause it have been carefully preserved in spirits of wine. . . . With respect to Physics, observations with barometer, thermometer and other instruments have been made at every hour of the day and night. Some experiments made with the apparatus of M. Biot to ascertain the composition of sea water at a great depth have produced some unexpected results ; and among other things Terrestrial Magnetism has been carefully studied. M. Gaudichaua has been equally indefatigable with respect to Botany, and has brought home an immense collection of woods, plants, fruits, seeds, drawings and notes. . . ."

University Events

Aberdeen.—The A. W. Garden fellowships will be awarded in June by the Senate of Aberdeen University. They are tenable from 3–5 years, and are of an annual value not less than £200. Graduates of medicine of any British university are eligible, but preference will be given to Aberdeen graduates. Application should be made to the secretary of the University, Marischal College, Aberdeen, before May 31.

Cambridge.—B. Cooper, of Clare College, has been appointed University demonstrator in engineering.

An election to the Isaac Newton studentships will be held early in the Michaelmas Term 1938. These studentships are for the furtherance of advanced study and research in astronomy (especially gravitational astronomy, but also including the other branches of astronomy and astronomical physics) and physical optics. Those members of the University are eligible for the studentship who have obtained a degree in the University, and who were under the age of twenty-five years on the first day of January 1938.

At St. John's College, the following have been elected to fellowships : Dr. D. H. Valentine, University demonstrator in botany ; G. C. Evans.

Oxford.—M. A. Jennings, Lady Margaret Hall, has been elected to the Schorstein research fellowship in medicine.

A. C. Hardy, of Exeter College, professor of zoology and oceanography in University College, Hull, has been granted the degree of D.Sc. for his work on plankton.

Perth, W.A.—On March 31 the University of Western Australia, Perth, reached the semi-jubilee of its teaching work, and the occasion was celebrated by a conversazione in the Winthrop Hall of the University held on April 29.

Prof. H. E. Whitfeld, vice-chancellor of the University, has been granted extended leave to visit Europe, America and South Africa. During his absence, Prof. A. D. Ross, of the chair of physics, will be acting vice-chancellor.

Sheffield.—Dr. R. P. Linstead, lecturer in chemistry in the Imperial College, has been appointed to the chair of chemistry, in succession to Prof. G. M. Bennett, who has resigned.

Societies and Academies

London

Royal Society (*Proc.*, A, 165, 453–595, April 27, 1938).

W. R. G. Atkins : Photo-electric measurements of the seasonal variations in daylight around 0·41μ, from 1930 to 1937.

J. S. Foster, G. O. Langstroth and D. R. McRae : Quantitative spectrographic analysis of biological material. (3). A method for the determination of sodium and potassium in glandular secretions.

C. T. Archer : Thermal conduction in hydrogen-deuterium mixtures.

D. S. Kothari : The theory of pressure-ionization and its applications.

A. Fage : The influence of wall oscillations, wall rotation, and entry eddies, on the breakdown of laminar flow in an annular pipe.

N. Feather and E. Bretscher : Uranium Z and the problem of nuclear isomerism.

D. H. Bangham and S. Mosallam : The adsorption of vapours at plane surfaces of mica. (1).

C. F. Elam : The influence of rate of deformation on the tensile test with special reference to the yield point in iron and steel.

Proc., A., 166, 1–177, May 4, 1938.

M. Blackman : On the diamagnetic susceptibility of bismuth.

F. W. Jones : The measurement of particle size by the X-ray method.

A. D. Misener : The resistance of superconducting cylinders in a transverse magnetic field.

B. F. J. Schonland, D. B. Hodges and H Collens : Progressive lightning. (5). A comparison of photographic and electrical studies of the discharge process.

H. J. Woods : X-ray studies of the structure of hair, wool, and related fibres. (4). The molecular structure and elastic properties of the biological cells.

T. E. Allibone and J. M. Meek : The development of the spark discharge.

N. Kemmer : Quantum theory of Einstein-Bose particles and nuclear interaction.

H. Fröhlich, W. Heitler and N. Kemmer : On the nuclear forces and the magnetic moments of the neutron and the proton.

Paris

Academy of Sciences, March 21 (*C.R.*, 206, 865–960).

Marcel Delépine : A special action of catalytic nickel during the hydrogenation of 2-methyl-4-amino-5-cyanopyrimidine.

Jean Cabannes, Jean Dufay and Junior Gauzit : Presence of sodium in the upper atmosphere. From observations on the yellow radiation of the nocturnal sky, made by interference methods, it is concluded that the vapour of sodium is a permanent constituent of the atmosphere.

Lucien Daniel : An unquestionable case of the heredity of acquired characters. Results of experiments on the grafting of the artichoke on the annual sunflower, tubercles appearing on the roots of the latter. In the fifth generation raised from seed, the variety *Helianthus tuberosus Costantini* has been found and this has inherited various characters of the grafted ancestor, including the tubercular roots. This variety, cultivated through the tubers, preserves the production of tubers on its roots.

Marc Krasner: The number of primitive superbodies of a given degree and the number of metagaloisian superbodies of a given degree of a body of g-adic numbers.

Léonidas Kantorovitch: The continuity and prolongation of linear operations.

Assène Datzeff: The graphical integration of certain differential equations.

V. A. Kostitzin: The Mendelian coefficients of heredity.

Mme. Christiane Pauc: The geometrical interpretation in non-holonome varieties of the theories of integration of systems of Pfaff equations.

Frédéric Roger: The equivalence of the ideas of quadrature and of primitive.

Jean Villey: Carburation by transference.

Roger Kling and Numa Manson: Liquid jets impelled with supersonic velocities.

Robert Fleurent and Maurice Beauvilain: The measurement of the time of reflection and acoustic levels by means of the fluxmeter.

Pierre Biquard: Study of the propagation of ultra-sounds in liquids under pressure. Description of experiments on benzene, toluene, methyl acetate and carbon tetrachloride at pressures ranging up to 700 kgm. per sq. cm.

Serge Gorodetzky: Analysis of the working of a selector with multiple coincidences. Description of an experimental arrangement.

Mlle. Marguerite Quintin: The potential of cadmium in cadmium benzenesulphonate.

Georges Ahier: Some dispersive liquids. Suggestions for various liquids capable of replacing ethyl cinnamate in prisms, possessing a lower temperature coefficient for the index of refraction and being less liable to change.

Raymond Ricard: The first spark spectrum of cæsium.

Mme. Irene Curie and Paul Savitch: The radio-element with a period of 3·5 hours formed in uranium irradiated with neutrons.

Mlle. Marcelle Pernot: The system mercuric iodide, cæsium iodide and water.

Clément Courty: The calcination residues attracted by a magnet. The application of the Curie-Chéneveau magnetic balance to the determination of minimal quantities of iron.

Victor Auger: The molybdic acid, H_4MoO_5. This acid is the yellow deposit from nitromolybdic solutions, and always contains ammonia. Various alternative methods of preparation are compared.

André Boullé: The dehydration of acid sodium pyrophosphate.

Mme. Yvonne Khouvine and Georges Arragon: The acetylation of perseulose.

Martin Battegay and Robert Krebs: The thiocarbamic esters.

Max Mousseron and Robert Granger: The dealkylation by sulphuric acid of the monoethers of the 1,2-cyclanediols with C_5 and C_6.

P. Bellair: The tectonic arrangement of the Provençal accidents.

Em. de Martonne: The tropical model in Brazil.

René Bernard: The interferential study of the yellow radiation λ 5893 A. of the twilight sky and the proof of the presence of sodium in the upper atmosphere (see also Nature of April 30, p. 788).

Georges Déjardin: The possible presence of certain lines of the neutral atom of sodium in the spectrum of the night sky. The hypothesis of the cosmic origin of atmospheric sodium cannot be rejected *a priori*.

Georges Lemée: The ecological characters of the Europeo-Atlantic floral element in the north-west of France.

Constantin Dawydoff: The endolarval metamorphosis in some Phyllodocians of Indo-China.

Jean Henri Vivien: The existence of accessory glands in the genital tract in the male of *Gobius paganellus*.

Léon Acolat: The distribution of the arterial and venous blood in the central arteries of batrachians and reptiles.

Henri Bierry and Bernard Gouzon: The spectral detection of the œstrogenic hormones in the urine of a pregnant woman. The method described, based on fluorescence spectra, characterizes the œstrogenic hormones, without confusion with cholesterol or other interfering substances.

Mme. Vera Dantchakoff: The rôle of hormones in the manifestation of the sexual instincts.

Maurice Lemoigne, Pierre Monguillon and Robert Désveaux: The reduction of nitrous acid by cystein and glutathione. Cystein and glutathione, like ascorbic acid, reduce nitrous acid with formation of hydroxylamine and ammonia.

Emile Rousseau: Melanine fixed on the non-dialysable protein complexes of the blood and of the urine of cancerous patients.

A. Sartory, J. Meyer and J. Waeldelé: Contribution to the study of a violaceine obtained in the crystalline state and arising from a violet bacillus isolated from the pus of a dental abscess.

Constantin Levaditi, Jules Bridré and Mme. Denise Krassnoff: The approximate dimensions of the claveau virus determined by ultrafiltration.

Marcel Lisbonne, Georges Roman and Gérard Renoux: The vaccination of the guinea pig against the brucellic infection (*Brucella melitensis*).

Max Aron: Serological researches on the existence of specific properties of the urine and blood of tuberculous patients.

Ivan Bertrand and Raoul Lecoq: Anatomical alterations of the peripheral nerves in the course of acute disturbance of food equilibrium of glucidic origin.

Dublin

Royal Irish Academy, April 11.

J. C. Harper and J. J. Hartley: The Silurian Inlier of Lisbellaw, Co. Fermanagh, with a note on the age of the Fintona Beds. This inlier, bounded by faults, was, in the Survey map of 1881, shown as consisting of both Llandeilo and upper Llandovery deposits. The whole is now shown to belong to the *Monograptus gregarius* zone of the Middle Valentian. It is one of the most north-westerly exposures of the Silurian System in the British Isles. A coarse conglomerate occurs having a sharp junction with the prevailing mudstones. *Pteraspis* is reported from the adjacent Fintona Beds, thus fixing their age as Lower O.R.S.

Cape Town

Royal Society of South Africa, March 16

Pottery from the Salisbury District, Southern Rhodesia. (1) Rev. Fr. Stapleton: The topography of Echo Farm, Didcot Farm, and the ruins on Didcot

Farm. (2) J. F. Schofield: The pottery from Echo Farm, Didcot Farm, and the ruins on Didcot Farm. (3) J. F. Schofield: A proposed classification for the pottery of Southern Rhodesia. (4) J. F. Schofield: Notes on iron implements from Echo Farm.

Geneva

Society of Physics and Natural History, March 3.

Renée Dovaz: The action of pre-pituitary extracts on the development of the organ of Bidder in the male castrated toad. Injections of prolan from the urine of ovariectomized woman, insertions and injections of hypophyses of frogs and toads into male castrated toads stimulate the transformation of Bidder's organ into the ovary, without, however, resulting in development as rapid as that described by Houssay, whose views were based on the weight of the organ. The effect on the ovocytes is in direct relation with the period of latency after castration. In the most favourable cases, a commencement of vitellogenesis is noticed in the ovocytes. The transformation observed is of the same order of magnitude as that undergone by the ovaries themselves, as will be described in a later note.

Renée Dovaz: The stimulation of sexual maturity in immature male and female toads, under the influence of pre-pituitary extracts. The injection into toads (*Bufo vulgaris*) of pituitary extracts (ox, toad, frog) and of prolan from the urine of ovariectomized woman, slightly stimulates the ovogenesis of immature females, and, more actively, the ovogenesis of the Bidder's organs of castrated males, still more actively, the spermatogenesis of immature males or, in a state of sexual prematurity, Bidder's organ behaves abnormally, and is activated at the same time as the ovary and testicle. The study of the problem would require that attention should be given to the time factor, on account of the slow development of the batrachians.

Ludwig Blum: The polarity of the buffer action in the tissues of an aquatic plant (*Potamogeton densus*). The buffer power of an aquatic plant (*P. densus*) has been measured towards acids and bases. The measurements were carried out on the apical and on the distal part of the stems. The *p*H of the stems is always distinctly acid and the buffering power against acids is more important than against bases. In general, the apical part shows a higher buffering power than the distal part.

Willy J. Schroeder: The discovery of submarine coulées of lava in the Flysch of the sheet of la Brèche. The author has identified in the crest situated between "Sur le Verchaix" and the pass of Jouxplane to the north of Samoëns (Haute-Savoie) submarine coulées of lava interstratified in the lower levels of the Flysch of the la Brèche sheet. Certain parts of the coulée are massive, others have a typical pillow-lava structure.

Willy J. Schroeder: Remarks concerning the coulées of lava in the Flysch in the la Brèche sheet. The most probable hypothesis concerning the origin of these coulées would be the following: A good part of the basic eruptive rocks of the Flysch of the la Brèche sheet would be remnants of submarine coulées of lava which date from the period of the deposit of the Flysch. The la Brèche sheet would then come from the eastern part of the zone of the Flysch and the crystalline rocks forming the lava would come from the zone of the green rocks of Versoyen.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 23

Wellcome Institute for Medical Research, at 5.30.—Dr. J. W. Trevan: "Variation in the Response of Animals to Drugs" (succeeding lectures on May 24 and 25).*

University of Oxford.—Prof. J. H. Hutton: "A Primitive Philosophy of Life" (Frazer Lecture).

Tuesday, May 24

Royal College of Physicians, at 5.—Prof. F. R. Fraser: "The Clinical Aspects of the Transmission of the Effects of Nervous Impulses by Acetyl Choline". (Croonian Lectures. Succeeding lectures on May 26 and 31).

Eugenics Society (at the Royal Society, Burlington House, W.1), at 5.15.—D. V. Glass: "Population Policies in Scandinavia and Elsewhere".*

Birkbeck College, London, at 6.—Prof. J. B. S. Haldane, F.R.S.: "The Marxist Philosophy" (Haldane Memorial Lecture).*

Institution of Mechanical Engineers, at 8.—Prof. H. J. Collins: "Engineering Problems of Modern Building Construction" (Chadwick Public Lecture).*

Wednesday, May 25

National Institute of Industrial Psychology (at the London School of Hygiene and Tropical Medicine), at 5.30.—Dr. Dwight L. Palmer: "Industrial Relations in the United States and Great Britain" (succeeding lectures on May 30, by Dr. C. H. Northcott, and on June 1, by Prof. John Hilton).*

Thursday, May 26

Royal Society, at 2.30.—Discussion on "Cosmic Rays" to be opened by Prof. P. M. S. Blackett, F.R.S.

Friday, May 27

Geophysical Discussion (at the Royal Astronomical Society), at 4.30.—"The Topography of the Ocean Floor" (Opener: Lieut.-Colonel R. B. S. Sewell, F.R.S.).

Royal Institution, at 9.—Prof. J. Chadwick, F.R.S.: "The Cyclotron and its Applications".

Rubber Technology Conference, May 23–25. To be held at the Hotel Victoria, Northumberland Avenue, London, W.C.2.

S. T. Rowe: President.

Linnean Society of London, May 24–26. One hundred and fiftieth anniversary to be held in London.

May 24, at 3.—Dr. J. Ramsbottom: "Linnæus and the Species Concept".

May 25, at 10.—Symposium on "The Concept of Species from the Time of Linnæus to the Present Day".

May 26, at 10.—Symposium on "Geographical Isolation as a Factor in Species Formation".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned.

Lecturers in Mathematics, Physics, Chemistry and Civil and Mechanical Engineering in the Woolwich Polytechnic, London, S.E.18—The Secretary (May 21).

Lecturer in Telecommunications (June 3) and **Lecturer in Mechanical Engineering** (May 23) in the Polytechnic, Regent Street, London, W.1—The Principal.

Head of the Department of Economics and Social Studies in the City of Birmingham Commercial College, Suffolk Street, Birmingham, 1—The Principal (May 25).

DEMONSTRATOR IN ELECTRICAL ENGINEERING in the Military College of Science, Woolwich, S.E.18—The Commandant (May 26)

LECTURER IN MECHANICAL ENGINEERING in King's College, London —The Secretary (May 27).

CHEMISTS under the War Department Chemist—The Under-Secretary of State (C.5), The War Office, S.W 1 (May 28).

TEACHERS OF CHEMISTRY AND OF MECHANICAL ENGINEERING in the Luton Technical College—The Director of Education, Shire Hall, Bedford (May 28).

HEAD OF THE DEPARTMENT OF PHYSICS in the Chelsea Polytechnic, London, S.W.3—The Principal (May 28).

LECTURERS IN MATHEMATICS, CHEMISTRY AND ENGINEERING in the Derby Technical School—The Clerk to the Governors, Derby Technical School, Normanton Road, Derby (May 28).

LECTURER IN MECHANICAL ENGINEERING in the St. Helen's Municipal Technical School—The Director of Education, Education Office, St. Helens (May 28).

TEACHER OF ENGINEERING DRAWING, MATHEMATICS AND SCIENCE in the Rochdale Municipal Technical School—The Secretary (May 30).

ASSISTANT (Grade III) for abstracting scientific and industrial papers at the D.S I R, 16 Old Queen Street, Westminster, S.W.1—The Establishment Officer (May 30).

TEXTILE ENGINEER to the Wool Industries Research Association, Torridon, Leeds—The Secretary (May 31)

UNIVERSITY DEMONSTRATOR IN CHEMISTRY in the University of Cambridge—Prof R G W Norrish, University Chemical Laboratory, Pembroke Street, Cambridge (May 31)

TEACHER OF PHYSICS in the Rugby College of Technology and Arts —P. I. Kitchen, 61 Clifton Road. Rugby (May 31).

BACTERIOLOGIST in the Veterinary Department, Kenya—The Director of Recruitment (Colonial Service), 8 Buckingham Gate, London, S W 1 (May 31).

LECTURER IN ELECTRICAL ENGINEERING in the Carlisle Technical School—The Director of Education, Education Offices, Fisher Street, Carlisle (June 1).

ASSISTANT LECTURER IN CHEMISTRY in the University of Manchester —The Registrar (June 2).

LECTURER IN MATHEMATICS in University College, Dundee—The Secretary, University, St. Andrews (June 4).

TWO UNIVERSITY LECTURERS IN ZOOLOGY and ONE UNIVERSITY DEMONSTRATOR IN BOTANY in the University of Cambridge—Dr. A. D Imms, Department of Zoology, Downing Street, Cambridge (June 7)

TWO CHEMISTS AND TWO FIELD GEOLOGISTS in the Geological Survey Department of the Federated Malay States—Director of Recruitment (Colonial Service), 8 Buckingham Gate, Westminster, London, S W 1 (June 10)

PROFESSOR OF BIOCHEMISTRY in the All-India Institute of Hygiene and Public Health, Calcutta—High Commissioner for India, General Department, India House, Aldwych, W.C.2 (June 24).

LECTURER IN CHEMISTRY in the University of Reading—The Registrar.

JUNIOR INVESTIGATOR to the British Non-Ferrous Metals Research Association—The Secretary, B.N.F.M R A, 1–6 Regnart Buildings, Euston Street, N W.1.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Non-Ferrous Metals Research Association Research Reports. Association Series, No. 473 Elastic Properties of Non-Ferrous Metals and Alloys; Collected Data. By Dr J McKeown and E. D. Ward. Pp 35 (London British Non-Ferrous Metals Research Association) 6s. [254

King's College. Dove Marine Laboratory, Cullercoats, Northumberland Report for the Year ending July 31, 1937. (Third Series, No. 5) Pp. 42+2 plates (Newcastle-upon-Tyne Marine Laboratory Committee of King's College.) [264

Institution of Professional Civil Servants Annual Report of Council for the Year 1937. Pp. xiv+66 (London: Institution of Professional Civil Servants.) [264

International Tin Research and Development Council Second General Report, 1937 Pp. 69. Free. Synopsis of Second General Report. Pp. 21. Free. Technical Publication, Series A, No. 76: The Coating of Metals with Tin from the Vapour Phase ("Stannising") By Dr B W. Gonser and E. E Slowter. Pp. 17+4 plates. Free (London International Tin Research and Development Council.) [274

Report of the Commission appointed to enquire into the Financial and Economic Position of Northern Rhodesia (Colonial No. 145.) Pp xi+394+4 maps (London. H.M Stationery Office.) 7s. net [284

Ancient Monuments of Great Britain List of Monuments (to 31st December 1937) prepared by the Commissioners of Works Pp. 101. (London. H.M Stationery Office.) 1s. 6d net [284

Manchester Statistical Society. An Outline of the Working of Money: shown by a diagrammatic Film. By Prof. M. Polanyi. Pp. 19+1 plate (Manchester. Statistical Society.) [294

Observationes Anatomicæ Selectiores. Amstelodamensium 1667–1673 Edited with an Introduction by Prof F J. Cole. Pp. xi+45+59+4 plates. (Reading: Prof. F. J. Cole, University) [294

Milk and Nutrition. New Experiments reported to the Milk Nutrition Committee. Part 2. The Effects of Dietary Supplements of Pasteurised and Raw Milk on the Growth and Health of School Children (Interim Report) Pp 34 (Shinfield, Reading: National Institute for Research in Dairying) 1s 9d [25

Other Countries

Statistical Year Book 1938 of the International Tin Research and Development Council Pp 206 (The Hague International Tin Research and Development Council Statistical Office) 6s [274

Deliberado e Rovado Da Gilbert H Richardson. Pp 18 (Örebro: Littorin Rydén Boktryckeri, Newcastle-upon-Tyne. The Author, Rye Hill) 0 50 kr, 6d. [274

Imperial College of Tropical Agriculture. The Report of the Governing Body for the Year 1936–37 and the Accounts for the Year ended August 31, 1937 Pp. 38. (Trinidad and London. Imperial College of Tropical Agriculture) [274

Transactions of the National Institute of Sciences in India Vol. 1, No 12 On the Theory of Liquids. By Dr. T S. Wheeler Pp 333–365 (Calcutta National Institute of Sciences in India) [274

U S. Department of Agriculture Leaflet No 150 Carpet Beetles. By E. A. Back Pp 6. (Washington, D C: Government Printing Office) [294

Carnegie Institution of Washington Year Book No 36, July 1, 1936–June 30, 1937; with Administrative Reports through December 10, 1937 Pp xxxiv+430+1 plate (Washington, D.C Carnegie Institution) [294

League of Nations. The League from Year to Year (1937). Pp 246 (Geneva League of Nations, London George Allen and Unwin, Ltd) 1s. [294

Memoirs of the Department of Zoology, Panjab University Vol 1: Fauna of Karachi 2 Polychætes By N D. Aziz. Pp 19–52+plates 3–8. (Lahore Panjab University.) 3 rupees. [25

Commonwealth of Australia. Council for Scientific and Industrial Research Bulletin No 114 The Wood Structure of some Australian Rutaceæ with Methods for their Identification (Division of Forest Products—Technical Paper, No. 25.) By H E. Dadswell and Audrey M Eckersley Pp 32+10 plates. Pamphlet No 75: Collapse and its Removal, some recent Investigations with *Eucalyptus regnans*. (Division of Forest Products—Technical Paper. No. 24) By W. I. Greenhill Pp 29+3 plates Pamphlet No. 76 Grading Studies in "Ash" Eucalypts (Division of Forest Products—Technical Paper, No 26) By R F. Turnbull, A. J Thomas and F E Hutchinson. Pp. 36 (Melbourne: Government Printer.) [25

Punjab Irrigation Research Institute Report for the Year ending April 1937. Pp vi+228+80 plates Research Publication, Vol 2. No. 17 Graphical Determination of Exit Gradient for some Standard Types of Structures By Jai Krishnan Malhotra and Dr E McKenzie Taylor. Pp 11. 4 annas, 5d. Research Publication, Vol. 2, No. 18. Uplift Pressures under a Sloping Floor. By Jai Krishnan Malhotra and Dr. E McKenzie Taylor. Pp 9+1 plate 4 annas 5d Research Publication, Vol 2, No. 19. Relative Efficiency of a Vertical Sheet Pile under a Flush Floor By Jai Krishnan Malhotra and Dr E. McKenzie Taylor Pp 15+1 plate. 5 annas, 6d. Research Publication, Vol. 2, No 20. Some Notes on Khosla's Principle of Independent Variables. 1 Mutual Interference of Equal Piles at Ends of a Floor By Jai Krishnan Malhotra and Dr E McKenzie Taylor Pp 10. 4 annas, 5d. Research Publication, Vol 2, No 21. Graphical Methods for the Determination of Pressure Distributions under some Standard Forms of Irrigation Works By Jai Krishnan Malhotra and Dr. E McKenzie Taylor Pp. 17. 5 annas 6d. Research Publication, Vol 2, No. 22 Notes on Khosla's Principle of Independent Variables in its relation to the Design of Weirs. 2. Pressure Distribution under a Floor having Equal End Piles and a varying Intermediate Pile. By Jai Krishnan Malhotra and Dr. E. McKenzie Taylor. Pp 16. 5 annas, 6d. Research Publication, Vol 4, No 9. Soil Deterioration in the Canal Irrigated Areas of the Punjab Part 3 Formation and Characteristics of Soil Profiles in Alkaline Alluvium of the Punjab. By Dr Amar Nath Puri, Dr. E. McKenzie Taylor and A. G Asghar. Pp. 7+3 plates. 4 annas, 5d. Research Publication, Vol 5, No. 7. A New Method of determining Seepage from Canals in Areas of High Water-Table By D. C Midha, H. R. Luthra and Dr V I. Vaidhianathan Pp. 4+3 plates. 3 annas 4d. (Lahore Government Printer.) [25

Ontario Research Foundation Report for the Year 1937. Pp 35. (Toronto. King's Printer.) [25

Lac Cultivation in India Being a second and revised edition of "A Practical Manual of Lac Cultivation" By P M Glover (Nankum Indian Lac Research Institute) 2 rupees. [25

Memoirs and Observations of the Czech Astronomical Association at Prague No. 3: Activité solaire en 1935. Par B. Nováková. Pp. 18. No 4 Observations of Variable Stars Ry Bootis, St. Camelopardalis and R Scuti. By V Vand and J. Vlček. Pp. 10. No 5 Eclipse totale de Soleil du 19 Juin 1936 observée à Sara URSS, Résultats scientifiques de la Mission de la Société Astronomique Tchèque à Prague. Pp. 24+2 plates. (Prague Czech Astronomical Association.) [25

Survey of India. General Report 1937, from 1st October 1936 to 30th September 1937. Pp. xi+73+18 plates. (Calcutta: Survey of India.) 1·8 rupees, 2s. 6d. [25

Catalogues, etc.

Botanical Books, including the Library of the late Dr. A. B Rendle, F.R.S., and other recent Purchases. Monographs, Floras, Gardens and Gardening, Wild Flowers, etc., and a List of Recently issued Botanical and Gardening Books (Catalogue 271.) Pp 44. (London: Dulau and Co, Ltd.)

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Scientific Research in International Affairs

"IN the revolution of thought through which we are living, the profoundest and most disturbing element is the breakdown of that ethical system which, since the days of Constantine, has imposed upon European culture at least the semblance of moral unity." This remark made by the regius professor of Greek at Oxford in his inaugural lecture last year, was recalled by Sir Alfred Zimmern in his address at Chatham House last October on the decline of international standards. Recent events should convince the dullest mind of the extent to which international standards have deteriorated and the anarchy which threatens the repudiation of law and order in favour of brute force.

Sir Alfred Zimmern suggests that among the factors which have led to the deterioration of international standards the weakening of the Christian ethics and sanctions is significant; and there will be those ready to place upon science some of the responsibility for weakening such sanction and belief. However profound may have been the influence of science upon religious thought, the whole trend of scientific thought is in the direction of law and order, and in recent years there has been mutual recognition of the spiritual purposes of both science and religion if mankind is to regain control over events.

The present crisis places beyond question the supreme importance of some alliance of moral and scientific forces if the downfall of civilization is to be averted; and scientific workers in those centres where science still retains its freedom of thought and speech will be as united in their repudiation of the methods by which these are being repressed as they will be sincere in their sympathy for those distinguished men of science whose work and freedom are now threatened.

Outside the totalitarian States, differing political views are indeed largely determined not so much by matters of fact—though, of course, the extent to which particular holders of them have access to the facts may well vary enormously—but also, and even more important, by questions of judgment and values. It is precisely this point which was emphasized by Prof. M. Ginsberg in his thoughtful paper to the British Association at Nottingham last year. The present situation does indeed throw down yet a further challenge to the universities to play their part more fully in shaping and moulding a public opinion competent to sort out the issues and form sound judgments on questions of value as well as of fact.

In this respect, as Prof. Ginsberg has shown, the contribution of science is largely one of technique to resolve the difficulties in the way of clear, accurate and unprejudiced thought. This is, however, far from being the only contribution of science to the problem of international relations at the present time. Fully as significant is the question of painstaking and accurate research into the basic facts upon and by which decisions must be based, judgment determined and policy guided. Of the contribution which science could make in this field there could be no more admirable illustration than is offered by the study of the work of the Institute of Pacific Relations and its bearing on the problem of peaceful change, by H. F. Angus, which was issued for the Tenth International Studies Conference at Paris last June.

In this particular study, Mr. Angus is not concerned with practical issues, but he gives an impressive picture of the wide field for research which such questions as trade and tariffs, comparative standards of living, land utilization, population and migration, commercialization or industrialization present in China and in other Pacific countries. The basic research involved in the solution of such problems has its bearing on such particular questions as the Chinese claims for the rendition of Shanghai and other settlements and concessions, for tariff autonomy and the abolition of extra territoriality, and no one can read this study without realizing how imperfect as yet are the knowledge and facts available for the decision of many of the problems the solution of which is being attempted so unhappily by force at the present moment.

It is true, of course, that research in itself can accomplish very little in promoting the peaceful settlement of disputes, and the significance of the Institute of Pacific Relations lies in the use made of its research. By referring the conflict of beliefs to the arbitrament of research, it is possible to banish the acrimony which often embitters international relations through the conflict of different beliefs held by parties to the dispute. A politician may find it necessary, in order to retain his popularity, to reiterate the beliefs generally held by his supporters. It is a different matter for him, however, to repeat the same views in quarters in which repetition will appear merely as evidence of his ignorance or his insincerity.

Part of the achievement of the Institute of Pacific Relations has been to bring international controversy into the atmosphere of scientific research, but as yet it has made no determined effort to diffuse this atmosphere among the general public by making accurate information and its thoughtful interpretation widely available. There has, of course, been a great improvement in the position here in recent years. The extent to which careful analysis has been made in the scientific spirit of the facts which lie behind the demands of a nation for an alteration of the *status quo* is being made plain by the publications of the Institute of Pacific Relations, the Royal Institute of International Affairs and other such organizations. Though the field of research is still immense, much is being done and is already available as a basis for action if Governments and nations are prepared to use the results of such research.

It is here that we reach the crucial issue at the present. The degree to which force is being accepted as the means for one-sided redress of real or imagined grievances raises new and disturbing issues, and it becomes more and more difficult to deal justly even with the original matters in dispute. The indignation raised by Japan's campaign in China, for example, leads many to overlook the genuineness of many of her grievances and the sincerity of her point of view. Sir Alfred Zimmern's address indicates how grave has been the deterioration in this field and how imperative is the work of education and of promoting a social integration between countries and groups of centres which will give the existing organization for co-operation an opportunity to function.

It is still true that public opinion remains the decisive factor in determining the conduct of foreign affairs and international relations by any Government. The Press and broadcasting and educational policy are, under modern conditions, far more potent instruments than ever before by which a Government can influence public opinion. But none the less, even in the totalitarian State, a Government can rarely proceed far in advance of the point for which propaganda has prepared its supporters, and may easily on the other hand arouse feelings which carry it far beyond the point at which it intended to halt.

It is this situation, in which nationals of one country make little or no attempt to appreciate the point of view of those of another, and do not seek to understand the reasons for one another's prejudices, that constitutes one of the greatest obstacles to international progress and co-operation to-day. International agreements, whether between individual powers or collectively through the League of Nations, have little force unless there is some common standard and measure of understanding in the minds of the parties to them. To promote such understanding and standards is of vital importance. The real significance of the admirable non-political work of the League of Nations to-day in the field of health, the settlement of refugees, the protection of women and children, the suppression of slavery and the control of the trade in opium and other narcotic drugs, or its reconstruction work like that in Austria, Hungary, Greece or in China, now interrupted by the war, like the work of the International Labour Organization, lies not less in the direct contribution offered to the relief of human suffering and distress than in the extent to which it prepares the way for understanding and good will and co-operation in a wider field.

The history of international sanctions, as revealed in the important recent study by a group of members of the Royal Institute of International Affairs, does not indeed indicate the invalidity of sanctions. What it reveals is the dangerous loose-thinking in this subject, the widely differing standards of values and thought in different centres. It demonstrates beyond question that collective security can only function effectively when public opinion in the different countries has been educated out of its parochialism and brought to an appreciation of what is really involved in international relations in this new world, in which the forces that science has placed at our disposal have much power to build or to destroy.

Those responsible for this wise and well-balanced study were not concerned directly with the larger questions as to whether or no the attempt to establish a world order on the basis of international law should be continued. Their purpose was rather to discover how far the constitution of a system of sanctions for the enforcement of international legal obligations is a feasible proposition. To this question they give no categorical answer. The book embodying the results of their investigation marshals the facts and analyses the experience so that others may be in a position to form their own conclusions. None the less, if the weaknesses and dangers of sanctions as hitherto applied are clearly expressed, the report puts the pregnant question whether, if the world lacks the spirit of courageous and self-sacrificing co-operation on which sanctions depend, any alternative course is available whereby the calamity of war can be permanently averted. The whole trend of recent events reinforces these pleas for calm and courageous thinking, and for a moral basis for the wise and determined action which must be taken if the rich heritage of civilization as we know it to-day is to be preserved from relapse into barbarism.

The Fourth Estate

Report on the British Press: a Survey of its Current Operations and Problems, with special reference to National Newspapers and their Part in Public Affairs. Pp. ix + 333. (London: Political and Economic Planning, 1938.) 10*s.* 6*d.*

THERE could be no more appropriate time than the present for a searching examination and re-appraisal of the British Press. Over a large part of the globe, freedom of thought and of speech has disappeared; and in the countries where truth still survives, its free expression is being subjected to economic, political and social pressures never before known except in time of war. The continued freedom of the Press, once taken for granted, is by no means a certainty even in Great Britain, if the intolerable political stresses of the past two or three years are not eased soon.

Moreover, there are many in Great Britain, devoted to the cause of truth, who cannot regard the present-day freedom of the Press as an unmixed blessing. Dissatisfaction with the performance of the British Press is growing, almost as fast in Fleet Street as elsewhere. How satisfactorily does the Press inform its readers promptly, truthfully, fairly, of what is going on in the world? How seriously is it dominated by its commercial proprietors or by outside pressure-groups like the advertisers? Is it, in fact, living up to its high position as the Fourth Estate?

These are only a few of the scores of pertinent questions which the research workers of P E P (Political and Economic Planning) have sought to answer in their admirable report on the British Press, published after three years of effort. The report makes no claim to be exhaustive; indeed, its authors found the utmost difficulty in assembling the material needed for what they have modestly described as a "preliminary analysis". Too often they have had to use one newspaper office as the source of their detailed information, although they should have had the co-operation of all.

Within its admitted limitations, their work is, however, beyond praise as a severely objective study of what is at the same time a great industry, a vital profession and a public utility of incalculable importance. The report is a rich storehouse of information on every conceivable aspect of British newspapers. It tells, in astonishing detail, how newspapers are produced, how they are financed, how the news is gathered. It takes the layman behind the scenes in newspaper offices on a night when some important event "breaks" after the first edition has gone to press. Considering the speed and pressure of daily newspaper production, it is one of the miracles of modern life that they should be as complete and as accurate as they are.

Yet this report is by no means a 'white-washing' document. It at least touches upon most of the shortcomings of the British Press and finds much cause for uneasiness. Admitting that all the British newspapers cannot and should not be remade in the image of *The Times* or the *Yorkshire Post* or the *Manchester Guardian*, the report finds particular fault with the reporting of scientific news. It doubts whether the Press "is adapting itself quickly enough to the growing output of potential scientific and industrial news and the growing demand for it". Scientific workers would do well to browse through these sections of the report; for the gulf between Fleet Street and the science laboratories is wider, perhaps, than between the public and any other field of endeavour.

> "Frequently," says the report, "good stories from the laboratory and the studio are bungled and misrepresented, simply because the journalist who writes them up cannot grasp their real significance. The ability to reason scientifically, the scientist's respect for facts, is essentially the product of higher education, and it is precisely this that so many journalists have missed. . . . Really competent scientific journalists, who are both good scientists and good journalists, are few and far between, and regarded as neither fish, flesh nor good red herring by scientists and journalists alike."

In short, the British Press, with one or two exceptions, does not yet know or care to know how to report scientific news. "The public doesn't want it" is the defence of nine editors out of ten—most of them unaware of the interest in scientific news which has been built up by intelligent reporting and editing, and by the co-operation of men of science, in the United States and Canada. In Great Britain scientists (again with a few exceptions) are apt to be distrustful of the Press and have as little to do with it as possible.

The fault, as the report sees it, is fairly evenly divided, and will require conscious effort by newspapers and scientists to correct it. On the newspapers' side the chief fault appears to be the slipshod recruitment of journalists. The habit of most Fleet Street organizations is to recruit their reporters from half-educated young men who have served apprenticeships on provincial newspapers from the age of fifteen or sixteen. The editors' prejudice is to distrust specialists and to assign everyday reporters, without the slightest training in science, to 'cover' such events as the meetings of the British Association. The result is the imbecilic 'bright' reporting one encounters all too often at the time of a British Association meeting, with trivial remarks picked out of Section E or Section L to make a good headline, while announcements of outstanding importance in fields of nuclear physics or genetics or medical research are left unreported.

The remedy, therefore, lies partly in the news editors' hands. If an editor makes up his mind that the public will read scientific news, and if he assigns his best qualified reporter to find it and write it, we may yet have adequate science news in the British Press. But men of science themselves also have it in their power to correct many of the evils of which this report complains. The late Lord Rutherford was not too busy, or too eminent, to help any reasonably intelligent journalist who came to him in search of 'background' information for science news. The achievements of the Cavendish Laboratory became known throughout the world because Lord Rutherford, without self-seeking or self-advertisement, liked the world to know what he and his colleagues were doing. It requires much patience for a scientific investigator to describe an experiment to non-technical journalist in non-technical language. It calls, also, for a broad outlook which is not always found in science laboratories. But, as this report indicates, the improvement of scientific news in Great Britain is a job worth doing. For there can be no public awareness of the mighty influence and inspiration of the scientific spirit unless science makes itself known.

F. K.

Sex and Society

Sex in Relation to Society

Being the first English edition of Vol. 6 of "Studies in the Psychology of Sex", abridged and revised. By Havelock Ellis. Pp. xv + 529. (London: William Heinemann (Medical Books), Ltd., 1937.) 12*s*. 6*d*. net.

HAVELOCK ELLIS'S book is a new edition, abridged and revised throughout, of the concluding volume of his monumental "Studies in the Psychology of Sex", the greatest contribution to the subject ever made by any single writer. The original edition, however, is not thereby superseded, the present one being intended for a wider public. The author points out that thirty years ago his work on the problems of sex had to be published in a way that made it accessible only to specialists, whereas since then social and legal opinion has so far changed that it can now be presented to all serious readers. This is an important fact. For in the field of the marriage institution, only a very strong public opinion is able to effect reforms in the face of ancient entrenched traditions. Havelock Ellis says that this is particularly the case in England.

Among the reforms there is none that he has insisted on more strenuously than a change of the English divorce law. The most serious and the most profoundly unnatural feature of the ecclesiastical conception of marriage was "the flagrant contradiction between the extreme facility with which the gate of marriage was flung open to the young couple, even if they were little more than children, and the extreme rigour with which it was locked and bolted when they were inside. That is still the defect of the marriage system we have inherited from the Church". What is particularly needed is, that if a husband and wife can no longer live together, they should be allowed to part amicably, and in harmonious agreement effect all the arrangements rendered necessary by their separation; but "the law ridiculously forbids them to do so, and declares that they must not part at all unless they are willing to part as enemies".

Strangely enough, many legislators are still imbued with the idea that a marriage must inevitably end in a catastrophe, either by the death or some great misfortune of one of the consorts or by the commission of a criminal or immoral act, which is evidently regarded as a more proper ground or excuse for dissolving the marriage than the mutual agreement of both. Yet divorce by mutual consent is very ancient in European legislation. According to Roman law, a 'free' marriage could be dissolved either by mutual agreement between both parties or by the will of one party only, and divorce by mutual consent was permitted in the Roman Empire even in Christian times. The facility of such divorce remained in the Roman codes of the German kings; and those subjects of the Western rulers who elected to live under the old Teutonic systems of law seem to have had an equal facility, as is suggested by the dooms of Aethelbirht, Christian though they be. In modern times, divorce by mutual consent was reintroduced in France by the law of divorce of 1792—not, as has been alleged, by Napoleon, who on the contrary made such divorce more difficult, after that law had been in existence during twelve years. Nowadays a marriage may be dissolved upon the common application of the parties, after a short period of separation, in a few Catholic countries and in the States of northern Europe.

The present book contains twelve chapters, dealing with such subjects as sexual education, the function of chastity, the problem of sexual abstinence, prostitution, sexual morality, marriage, the art of love, the science of procreation. Each of these chapters is full of interesting and instructive facts, presented with none of the aridity so often found in scientific works, and accompanied by illuminating and well-balanced judgments, most of which every unprejudiced reader is bound to accept. In discussions of this kind, however, there is always likely to be some difference of opinion; which gives even the most appreciative reviewer an opportunity to express certain views of his own.

To the reviewer, it seems that Havelock Ellis's high estimation of sexual love—which he defines as a synthesis of lust and friendship—has made him unduly severe upon marriages contracted from other motives. He writes: "A man who marries for money or for ambition is departing from the biological moral ends of marriage. A woman who sells herself for life is morally on the same level as one who sells herself for a night." It would seem that wealth is better fitted than poverty for the biological purposes of procreation and the rearing of children, and, as Marañon remarks, a man's money is among ourselves a quasi-biological substitute for his physical ability in early times as a means of supporting his family. Further, how do the severe strictures upon mercenary marriages square with the statement that the community has no right to interest itself in the sexual behaviour of its members until a child is born or conceived, and that "it is an impertinence, if not an outrage, to seek to inquire into it?" Economic considerations are certainly of great importance at the conclusion of a marriage. Poverty may cause much hardship to the couple, and may prevent them from having children, or, if they have any, from giving them a proper education; and even some amount of wealth is not to be despised. No wonder, therefore, that economic circumstances influence very largely the choice of a partner.

Indeed, it is a very common observation that love-matches, especially early ones, easily come to grief. Schopenhauer quotes in support of his own opinion the Spanish proverb, "Quien se casa por amores, ha de vivir con dolores" ("He who marries for love has to live in sorrow"). Lord Beaconsfield wrote in his younger days: "All my friends who have married for love and beauty either beat their wives or live apart from them. This is literally the case." Bloch says "it is a well-known fact that marriages of reason are often more enduring than love-marriages". Loewenfeld points to cases of so-called "marriages of convenience" which in the course of years took on a form that converted connubial fellowship into a source of purest conjugal happiness for both parties concerned. Though love is commonly considered to be the proper motive for a marriage, it is, after all, more important that the parties should love each other after marriage than before.

In another respect, Havelock Ellis rather seems to be too tolerant. He opposes the view that marriage is a contract in the true sense, but admits that the entrance into the world of a child should be preceded by the formation of "a marriage contract which, while in no way binding the father and mother to any duties, or any privileges, towards each other", binds them towards their child—"a contract which leaves entirely unaffected their past, present, or future relations towards other persons". How is that possible ? The presence of the child certainly imposes duties on the father and mother in their behaviour towards each other, which in a very high degree affect the welfare of the child. Havelock Ellis seems to regard jealousy as a useless and stupid feeling, which, as he says, seldom makes a person more lovable, and frequently much less lovable. But if a married person behaves in a manner that causes jealousy in the other partner, the relations between them may be seriously disturbed thereby ; and, as Mr. Shaw says, "an unhappy household is a bad nursery".

EDWARD WESTERMARCK.

Petrology and Mineralogy

(1) **The Petrology of the Igneous Rocks**
By the late Dr. F. H. Hatch and Dr. A. K. Wells. (Text-Book of Petrology, Vol. 1). Ninth edition. Pp. xx + 368. (London : George Allen and Unwin, Ltd., 1937). 15*s*. net.

(2) **Elements of Optical Mineralogy :**
an Introduction to Microscopic Petrography. By Prof. Alexander N. Winchell. Fifth edition, revised and enlarged. Part 1 : Principles and Methods. Pp. xii + 263. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1937). 17*s*. 6*d*. net.

(3) **Introduction to the Study of Minerals**
By Prof. Austin Flint Rogers ; with a Section on Microchemical Analysis, by Dr. Lloyd W. Staples. Third edition. Pp. xviii + 626. (New York and London : McGraw-Hill Book Co. Inc., 1937). 30*s*.

(1) THE appearance of a revised edition of Hatch and Wells's "Petrology of the Igneous Rocks" is a matter of interest to British petrologists, since this has long been a standard text-book in British universities. Owing to the death of Dr. Hatch, the work is now, so far as the introduction of new matter is concerned, that of Dr. Wells, and this author has incorporated in the new edition, not only new material but also new ideas.

A most important innovation is the introduction of a new scheme of classification which, the author states, he has advocated and taught for years. Actually the scheme is, in principle, that recommended by a committee of the British Association in a preliminary report issued in the *Geological Magazine* in July 1936. This report was published with the view of attracting criticism and suggestions for the improvement of the proposed scheme, with the realization that it could only prove successful in so far as it met with general approval.

The essentials of the new classification are : (1) that the name given to a rock shall no longer carry any implication of *mode of occurrence* (for example ; plutonic, hypabyssal, or extrusive) ; (2) that the names now proposed for the main rock types are based on, and imply a definite *grain size* for the ground-mass (ignoring phenocrysts). Only a brief outline of the new plan can be given here. Dr. Wells first divides rocks into 'clans' on a chemico-mineralogical basis. Each clan is then sub-divided into three major classes, defined in terms of grain size. One example will suffice as an illustration. The granite clan is subdivided into granites, coarse-grained rocks of grain diameter exceeding 0·5 mm., micro-granites with grain diameter 0·5–0·05 mm., and rhyolites with crystals of grain diameter of less than 0·05 mm and not exceeding 0·0025 sq. mm. in area. Mode of occurrence can still, of course, be indicated by prefixing a suitable adjective to the rock name

The committee's report dealt only with the granite and gabbro series, and it is, apparently Dr. Wells alone who has assumed the responsibility of publishing a complete new classification, before the committee has issued a final report. This may be one way of testing geological opinion, but it is questionable whether it is advisable to adopt in a widely used text-book, a system not ye generally accepted. In any event it is unfortunate that the definitions of the new classification are not set out clearly, preferably in tabular form at the beginning of each section. It would also have been an advantage for students to have indicated which are the new rock names no previously in general use.

The classification has the advantage that i simplifies the teaching of petrology, and, to some extent, if it were generally accepted, it migh ultimately simplify the literature of petrology

Judging by the fate of other attempts at reform, this seems unlikely. Dr. Wells himself, for example, still uses terms, the disuse of which was recommended by a strong committee on nomenclature so long ago as 1921.

The chapter on the metamorphism of the igneous rocks has been omitted.

So much for the changes in the book, the desirability of which is a matter of opinion. There are also certain points that call for criticism. In Part 5, on cycles of igneous activity, the section on North Wales has been considerably enlarged. This is all to the good, but in dealing with the equally interesting igneous rocks of Scotland and the Border the treatment is unequal, and Dr. Wells has not always made full use of new work. The dyke swarms surrounding the Cheviot granite are no longer regarded as radial, and a more up-to-date diagram is available. This information can scarcely have escaped the author's notice, since he actually refers to the memoir in which it appears. There is no mention of the extensive Strontian granite mass, which was carefully described a few years ago. The Permian lavas of Ayrshire are erroneously shown in two text-figures as Carboniferous. Other lavas of the same age in Dumfriesshire are not mentioned. There are one or two other defects of a like nature, of which space forbids mention.

Hatch and Wells's text-book, being so well known, attracts criticism that a less widely used book might have been spared. It only remains to state that in a new and more attractive format it still retains its character as an excellent and readable introduction to the petrology of the igneous rocks.

(2) No important changes have been made in the fifth edition of Part 1 of Winchell's well-known text-book, but a number of corrections and additions have been incorporated. Among the latter may be mentioned the inclusion of illustrations of the latest models of polarizing microscopes.

(3) The scope of Rogers's "Introduction to the Study of Minerals" has been enlarged in the third edition by the inclusion of a section on microchemical analysis. The whole work has been thoroughly revised, particularly the sections on crystallography; and the determinative tables have been enlarged by the inclusion of forty-seven additional species A novel and useful feature of the latter section is the listing of the French and German equivalents of mineral names.

Mortality in the United States

Twenty-Five Years of Health Progress:
A Study of the Mortality Experience among the Industrial Policyholders of the Metropolitan Life Insurance Company 1911 to 1935. By Dr. Louis I. Dublin and Dr. Alfred J. Lotka. Pp. xi+611. (New York: Metropolitan Life Insurance Company, 1937.)

THIS interesting volume records the experience of more than 340 million years of life, with nearly three million two hundred thousand deaths, observed in the twenty-five years 1911–35. The industrial policy holders consist mainly of urban populations at the lower level of income, so that their mortality rates would be expected to be somewhat higher than those of the whole population of the same age groups. That is, in fact, the case, but there is clear evidence of convergence, a gratifying testimony to the effects of modern sanitary progress. The trends of mortality rates for the very large number of separate causes of death examined are so similar to those of the United States where comparison is possible, that the volume may be taken as a reliable index of the changes of the last twenty-five years.

In the very large majority of instances, the secular movement in America has been similar to that in Great Britain; thus what is said in this volume of changes in mortality from tuberculosis, cancer, diabetes and cardiac diseases might be applied almost unmodified to English experience. The authors comment energetically on the black record of the United States with respect to automobile accidents and homicide. In 1934 there were more than 12,000 homicides in the United States, which, they say, "is a shocking record and places the country in the unenviable position of being the most lawless nation in the world"; and they contrast this, which gives a rate of 9·5 per 100,000, with a rate of 0·5 per 100,000 in England and Wales. Before priding ourselves too much, we should reflect that England and Wales is, areally speaking, a very small country indeed.

The authors comment with almost equal severity on the 34,000 deaths in 1934 due to automobile accidents, giving a rate more than twice that of England and Wales. But they note that 75 per cent of the world's motor cars are owned in the United States, so that we have certainly nothing to be proud of.

The volume is a most useful contribution to the literature of demography.

M. G.

Les Classique de la decouverte scientifique

(1) Traité élémentaire de chimie de Lavoisier
Pp. xxxviii+191+2 plates.

(2) Leçons de philosophie chimique
Par J.-B. Dumas. Pp. xxviii+270+2 plates.

(3) La synthèse totale en chimie organique
Mémoires de MM. Wöhler, Gerhardt, M. Berthelot, Le Bel, Van't Hoff, Jungfleisch, Ladenburg, Pasteur. Préface et commentaires par Marcel Delépine. Pp. viii+144+8 plates.

(Paris: Gauthier-Villars, 1937.) 21 francs each.

In reprinting these three classics of French chemistry with introductions, an important service has been rendered to the study of the history of chemistry.

(1) The famous "Traité" of Lavoisier, with an introduction by Le Chatelier, is reprinted in part only, but the important sections have been retained. The first part, giving the theoretical views of Lavoisier, has been reprinted in full; the second part of the original work, containing tables of compounds, has been omitted entirely, which has resulted in a few important sections being wanting, and a third part, dealing with apparatus, has been abridged. The illustrations have been incorporated in the text. The present work will serve the needs of students but it cannot be regarded as a critical edition. No indication is given as to which edition of the original has been followed for the text, and the title-page as reproduced does not correspond with either of the editions of 1789.

(2) The work by Dumas has been reprinted in full, with an introduction by G. Urbain; it is essentially historical and is still of considerable value. The style is lively and the choice of subjects is an excellent one. This volume will not only be read with profit by students but also will be useful to specialists.

(3) The volume on organic synthesis, with an introduction by M. Delépine, contains a very appropriate choice of texts in French, beginning with extracts from the registers of the Academy dealing with experiments of Bourdelin, extracts from the paper by Rouelle on urine (in which urea is first described) and from the paper describing the work of Fourcroy and Vauquelin in which this substance is first isolated, a translation of Wöhler's paper on the synthesis of urea, extracts from Gerhardt's "Traité", long extracts from Berthelot's "Chimie organique fondée sur la synthèse" and other publications by Berthelot, papers of van't Hoff, Le Bel, Jungfleisch and Ladenburg, and notes on the work of Pasteur and recent publications.

The three volumes contain portraits.

Science (K'o Hsüeh)
Vol. 22. Nos. 1 and 2 (January–February, 1938). (Shanghai: Science Society of China, 1938.) 50 cents (6*d*.).

At this time of unparalleled unhappiness for China, it is particularly interesting to see that scientific work is going on and that sufficient support is available for the circulation of a monthly journal very similar in its aims and format to Nature.

The January–February number, which lies before us, opens with a translation of the Mather Lecture of the late Right Hon. Ramsay MacDonald, published in Nature of October 30 of last year. This is followed by more specialized articles, such as a mathematical paper by Mr. H. C. Wang and an account of work on pentosan fermentation by Mr. C. L. Kuo. Anthropology is represented by an especially interesting review of the geographical distribution of the "Jew's Harp" in the Orient, based on a good deal of British field work as well as on Mr. H. Liu's own researches and drawing upon the descriptions of the instruments in classical Chinese literature. Another interesting contribution is from Mr. C. F. Hsü, who lists a further thirty indigenous Chinese drugs, giving their names, characteristic place of origin, traditional therapeutic use and the nature of the active principles found in them by modern chemical methods. An appeal is made to botanists to help to identify these plants which have been known for so many centuries in the Chinese classics.

Besides these articles there are accounts of contemporary events such as the Galvani celebrations at Bologna, the ceremonies attending Prof. H. Wieland's sixtieth birthday, and various congresses. Translations of certain reviews from Nature are also given.

The journal is printed in the modern 'scientific' style extremely well and gives an excellent impression. It should be realized that scarcely twenty years have passed since Western science began to be studied seriously in China. The application of Western science to Chinese conditions is by no means easy, since a large body of men educated in this tradition has not yet grown up. Moreover, the glaring necessities of the social situation require an emphasis on studies of immediate practical importance. Chinese scientific men are thus especially well aware of their social responsibilities. The recent discussions in Nature of such problems, having been in the minds of Chinese scientific workers for many years past, will find a very sympathetic understanding in China.

G. D. Lu.

Naturwissenschaftliche Erkenntniss und ihre Methoden
Von M. Hartmann und W. Gerlach. Pp. v+70. (Berlin: Julius Springer, 1937.) 2.40 gold marks.

Two addresses on the origin and methods of progress in biology and on theory and experiment in the exact sciences, delivered in September 1936 by Prof. Hartmann of Berlin and Prof. Gerlach of Munich before the Gesellschaft Naturforscher und Ärzte have been issued in pamphlet form, the second with considerable additions extending it to 49 pages as against 21 for the first. The aim of both addresses is to show that the methods by which science is advanced are the same in principle in all fields. In biology the methods are illustrated by the development of the chromosome theory of heredity, and in physics by the ways in which the detailed study of the physical memoirs of the last hundred years rather than philosophical discussions have made progress possible. Many examples of the way in which theory and experiment have reacted fruitfully on each other and stimulated growth are given by Prof. Gerlach, some taken from the newer, but more from classical physics.

Photographic Measurements of the Great Aurora of January 25-26, 1938

By Prof. Carl Stormer, Institute of Theoretical Astrophysics, Blindern, Oslo

THE great aurora of January 25–26 last was observed and photographed from my nine photographic aurora-stations in southern Norway. From $18^h 16^m$ until $6^h 7^m$ G.M.T., about 1,390 photographs were taken, of which about 710 were successful. Among these, there are 95 sets taken simultaneously from two stations, 48 from three and 14 from four, to determine height and position. Furthermore, about twenty spectra were secured. Besides this, I received about 180 letters with observations from different parts of Norway and about 20 from abroad. The working up of this extensive material will take a long time, but some preliminary results already obtained may be of interest.

My assistant, O. Hassel, who works without telephonic connexion with the other stations, began to take pictures as early as at $18^h 16^m$ G.M.T. A fine series of about sixty pictures had already been taken when the other stations began their work at $19^h 40^m$ G.M.T. Clouds at the eastern stations prevented good simultaneous pictures being obtained before $20^h 11^m$, but from that moment until dawn photographs were taken in rapid succession as fast as possible from all stations connected by telephone. The stations were combined as two sets. Each set, with the main station in Oslo, had up to three secondary stations, and the two sets worked independently of each other. The work was directed from the main stations in Oslo.

Twenty-one sets of simultaneous pictures have so far been measured and calculated. Some of the results are here brought together. Fig. 1 represents the aurora towards the south photographed from the Tömte station at 21.40.09 G.M.T. Simultaneous pictures were taken from Oslo and Oscarsborg. The arc near the southern horizon was green and persisted for a long time as the southern boundary of the aurora. Above it are seen rays which were of red colour. For a long time the northern half of the sky was quite free from any aurora. With the base-line Oscarsborg–Tömte, 73.7 km., the following heights were found: Lower border of the green arc, about 95 km. Base points of rays, from 150 to 200 km.: summits, from 500 to 600 km. The whole aurora was lying in the earth's shadow. The geographical situation of the rays measured is seen on the accompanying map (Fig. 2) over Denmark.

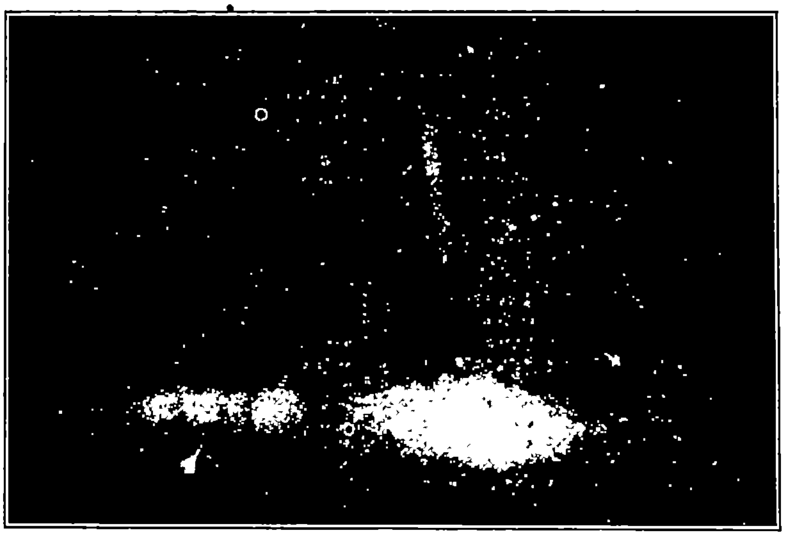

Fig. 1.

Aurora in the south photographed from Tomte, north of Oslo, at 21.40.09 G.M.T.

The green arc was lying under the base points of the rays. The further extension of the arc eastwards and westwards could be found from single pictures taken a little before, or after, the set mentioned, the height being supposed to be 95 km. The arc was sometimes single, sometimes double, and stretched from Ösel over Denmark to the northern part of Ireland, as seen on Fig. 2.

At the same time, two other rays were photographed simultaneously from Askim and Lillehammer. With this base-line, of 173 km., the base points of the rays were found to be at about 106 km. and 108 km., and the summits about 500 km. and 540 km.

All these rays were lying in the earth's shadow, and their great length, up to 400 km. and more, is quite astonishing; it seems to indicate that the high atmosphere is lifted up by the action of the big aurora, like the lifting up by the action of the sunlight in other cases.

At $21^{h}\ 41^{m}$ G.M.T., the ray-summits had neared the magnetic zenith in Oslo. With the base Oslo–Lillehammer, 133 km., the summits were again measured and gave heights up to 500 km.

A fine corona next developed. The point of radiation found from the Oslo picture at 21.41.40 G.M.T. could be measured with a precision of ± 0·2° in altitude and ± 0·6° in azimuth, to altitude 70·0°, azimuth 6·4° east of south. At 21 45.34 the base points of the rays of the corona in the east were measured with the base-line Oscarsborg–Tømte, and found to be 95–105 km. (parallax, 15–20°).

During the later maximum, near midnight G.M.T., new determinations of high rays were made and heights even to about 650 km. were found for rays lying in the earth's shadow, a very remarkable fact. At $0^{h}\ 14^{m}$ G.M.T. the whole heavens was filled with a gorgeous corona, and it was difficult to find parts of it characteristic enough to be measured. Only the base points of some rays towards the east against the dark sky behind could be measured, and a height of about 95 km. was found. During this corona, which may be characterized as the maximum activity of the aurora in Norway that night, my assistant, Mr. Tjönn, at my station on Njuke Mountain in Tuddal, 733 metres above sea-level, reported that he heard sounds with the aurora. He says in a letter to me :

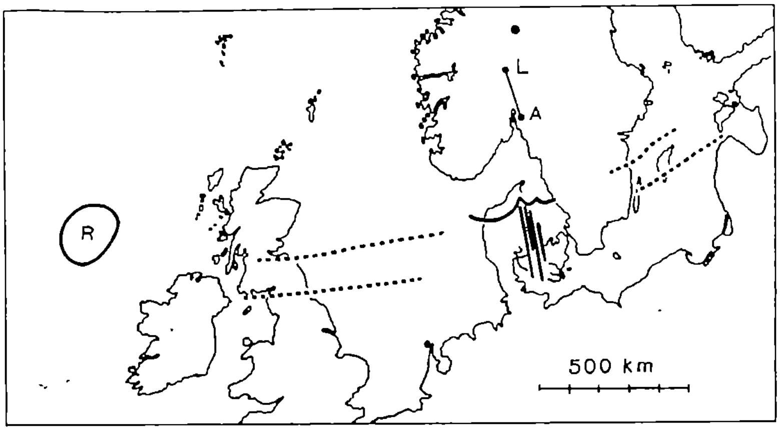

Fig. 2.

Geographical situation of auroral arcs and rays at about $21^{h}\ 40^{m}$ G.M.T. and of a red spot (*R*) at $0^{h}\ 35^{m}\ 45^{s}$. The dotted lines are found from single pictures supposing the lower border of the arcs equal to 95 km. *L–A* is the longest base-line, Lillehammer–Askim, 173 km.

"During the imposing display of this big corona, where the whole heavens was like an ocean of flames, my assistant and I heard a curious sound which came from above, first from the south-west, then from the zenith and at last from the north-east. The sound lasted about ten minutes, rose to a maximum and fell down again, following the intensity of the aurora. I had the impression that it had something to do with the white rays. At that time I had taken off the earphones from my ears (when I had them on, I heard nothing of this sound) and went some steps aside to hear it better ; that the sound came from the telephone is quite excluded. The sound is difficult to describe, it was similar to the sound from burning grass and spray. On the mountain it was absolutely quiet, no sound coming from wind, waterfalls, telegraph lines or motors. Both my assistant and I heard it and are quite convinced that the sound was real. On the summit of the mountain where we had our station, only a few fir trees grow. Under us on all sides we had the forest."

The same sound was heard independently of Mr. Tjonn, down in the valley Tuddal, by Öystein Reisjaa, who in a letter has confirmed in all details the description given by Mr. Tjönn. When Mr. Tjönn heard the sound, he telephoned to me ; but I was so occupied by securing height determinations of the big corona that I did not pay sufficient attention to his call. On account of the great height of the aurora, it is clear that the sound could not come from the aurora itself, but from lower parts of the atmosphere ; but where its origin was future observations may decide.

A very characteristic feature of the aurora of January 25–26 was the red colour, which appeared both as diffuse surfaces occupying sometimes vast areas of the sky, and as a red glow at the top of the aurora, well seen from stations so far south as northern Africa and so far north as middle and northern Norway. This fact made it most probable that the red coloration reached enormous heights, and at $0^{h}\ 35^{m}\ 45^{s}$ G.M.T. we also succeeded in getting simultaneous pictures of a red spot in the west-south-west from the three stations Askim, Oslo and Lillehammer on panchromatic plates, Agfa ISS. As the base-lines were almost normal to the direction to the spot, the determinations are fairly trustworthy. We found for the lowest part about 350 km., and for the summit, almost 700 km. above the earth. The spot was situated about 1,500 km. away over the Atlantic Ocean north-west of Ireland, and was quite in the earth's shadow. I am sorry that the weather prevented us from measuring the sunlit parts of this aurora early in the evening. Records of auroral heights would probably have been the result.

Among the spectra taken by my assistant, Herlofson, only a few need be mentioned. On the same Agfa ISS plate were taken two spectra when the spectrograph was pointed towards the green arc in the south mentioned in the first part of this report. They show the green line 5577 A. as the strongest; then come with decreasing intensity the lines 6300 A., 6550 A. and 4278 A. On the same plate were taken two spectra when the spectrograph was pointed towards red areas. They show 6300 A., by far the strongest, next 5577 A. and faint traces of 6550 A. and 4278 A.

On Agfa red ultra-rapid plate was taken with the same spectrograph a spectrum of the red colour in the southwest between 0^h 10^m and 0^h 30^m G.M.T. Here 6300 is again by far the strongest line, then 6550 and 5577 about equally strong, and traces of 4278. On the same plate were taken spectra of pulsating auroras and corruscations between 2^h and 4^h G.M.T., situated in the height interval from 90 to 120 km. Here all four lines have about the same intensity.

Photometric measurements of these spectra will be made later.

Medical Research in Great Britain

THE report of the Medical Research Council for 1936–37* gives, in summary form, an account of the researches carried out by members of its staff, either at the National Institute for Medical Research or in external institutions, as well as by the numerous investigators, working in different laboratories, who receive grants-in-aid from the Council. In this report, separate sections are devoted to the work carried out by members of the Council's staff in external institutions, instead of its being included in the sections also describing the investigations aided by grants, in order to give a truer picture of the organization of the Council's activities.

Lord Mildmay of Flete, treasurer of the Council, resigned his membership during the year; Mr. Goodenough was appointed to succeed him. Sir Thomas Lewis and Sir David Wilkie retired in rotation and were succeeded by Prof. Gask and Prof. Witts. The Council has made appointments to Dorothy Temple Cross research fellowships, to research fellowships in tropical medicine and also to Rockefeller medical fellowships. It will be recalled that last year it was announced that the Rockefeller Foundation had suspended the arrangement under which the Council awarded these fellowships, as it wished to concentrate its activities on certain selected fields of medical research: the Foundation has, however, now generously agreed to restore and augment the former arrangement. The Council has continued to maintain close touch, at relevant points in its work, with the Government departments concerned with questions of health and has also been closely concerned with international health work under the League of Nations, and especially with regard to questions of nutrition and of biological standards, upon the Commissions dealing with which it is directly represented.

The need for additional laboratories for work on chemotherapy and biological standards and for nutritional studies as well as to relieve the present overcrowding at the National Institute for Medical Research has led the Council to consider the possibilities of development at the present site at Hampstead and at the site of the farm laboratories at Mill Hill. Owing to the fact that the Hampstead site has been reported on as unsuitable for further development on the scale which is now in view, even without allowing any margin for future expansion, the Council has decided in principle to abandon this site and to concentrate the whole of the National Institute at Mill Hill. A final decision can be taken only in the light of a definite estimate of the cost, based on the detailed plans which are now being worked out. If the project can be undertaken at once, it should be possible to complete it within about two years, and to provide additional accommodation for some purposes at an earlier date.

The grant-in-aid provided by Parliament for the expenditure of the Medical Research Council was greater by £30,000 than the amount in the previous year, the difference representing special provision for the development of research work in chemotherapy. Chemotherapy is the treatment of infective diseases by the administration of chemical compounds synthesized in the laboratory, which have been found to have specific actions on the infective organisms associated with these diseases. The principal successes of this form of treatment have so far been in infections with spirochætes and protozoa rather than with bacteria, in venereal and tropical diseases rather than in the bacterial infections common in a temperate climate. Quite recently, however, success has attended the use of the sulphanilamide group of drugs in streptococcal and other infections, thus opening up a new field of chemotherapy, which is being rapidly and effectively developed.

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* Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1936–37. Pp. 165. (London: H. M. Stationery Office, 1938). 3*s*. net.

Although this is the usual sense in which the word "chemotherapy" is employed, there is a much wider field of medical treatment in which advance depends on the same kind of investigation, made by chemists and biologists working in close collaboration. In this field is included the discovery of chemical substances which have specific actions on certain bodily functions, and therefore great value in the systematic treatment of disease The Council points out that the discovery of chemical compounds of this nature has depended almost entirely on German science and industry, and still so depends, although several fundamental discoveries were made in Great Britain. There is therefore great need for further research in Great Britain aimed at the discovery of new chemical substances of therapeutic value, and strong reason for developing a national scheme of investigation not unworthy of comparison with the work that is done abroad, especially considering that the British Empire is the chief consumer of drugs used in the treatment of tropical diseases. The financial requirements of an effective scheme are too large to be met from the ordinary resources for medical research, so that it can only be supported by funds specially provided as a matter of national policy. In Germany, the research work has been mainly carried out in institutions maintained by manufacturing chemists: in Great Britain the interests of the larger firms have lain in other directions, and the smaller firms have been content to act as agents for the foreign producers. In the absence of the necessary expansion of chemical industry, the only possibility of securing that Great Britain takes its proper part in this matter, in relation to its imperial responsibilities, is a national scheme supported from public funds.

For some years, the Council has supported research work on chemotherapy at different centres and valuable results have been obtained; witness the recent discovery of the trypanocidal properties of compounds with terminal iso-thiourea and amidine groupings. Notwithstanding the results obtained under the present scheme, it had become clear that improved research facilities were needed to secure substantial advances in chemotherapy from the point of view of the ultimate practical effect on diseases inaccessible to other forms of treatment, and especially on the major problems of protozoal infections in the tropics. It is considered that a central research laboratory is an essential factor in a national scheme: it will provide for the close association of the biological investigators with those engaged in the synthetic production of new compounds: and it will provide mass data from which it may be possible to discover laws relating chemical structure to therapeutic effect, so that research in this field will become less empirical than it is at present.

The main part of the report is devoted to short accounts of the researches carried out by members of the Council's staff or by workers assisted with grants-in-aid; but certain subjects are selected for more detailed consideration in the introduction, of which two have been referred to above. Among others may be mentioned influenza and the study of viruses, the surgery of the heart, the causes of mental defect, the role of salt in the body, the diagnosis of cholera and the experimental study of leprosy. It is now known that the virus of influenza is multiple, that responsible for the 1933 epidemic being of a different strain from that isolated in the 1936–37 epidemic. Hence, if vaccination is to have the best chance of success in any future outbreak, it will be necessary to choose an inoculum made from a virus belonging to the same immunological group as that responsible for the immediate outbreak. Experiments with ferrets suggest that such vaccination may successfully prevent the ordinary human contact infection. The discovery that many viruses will grow in the chorio-allantoic membrane of the developing chick provides an experimental method of research into their properties, which is simpler and more precise than that involving inoculation of laboratory animals. It is possible that the egg-culture technique may be used in the future for producing vaccine to protect against smallpox on a large scale, thus superseding the lymph of infected calves.

An interesting account is given of recent experimental work on the surgery of the heart and its application to cases of heart disease in man. Vascular obstruction in the heart cannot ordinarily be remedied as in most other organs by the development of a collateral circulation: it has been found, however, that the great omentum can be brought up from the abdomen through the diaphragm and secured to the heart, when new blood vessels will grow into the heart muscle from it. Several patients have now been operated on and only one may be considered to have died as the direct result of the operation; the survivors are all improved and some formerly bed-ridden patients are now leading a life of normal activity. About a quarter of the patients operated on only survived a few months, but it is pointed out that individuals suffering from diffuse disease of the vessel walls in the heart are in any event liable to sudden death; two in fact died suddenly a few days before the date on which the operation had been arranged for them.

The discovery that the bacillus of rat leprosy can be transmitted to the Syrian hamster, has been followed by the announcement from Palestine that this species can be similarly infected with the causative organism of human leprosy. This work should provide the basis of a new attack on the problems of this disease, and, in particular, make possible the experimental study of the treatment of leprosy by chemotherapeutic methods.

A few only of the subjects dealt with in the report have been selected for notice in this review: for a fuller picture of the Council's activities reference must be made to the original. It may be mentioned that full titles and references to the original papers published by members of the Council's staff and other investigators are given throughout the report, so that those interested can easily obtain the further details they require.

The Linnæan Tradition

FOUNDED ten years after the death of the celebrated Linnæus, the Linnean Society of London has for the past hundred and fifty years carried on the work he initiated in systematic botany and zoology. The anniversary was celebrated in London by appropriate meetings on May 24–27. Without any doubt the founding of the Society was due to the presence of the Linnæan Collections in England in 1784, in which year they had been received by purchase from Linnæus's widow by James Edward Smith, a medical student then twenty-four years of age. That close contact with the materials used by the great Swede resulted in the English naturalists adhering very closely to what may be called the Linnæan tradition; and although the systems used by Linnæus have been greatly changed or superseded, it is significant that his authority and influence are still felt strongly to-day.

The tradition left by Linnæus was indeed a great and a worthy one. Despite the carping criticisms of certain historians, there is no doubt at all that Linnæus wrought a great and fundamental work in both botany and zoology. Concentrating his efforts on the classification and description of plants and animals, he did the task most needed for his time; leaving a vast body of completed work, and, as the result of his deep and sincere thought, methods which are followed in the main by taxonomists to-day. Looking across two centuries, we can visualize that short sturdily built man with his keen-sighted brown eyes and his open and pleasant face, who worked from boyhood to old age with singleness of purpose towards one objective—to know and classify all forms of living organisms. No living organism can be named correctly until it is known; none known properly until it is classified correctly.

Linnæus's achievements in botany and zoology can be gauged rightly only when considered in relation to the states of those sciences at the time when he worked. He came at a time when Western naturalists had succeeded in disentangling themselves from the ancient authority and superstition that had clung to them long after the Renaissance. Men had turned from the authority of books to study Nature; from travels and exploration more new plants and animals were becoming known each succeeding year; attempts were being made to present in systematic form the knowledge then extant; but the net result had been a chaos in which each worker had put forward his own ideas of system and nomenclature.

Coming at the very time when he was urgently needed, Linnæus, clear-headed, practical, imaginative, resolved that chaos into order. Although so early as 1738 he had published in "Classes plantarum" a sketch of a natural system in botany, and throughout his life continued to elaborate it, his botanical works were always arranged according to the sexual system, which he had devised when he was twenty-four years of age. His reason for adhering to that system was a sound one: at the time he worked, an insufficient number of plants were known to found properly a natural system. Nevertheless, his own system brought together automatically some of the natural groups; and when the rise of the natural system began with the work of the de Jussieus, Robert Brown and others, much of Linnæus's work on genera and species still held good. In zoology, also, Linnæus's influence continues in spite of changes of system.

The Linnean Society's early history reflects most clearly that almost religious adherence to the Linnæan tradition; but the rise of the natural system in botany, the impact of the Darwinian theory of natural selection, the influence of the great school of German physiological botanists, or the specialistic developments of modern biology, have not obliterated that tradition. None of these waves of influence could or can sweep away the ultimate necessity of presenting the facts of Nature in taxonomic form. Under his will, Darwin left a sum of money to be devoted to the compilation of a great index for the use of taxonomists, the "Index Kewensis"; the aim of the German physiologists was to find a better basis of taxonomy (one of the negative results of which is that to-day real systematic botany is but scantily touched upon in British universities); and the efforts of the ecologists, geneticists and cytologists can have but one real object—the ultimate reclassification of living organisms.

Among the tendencies of the present time, it is possible to detect an impatience with the existing forms of taxonomy; but any attempt to alter such forms without very profound consideration and fair trial would seem likely to lead to a chaos similar to that from which Linnæus rescued the learned world. Often without being able to read with any ease the Latin works of the older naturalists, some of the modern workers appear to be inclined to cut adrift entirely from the past. The remedy surely lies in a more careful consideration of the philosophical ideas upon which all taxonomy must be based.

A Discontinued Darwin Medal

By T. E. James

THE rise and mutual development in Great Britain of provincial natural history and literary societies, microscopical clubs and field clubs is one of the stories of nineteenth century science that scarcely requires iteration. Yet in regard to one of these, the Midland Union of Natural History Societies, an amalgamation of 1878, due in the main to the efforts of Mr. Lawson Tait, F.R.C.S., of Birmingham, there is a connexion of Darwinian interest in the Union's institution of a Darwin Medal, which in course of time has lapsed in award, and possibly is now altogether out of mind.

The medal bore on the obverse the portrait-bust of Charles Darwin in bas-relief and the reverse a branch of coral; while the medal itself was the work of Joseph Moore (1817-1901), a well-known medallist-sculptor and die-sinker in Birmingham.[*] Why the award of this medal ceased will be considered presently. Apart from the Royal Society's Darwin Medal (the first award of which was not made until 1890), there would appear now to be no medallic gift in Great Britain which periodically commemorates the researches of the great naturalist in this way.

The idea of an amalgamation of the numerous scientific and literary societies already existing in various parts of the Midland counties took practical shape in 1878 as above mentioned, and a journal called the *Midland Naturalist* was started as the organ of the Union; the journal appeared successfully down to the end of the year 1893. It was an effective and highly popular medium of intercommunication, but like other official fusions of the period, strength of membership carried latent weaknesses. The magazine eventually became an onerous task, its issue resting on the efforts of the zealous minority.

Returning to the Darwin Medal of the Midland Union, it appears that at the annual meeting held in 1880 at Nottingham, a suggestion was made by Mr. W. Jerome Harrison for the foundation of a yearly prize which should have as an objective the encouragement of original research connected with the natural history of the Midlands. Regarded favourably, it was unanimously agreed to institute an annual Darwin Prize of the value of £10, to include a gold medal denominated the Darwin Medal, for a paper embodying original research contributed by a member of the Union for publication in the *Midland Naturalist*. Incidentally, it may be said that Charles Darwin was a subscriber from the first to this publication.

DARWIN MEDAL OF THE MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

Steps were taken to acquaint Darwin with the proposal and to ask his permission to adopt his name. Darwin replied as follows:

> "I request that you will be so good as to inform the members of the Committee that their wish to name the medal after me is a very great honour, which I gladly accept. It is particularly pleasing to me to have my name connected, in however indirect a manner, with a scheme for advancing science—the study of which has been my chief source of happiness throughout life."

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[*] Joseph Moore also designed a medal for the British Association meeting at Birmingham in 1849 and at Cheltenham in 1856.

This cordial letter is not recorded in the "Life and Letters"; but somewhere perhaps the original may be in existence.

Regarding the provision of regulations for the "Darwin Prize", it was decided that the subjects for each of the three years ensuing should be geology, zoology and archæology. The following committee of five adjudicators was chosen: Dr. Thomas Wright, the Rev. George Deane, Prof. Charles Lapworth, J. J. Harris Teall (afterwards Sir Jethro Teall) and W. Jerome Harrison. The first recipient of the gold medal, for the year 1881, was Edward Wilson, of Nottingham, for his paper "The Permian Formation in the North-east of England". The award for the year 1882, in zoology, went to Prof. A. Milnes Marshall, M.D., and W. P. Marshall, M.Inst.C.E., for their joint paper on the "Pennatulida". Space forbids naming the adjudicators. The medal was presented at the annual meeting held at Tamworth in June 1883.

At this meeting it was reported also that a bronze copy of the medal had been sent to the family of the late Charles Darwin, and that Mr. W. Erasmus Darwin, writing from Basset, Southampton, on December 14, 1882, had expressed the opinion that it embodied a striking likeness of his father, who had much appreciated its foundation.

Awards continued, mostly yearly, but always subject to the receipt of meritorious papers. Mention may be made of the annual meeting of 1889, held at Oxford, with Mr. (now Sir Edward) E. B. Poulton, F.R.S., as president of the Union. His address bore the title "Theories of Heredity". We hear of "trenchant criticism" of the word "heredity" by Lawson Tait, and a "lively passage of arms" thereon with Francis Galton. The Darwin Medal for the year was handed to T. W. Walker, for a thesis on a geological subject.

So far back as 1882 a note of warning had been given in the *Midland Naturalist* that an endowment fund of £250 would be required if the gift of a gold medal was to continue as a permanent memorial. Alas! this object was never achieved; the Union sailed over uncharted and uncertain waters, and some indeed of its constituent bodies were bad sailors in Darwinian days. The *Midland Naturalist* ceased publication at the close of 1893, and the Darwin Medal became a final award in 1895 with its allocation to Dr. Walter E. Collinge, now keeper of the York Museum, for studies in comparative anatomy.

Obituary Notices

Mr. Hugh Ramage

THE death of Mr. Hugh Ramage, on April 16, at seventy-three years of age, will be deeply regretted by all who knew him. He was one of the most unassuming of men, yet his work in certain fields of spectroscopy was of a very high order, and his devotion to these studies in the leisure hours of a busy life manifested a spirit of self-sacrifice in the pursuit of scientific knowledge not often found at any time.

Mr. Ramage was born on March 31, 1865, at Wolverton, Bucks, but both his father and his mother were natives of Catrine, Ayrshire. He left school at twelve years of age, and a year later, after his parents had removed to Crewe, he entered the L.N.W.R. carriage works there in the telegraph office, his duties being to work the single needle telegraph instrument. While in this position, and afterwards when he became an apprentice in coach-making, he attended evening classes in elementary scientific subjects and mathematics at the Mechanics' Institute. Probably on account of these studies, he was eventually transferred to the laboratory of the locomotive works and became engaged in analytical work. When twenty-one years of age, he entered for the annual competition for National Scholarships or Royal Exhibitions, then awarded on highest successes in the Science and Art Department's examinations. As the result, he obtained a Royal Exhibition tenable at the Royal College of Science, Dublin, which he entered in October 1886.

After completing his course at the Royal College of Science, Mr. Ramage returned to the Crewe laboratory in 1889 under Joseph Reddrop, and while there carried out investigations on the bismuthate method of estimating manganese and the estimation of phosphorus and carbon in mild steels. He left Crewe in 1891 to become demonstrator in chemistry under Prof. (afterwards Sir Walter) Hartley at the Royal College of Science, Dublin; and in the following year he began to assist Sir Walter in researches on flame spectra. One of the chief objects in view was the study of Bessemer flame spectra; and the results obtained were valuable contributions to the knowledge of the thermo-chemistry of the Bessemer process. It was in conjunction with Mr. Ramage that Sir Walter Hartley discovered the existence of the bands in the flame spectra of many metals and from a study of these was able to draw important conclusions about the relation between the band and line spectra of the same element.

Mr. Ramage's introduction to the use of the spectroscope in chemistry in association with Sir Walter Hartley determined his main scientific interests and activities throughout the rest of his life. In 1899 he left Dublin and went to Cambridge as a research student, Prof. Liveing giving him facilities for work on the oxyhydrogen flame spectra of metals, especially the band spectra of copper, silver and gold, but also of other elements, and to study homologous lines in spectra and relationships between wave-length or wave-number and atomic weight. In his ninth term he submitted two theses to the Board of Studies and obtained his degree upon them. Three years later, in 1904, he was appointed organizer of higher education and principal of the Technical Institute at Norwich, out of which developed the Norwich Technical College, of which he was the principal until his retirement in 1930.

Mr. Ramage was the author, or joint author, of a number of papers published in the proceedings or transactions of societies and in scientific journals. Reference has already been made to his work with Reddrop, with whom he was associated in his first paper published by the Chemical Society in 1895, on the volumetric estimation of manganese by oxidation with sodium bismuthate, which is now in general use. From that date until 1901 he was the joint author, with Sir Walter Hartley, of fourteen papers contributed to the Royal Society, Chemical Society, Iron and Steel Institute and other societies, on spectrographic analysis of various minerals and metals and related subjects. Among the subjects of similar papers of which he was the sole author are the spectra of potassium, rubidium, cæsium and their mutual relations, abnormal changes in some lines in the spectrum of lithium, and the distribution and spectra of metallic vapours in electric sparks. He also discovered that Norwich flue-dust was a source of gallium.

In recent years, Mr. Ramage devoted chief attention to the use of the spectroscope to biology and medicine, and his researches in this field are of particular importance. Some of the most interesting of these were published as communications to NATURE, and others appeared in the *Biochemical Journal*. The first account of results obtained by Mr. Ramage in his extension of spectrographic analysis to vegetable and animal matter seems to have been given by him in NATURE of April 20, 1920. This was followed, in the issue of August 23, 1930, by a communication on such an analysis of mushrooms, which showed that each part had a high potassium and a low calcium content. Copper and silver were also shown to be contained in different parts of a mushroom. (In August of last year Mr. Ramage extracted from half an ounce of dried mushrooms in powdered form a tiny pellet of silver and a similar one of copper.) In NATURE of November 1, 1930, a joint communication from Prof. Munro Fox and Mr. Ramage summarized the results of a survey of animal tissues with the view of detecting and analysing quantitatively those of the less common elements contained in protoplasm and its products capable of being investigated by spectrographic methods. A paper on this subject by Fox and Ramage was published in the *Proceedings of the Royal Society* in the following year. It was shown by these studies that manganese was widely distributed and that the manganese content of animal tissues varied with the locality in which a given species of animal lived. Further work showed that strontium occurred in the genital duct of the edible snail and that manganese was a prominent element in its liver. Copper and iron were always detected; and silver was present in the kidney and liver of all crabs and lobsters examined. Similar methods were applied to the study of the composition of human tissues, the results of which appeared in the *Biochemical Journal* and the *Proceedings of the Royal Society*. Among other results, this work led to the first description of the presence of barium in the human choroid.

The essential importance of small amounts of mineral constituents in soils, as affecting the growth of both plants and animals, is now fully recognized, and the researches carried out by Mr. Ramage himself, and in association with others, upon the occurrence of such elements in plant and animal tissues have proved to be of greater practical value than was ever anticipated by him. He played an important part in the study of a deficiency disease of sheep in Australia, which ultimately proved to be curable by cobalt, by virtue of his discovery that the soil in the affected areas was deficient in this element. The sole motive of his scientific work was to increase his own knowledge of natural actions and phenomena, and to present the world with the results obtained, whether they were of practical use or not. In this respect he represented the noblest type of the scientific spirit.

While attending the Toronto meeting of the British Association in 1897, Mr. Ramage met Miss Winifred Pye-Smith, who became his wife in 1904 and survives him, with one son and one daughter.

Sir Wolseley Haig, K.C.I.E., C.M.G.

WE regret to record the death of Sir Wolseley Haig, distinguished as soldier, administrator and orientalist, which took place on April 28, at the age of seventy-two years.

Thomas Wolseley Haig was a son of Major Robert Wolseley Haig, of the Royal Artillery and fellow of the Royal Society, and was born on August 7, 1865. He was educated at Wellington College and Sandhurst, joining the Seaforth Highlanders in 1884. He transferred to the Indian Army and was engaged in the suppression of the dacoits of Upper Burma. His appointment in 1892 as a member of the Berar Commission, which was entrusted with the Assigned Dominions of the Nizam, brought him into close touch with the life of the Deccan and turned his interests to the study of its history and linguistics. After holding various administrative posts there, he entered the Political Department of the Government of India in 1901, serving at Hyderabad, at headquarters, and at Alwar, where as political agent he exerted great influence over the somewhat difficult Maharaja. His final term of service in the East, from 1910 onward, was passed mainly in Persia. He served in a consular capacity at various posts, including Baluchistan, Khorasan and Ispahan, to the last-named of which he was transferred in 1916, and where he was associated with General Percy Molesworth Sykes, who speaks highly of his abilities and achievement in dealing with Eastern peoples in his "History of Persia". In 1920 he retired, having received the orders of the Star of India, St. Michael and St. George, and the British Empire. In 1922 he was created K.C.I.E. In 1923 he accepted an heraldic appointment in Scotland. He resigned the office of Albany Herald in 1935 on the ground of ill-health.

As an oriental scholar, Sir Wolseley Haig will be remembered chiefly for his contributions to Indian history and for his detailed knowledge of Moslem rule. As a translator his version of Badaoni's history, one of the chief sources for Akbar's reign, is the standard of reference. He also translated the *Burhan-i-Maasir* of Tabatabai, the principal source for the Nizam Shahi dynasty of Ahmadnagar. On his return to England, Sir Wolseley was appointed professor of Arabic, Persian and Hindustani at Trinity College, Dublin, and later was lecturer in Persian in the School of Oriental Studies, London. He was also joint editor of the "Cambridge History of India", the third and fourth volumes, covering the whole Moslem period, being allotted to him. The third volume was largely his own work; but owing to a breakdown in health, after he had planned the fourth volume and prepared voluminous notes, the completion of the volume fell to Sir Richard Burn.

News and Views

Prof. J. J. Abel, For. Mem. R.S.

Prof. John Jacob Abel, who has just been elected a foreign member of the Royal Society, is the doyen of American pharmacologists. He is one of the best known and widely beloved personalities in medical science, in his own and other countries. After graduation, he worked under C. Ludwig in Leipzig and O. Schmiedeberg in Strassburg. Returning to the United States, he became professor of pharmacology at Ann Arbor, Michigan, migrated from there in 1893 to be the first professor of pharmacology at the Johns Hopkins Medical School, Baltimore, and held this chair with great distinction for nearly forty years. Prof. Abel's direct contributions to science have been chiefly on the chemical side of pharmacology. He was the first to bring to practical completion the isolation of epinephrine (adrenaline); later he discovered the same substance in the skin glands of a South American toad, from which he also isolated the toxic principle 'bufagin'; and he was the first to crystallize insulin. Among many other achievements, he devised methods for studying the diffusible constituents of the living blood, and the reconstitution of its plasma after hæmorrhage. Even in his retirement he is actively engaged in new and important researches on tetanus toxin. Throughout medical science in the United States his influence has been spread by his pupils, inspired by the example of a long life of selfless devotion to the pursuit of knowledge.

Prof. N. E. Nørland, For. Mem. R.S.

An unusually wide circle among men of science, including mathematicians, astronomers and geodesists, will approve and appreciate the election of Prof. N. E. Nørlund to the foreign membership of the Royal Society. Prof. Nørlund has since 1923 been the director of the Danish Geodetic Institute, an office always previously held (as in the case of the Ordnance Survey in Great Britain) by a military officer. In recent years, he has undertaken a new first-order triangulation of Denmark, and in Greenland also he has instituted a new triangulation which will extend up to 76° N.—a most valuable contribution to the determination of the figure of the earth. In mathematics, his works include memoirs on the theory of difference equations in the complex domain; on divergent series; and on continued fractions. In astronomy, at the University Observatory of Copenhagen, he has worked especially on the errors which affect the meridian observations of fixed stars, and has also made an important study of the double star ξ Ursæ Majoris, concluding from a very slight perturbation in its orbital motions that it is a triple star, the observable pair having an invisible satellite. Prof. Nørlund has held many distinguished offices in his own country, and has played a prominent part in the international organization of science; he has presided over the Baltic Geodetic Commission, the International Time Commission, and the International Council of Scientific Unions. He is a foreign member of the Academies of Science in Paris, Rome (Lincei) and Stockholm, and an associate of the Royal Astronomical Society.

Prof. René Leriche

The Lister Medal for 1939, which is awarded in recognition of distinguished contributions to surgical science, has been awarded to Prof. René Leriche, professor of clinical surgery in the University of Strasbourg, and he will deliver the Lister Memorial Lecture in 1939 at the Royal College of Surgeons of England. Prof. Leriche, who was born on October 12, 1879, received his medical education at Lyons, taking his degree in 1906. In 1906–9 he was chief of the surgical clinic of the Lyons hospitals, and then became full surgeon. In 1920 he became lecturer in experimental surgery at Lyons, and has also held there the professorship of external pathology. In 1924 he was appointed to the chair of clinical surgery in the University of Strasbourg which he now holds. He was made an honorary fellow of the Royal College of Surgeons of England in 1937. Prof. Leriche is chiefly interested in the surgery of the stomach, bones, joints, the sympathetic system, and diseases of arteries. This is the sixth occasion of the award, which is made by a Committee representative of the Royal Society, the Royal College of Surgeons of England, the Royal College of Surgeons in Ireland, the University of Edinburgh, and the University of Glasgow.

Dr. D. T. A. Townend

DR. D. T. A. TOWNEND has been appointed Livesey professor of coal gas and fuel industries in the University of Leeds. After nearly four years of war service, Dr. Townend entered the East London (now the Queen Mary) College, London. He graduated in 1920 and then proceeded to the Department of Chemical Technology at the Imperial College of Science, London, for post-graduate study and research under Prof. W. A. Bone. He has since collaborated with Prof. Bone more particularly in investigating gaseous explosions at high initial pressures. Dr. Townend was awarded successively a Salters' research fellowship and a Rockefeller international research fellowship. He has been largely concerned in the equipment and organization of the High Pressure Laboratories at the Imperial College. Dr. Townend, who is a recognized teacher in the University of London, is an authority on combustion and high-pressure problems and has published many books and articles both independently and in collaboration with his colleagues at South Kensington.

U.S. National Academy of Sciences: New Members

AT the annual meeting of the U.S. National Academy of Sciences held on April 25–27, the following were elected foreign members: Prof. Alfred Fowler, emeritus professor of astrophysics, Imperial College of Science and Technology, London; Prof. Pierre Janet, professor of psychology, Collège de France, Paris; Dr. S. P. L. Sorensen, director of the chemical division of the Carlsberg Laboratory, Copenhagen; and Prof. D. M. S. Watson, Jodrell professor of zoology and comparative anatomy, University College, London. The following members were also elected: Prof. M. H. Stone, professor of mathematics, Harvard University; J. A. Fleming, Department of Terrestrial Magnetism, Carnegie Institution of Washington; Dr. C. D. Anderson, California Institute of Technology; Prof. G. W. Stewart, professor of physics, University of Iowa; Prof. Theodor von Kármán, director of the Daniel Guggenheim Laboratory, California Institure of Technology; Prof. W. K. Lewis, professor of chemical engineering, Massachusetts Institute of Technology; Prof. C. S. Marvel, professor of organic chemistry, University of Illinois; Prof. W. H. Rodebush, professor of physical chemistry, University of Illinois; Prof. W. H. Bucher, professor of geology, University of Cincinnati; Prof. L. J. Stadler, professor of field crops, University of Missouri; Prof. T. S. Painter, professor of zoology, University of Texas; Prof. W. de Berniere MacNider, professor of pharmacology, University of North Carolina; Prof. E. Adelberg Doisy, professor of biochemistry, St. Louis University; Prof. S. B. Wolbach, professor of pathological anatomy, Harvard University; Prof. L. L. Thurstone, professor of psychology, University of Chicago.

Metal-Mining Enterprise

SIR WARINGTON SMYTH was the first professor of mining at the Royal School of Mines, and his forty years of service coincide with one of the most momentous changes in the history of the world, namely, the growth of industry on a metallic foundation. Prof. S. J. Truscott showed, in his Warington Smyth Memorial Lecture delivered on May 5 (Pp. 38 + 2 plates. London: Macmillan and Co., Ltd. 1*s*. net)how to-day everything civilized man enjoys depends on metals; without them rapid transport, modern housing, preservation of foodstuffs, etc., are impossible. Metals are durable as contrasted with vegetable and animal products, which are used once, whereas metals can be and are refabricated. The annual production of fresh supplies of metal merely augments the amount already in use, an amount greater in value than the total of all other commodities utilized by man. Metals, with the exception of gold, are not found to any extent as native metal and have to be extracted from highly complex ores. The enterprise of the miner has made many valuable discoveries such as the Bessemer process for ferrous metallurgy, the McArthur cyanide process for precious metallurgy and the flotation process for the base metals, and probably the same enterprise will find a cheap method of producing the light metals such as aluminium and magnesium. Further enterprise has rendered available vast sources of minerals which would otherwise have remained valueless, and in addition has shifted the centre of production of certain metals, for example, copper, from one continent to another. As the result of the exploitation of these processes combined with similar advances in engineering technique, one part of gold in 200,000 is being won at a profit, and one hundred million tons of base metal minerals are being treated by the flotation process per annum.

Mining Engineering as a Profession

IN his presidential address delivered on May 19 to the Institution of Mining and Metallurgy, Dr. C. B. Kingston discussed "Mining Engineering as a Profession". He said that mining is essentially a man's job and offers a splendid career to the keen ambitious man who is not seeking security first but likes a spice of adventure and finds satisfaction in a constructive occupation that makes some definite contribution to the world's welfare. The training of a modern mining engineer should be based on a sound general education, as not only must he be a technician but also in addition a man of affairs, a competent negotiator and preferably a linguist. The technique of mining is difficult to define, as it is all-embracing in its requirements, but briefly it can be described as the application of all the applied sciences to finding, winning and subsequent preparation for the market of a mineral deposit. The increasing importance of metal in the world's affairs is creating further demands on a mining engineer's accomplishments in an ever-widening field of activity and with larger-scale operations than ever before. A study of history, ancient and modern, in terms of minerals is fascinating because the growth of nations and the cause of many wars cannot be dissociated from the possession or a determination to secure control of high-grade deposits of essential minerals. The question has been asked, "Who owns the earth ?", and the answer given is "The nation which controls the greatest mineral resources."

Roman Wroxeter

RECENT excavations on the site of the Roman city of Uriconium, which lies beneath the modern Wroxeter, five miles from Shrewsbury, were described by Miss Kathleen Kenyon, the field director of the excavation, at a meeting of the Society of Antiquaries of London on May 12. Some years ago excavations were carried out with the object of determining the position and character of the defences of the legionaries' camp, but without success, nor has investigation been more successful on the present occasion. Much information, however, has been obtained about the history of the city. It would appear that Uriconium, which was the fourth largest Roman city in Britain, was founded about A.D. 48 as the headquarters of the Fourteenth and Twentieth Legions, of which it was the station while Wales was being subdued. When the legions were moved to Chester, Uriconium became the tribal capital of the Cornovii. Two successive defensive systems of the city have been found, of which the earlier, dating from about the end of the first century of our era, enclosed a much smaller area than the later. This latter dates from the middle of the second century, and encloses about 170 acres. It marks the largest expansion of the town. The structure known as the Baths Building, which was excavated in 1859, was re-examined. It was found that originally it had not been intended for use as baths, but had consisted of two ranges of large rooms on either side of an enclosed courtyard, with a long two-sided hall beside it. This was built about A.D. 140 and must have formed part of the public buildings, possibly the law courts, of the town. The Forum opposite was nearly contemporary. Not very much later the whole was transformed into an elaborate and complicated bath of the usual Roman type. An interesting discovery was the body of an infant which had been placed below the floor at the time of the alteration, possibly as a foundation burial. At the end of the third century the building was destroyed by fire, but was restored in a partial and slipshod manner. It remained in use for a further hundred years.

Archæological Exploration in the Panjab

ALTHOUGH a considerable period of time has elapsed since the Government of India, soon after the discovery of Mohenjodaro and Harappa, decided to allow duly accredited archæological expeditions from outside India to explore Indian archæological sites, little advantage, unfortunately, has been taken of the opportunity. Two American expeditions and one Belgian have visited India, of which the American expedition to the Salt Hills under Dr. H. de Terra, in a series of investigations extending over several years, has produced much valuable palæontological and archæological material. The excavations at Mohenjodaro for the Archæological Survey were conducted by Dr. E. Mackay, who has since been in charge of further investigations in the Indus valley; but although Dr. Mackay may be regarded as a British excavator, no British expedition has been sent out. This neglect of opportunity is the more to be deplored in view of the evident importance of India for understanding of early cultural development in the Near and Middle East. India itself is now to make an effort to repair this neglect by the inauguration of a "Panjab Exploration Fund", on behalf of which an appeal is issued by Diwan Chaman Lall, president; Prof. E. Dickinson, acting president; and Dr. C. L. Fabri, field director. Funds have been collected in India to begin excavation in the coming autumn on the ancient city site of Surkanwali Ali, near Bhera on the Jhelum, where trial excavations have been made recently by the field director of the Fund. These have revealed the existence of at least five superimposed cities, dating from the Moghul period to pre-Buddhist times. The Fund has the support of the principal scholars and notabilities of the Panjab. A considerable sum is required to place the Fund on a permanent basis; and if a sufficient amount can be raised, it is proposed also to found an ethnographical and archæological museum, for which nucleus collections are already in hand. Contributions should be addressed to the "Panjab Exploration Fund", Imperial Bank, Lahore, or to the London Branch of the Bank, 25 Old Broad Street, London, E.C.2.

Prehistoric Mines in East Africa

EXPLORATION of a cave in the Njoro Forest Reserve of Kenya by Dr. L. S. B. and Mrs. Leakey has brought to light cultural evidence, which they believe, it is stated by the Nairobi correspondent of *The Times* (May 23), points to a connexion with prehistoric opal mining on an extensive scale. The excavations have shown that this cave was used as a place for the disposal of the dead of stone age man. The bodies were brought to the cave, placed in a shallow excavation, and burnt to ashes by a fire lit over them. As time went on, the earlier ashes were disturbed by later incinerations, and the remains of at least sixty bodies have been discovered. The large number of cultural objects found include five hundred stone and one thousand bone beads. The stone beads are especially interesting, as among them are specimens of what appear to be jade and opal, as well as rock crystal and green quartz. Attractive jade pendants were also found. Many of the beads are said to show skilful workmanship, and it is therefore suggested that they may have been brought to East Africa by traders from Egypt and Mesopotamia. The beads are being submitted to experts in England for examination and report. It has been possible to reconstruct from charred fragments both basket work and rope work, and an exquisitely carved wooden vessel. Dr. Leakey, it is stated, attributes the large number of beads found here to trading activities attracted by the opal mines, and, tentatively, suggests 4000 B.C. as a possible date.

Plastics and the Glass Industry

IN his address to the Fifth Glass Convention held last week at Droitwich under the presidency of Mr. H. S. Williams-Thomas, Dr. V. E. Yarsley stressed the view that plastics are not to be regarded as substitutes for the older materials, glass, wood and metals. Much of the work done on the new transparent plastic materials such as the methacrylate and polystyrol products has been inspired by glass. In aircraft construction, where low weight must combine with security and good optical properties over a wide range of temperature conditions, 'organic glass' has no rival. The technique of the manipulation of these materials has progressed very considerably, but, as was brought out in discussion afterwards, not sufficiently to enable a bottle, for example, to be blown from a plastic mass in the manner in which molten glass is manipulated by fully automatic machinery. Much interest was aroused by the reference by Dr. A. Caress to the optical and other properties of materials of the 'Perspex' type, and Drs. W. M. Hampton and J. C. Peddle pointed out the tremendous range of optical properties furnished by the optical glass manufacturers to comply with the requirements of the instrument makers, and the need for both homogeneity and very precise annealing. It appears that as yet the only serious competition that might be feared in this field is in the manufacture of ophthalmic lenses, and mass-produced lenses of the type used in very cheap cameras.

"Frustration of Science" Exhibition

THE Scientists' Section of the Left Book Club held an exhibition on May 17–22 at the Unity Theatre, Goldington Street, N.W.1, illustrating "The Frustration of Science". Charts, pictures and select quotations illustrated the contrast between science as a constructive force in society and science as a weapon of destruction, science as a means towards arousing and satisfying communal needs and science merely as an instrument for profit. Side by side with evidence of the increasing concentration on productivity from the soil was shown the destruction of commodities and foodstuffs. Alongside the figures showing the multiplication of productivity was widespread evidence of malnutrition and scarcity. The meagre sum spent on health research was contrasted with that devoted to investigations in chemical warfare; and the repression of scientific work and the destruction of scientific opportunity in Fascist countries were pointedly illustrated. Comparative graphs showed the speed-up in production that follows from rationalization, and the lag that exists between this and the index of wage rates. In the advertising of fictitious remedies for all kinds of diseases, approximately £3,000,000 per annum is spent, as compared with £139,000 per annum expended from Government sources on medical research in Great Britain. A total retail turn-over of these remedies amounts to £20,000,000 per annum.

The exhibition was opened by Prof. P. M. S. Blackett, who dealt with the historical factors that called science into being, and underlined how these same forces were now frustrating it. In discussing the treatment of scientific men in Fascist countries, he stressed its blindly reactionary character, its penalization of scientific workers in the first instance and, in the drive towards war, how later it had become essential to reverse that policy, in order to regain military and aerial efficiency. It was not, he considered, the task of men of science to solve these problems by their action alone, any more than they had alone called this situation into being; but it was their duty to discard their scientific aloofness and to bring their special knowledge and understanding to bear on these social issues in order to show, in terms of social forces, how the present situation had arisen, and so to discover a way out.

Trans-Atlantic Steam Navigation

IN connexion with the recent commemoration of the centenary of the inauguration in 1838 of trans-Atlantic steam navigation, an article on which appeared in our issue of March 26, p. 540, Mr. J. W. Morgan, of Springfield, Ohio, has directed our attention to the voyage from Nova Scotia to England in 1833 by the Canadian-built steam vessel *Royal William*. The performance of this vessel led the Canadian Government in 1895 to place a commemorative tablet on the walls of the Parliament Buildings in Ottawa, on which she is referred to as "The First Vessel to Cross the Atlantic by Steam Power . . . The Pioneer of Those Mighty Fleets of Ocean Steamers by which Passengers and Merchandise of all Nations are now Conveyed on Every Sea throughout the World". The *Royal William*, of about 800 tons and 200 horse-power, left Pictou on August 17, 1833, and arrived off Cowes, Isle of Wight, nineteen days later. It has sometimes been stated that she crossed under steam power alone, but that statement cannot be substantiated. As Engr.-Capt. Smith was careful to point out in his lecture at the Science Museum on March 16, every steamship both before, and long after 1838, was fitted with sails and made the fullest possible use of the wind. Indeed it is quite impossible to say with certainty what vessel first crossed the Atlantic by steam power alone. The Atlantic had been crossed by the steamers *Rising Star*, *Curaçao* and *Savannah* before the *Royal William* made the passage, but their voyages, like hers, had nothing to do with a considered scheme for a regular service. The true significance of the events of 1838, the year which saw the Atlantic crossed and recrossed by the *Sirius*, *Great Western*, *Royal William II* and *Liverpool*, lies in the fact that they were the first vessels placed on the run with the idea of maintaining regular communication between Great Britain and the United States by steam in all weathers and at all times of the year. Of the four ships, it was the *Great Western* which unmistakably demonstrated the feasibility of the project. She was the true forerunner of our modern Atlantic liners.

Farming in the U.S.S.R.

FARMING in Soviet Russia is the title of a recent interesting article by Sir John Russell (*J. Min. Agric.*, 44, 1063). The natural conditions of this vast territory vary from arctic to sub-tropical, and the agricultural products are in consequence correspondingly wide, ranging from rye, flax and potatoes in the north, through wheat, sunflower and sugar beet in the temperate zones, to oranges and tea in the sub-tropical regions. The preponderance of grain cultivation and the small production of animal products is the chief general feature of Russian agriculture, a characteristic shared by other non-tropical continental regions such as Canada, but the distinguishing mark of the Russian system is that it is planned by a central authority, and the production of certain quantities of the various products are allocated in turn to the constituent republics, regions and collective farms by their appropriate managements. There are two types of farm, namely, the State and the collective farm. The former are managed by State officials, and the employees receive a definite wage in money. The collective farm, on the other hand, is a new departure in agricultural organization. The entire land, live stock and implements are pooled and the whole is worked as a single unit under a committee of management. Workers are allotted certain duties and their achievement is reckoned in terms of 'labour days', a standard day's labour of ploughing or milking, for example, being assessed by the committee. After the Government's claim on the produce has been fulfilled, the remainder is divided between the workers on a basis of their 'labour days', that is, their wages are in kind only. Some 98 per cent of the sown area is now in collective farms, and the peasants appear more contented than previously, so quite apart from political and social issues, the progress of this new system will be closely followed by all interested in agriculture.

Fuels for Heating and Hot-water Supply

MR. H. L. PIRIE, in a paper presented at a joint meeting of the Institute of Fuel and the Institute of Heating and Ventilating Engineers on December 1, discussed the suitability of British coal and its derivatives for heating and hot-water supply. Selection of fuel must be dependent entirely on the purpose in view, available supplies and apparatus. Gas and electricity may be regarded as coal derivatives and present certain advantages over both coal and coke for specific requirements. Nevertheless, fuel and appliances must be considered together if efficient performance is expected. Open fires, continuously burning stoves, hot-water boilers, central heating boilers and steam boilers all require special types of fuel. Mr. I. Lubbock, at the same meeting, assessed the advantages of fuel oil for heating and hot-water supply. Summarily these are: comparatively small space occupied by plant and fuel, rapid and easy filling of storage tanks, which, by suitable piping may serve two or more widely separated boiler houses, cleanliness, lack of smoke, flexibility of supply to meet the needs of varying atmospheric conditions, elimination of standby losses, automatic control, and thermal efficiency. Admittedly, gas and electricity may possess in many cases similar advantages, but they should all be taken into account in fuel selection. Fuel oil is moreover suitable for widely different types of installation. For example, it is now extensively used in office buildings, cinemas and theatres, churches, factories, hotels, trains, garages, flats, and houses, and the types of boiler which it is possible to install in these places are of necessity highly divergent. It is not claimed that fuel oil is better in every case than any other fuel, but it is claimed that oil as a fuel for central heating and hot water should be considered on its own merits in relation to other fuels.

Archæology in the University of London

CHANGES of no little importance for archæological studies are announced in the examination arrangements of the University of London. In and after 1939 no examination for the degree of B.A. in honours in archæology will be held; but archæological subjects will be added as optional or special subjects in the B.A. honours examination in classics, Greek, Latin, Arabic, Chinese, Hebrew, Indo-Aryan, Persian and history. Further, the subject of "Prehistory of Western Europe" is added to the list of subjects which may be taken at the B.A. (General) examination. In view of the very marked progress and development in method of prehistoric studies relating to western Europe in recent years the inclusion of this subject in the general arts curriculum is especially noteworthy, marking an advance in status among academic studies. Similarly at Oxford, by a decree of Congregation, geography and anthropology jointly have been elevated to the dignity of a 'faculty'.

University of London: Progress since 1900

IN his report on the work of the University during the year 1937–38, Dr. H. L. Eason, the recently appointed principal, briefly reviews the progress that it has made since it became a teaching university in 1900 (University of London. Report of the Principal on the Work of the University during the Year 1937–38. Pp. 13. London: University of London). The number of candidates for examination increased sevenfold to 46,000, their fees tenfold to £188,000, the expenditure of the University, exclusive of grants dispensed to schools, institutions and departmental institutes, tenfold to £247,000. There are now in the schools and institutions of the University 240 professors, 160 readers and 945 recognized teachers; the roll of internal students reading for degrees and diplomas comprises 13,730 names, whilst the registered external students number 10,771. Of the 4,863 candidates for degrees in 1937, 3,074 were internal and 1,789 external. The principal recalls words used by Lord Haldane in 1920: "It ought to be the chief centre of learning in the entire Empire, . . . Here ought to be concentrated the highest talent, the highest level in that passion for excellence of which I have spoken, the highest atmosphere, such as only can come in a great capital at the heart of a great country." More and more, says the Principal, does the University approach this ideal. Among the notable events of the past session was the inauguration of a Research Fund to which the University Court resolved to appropriate not more than £5,000 a year, from which grants are to be made for specific projects for research.

Research in Tropical Medicine

The Medical Research Council is offering up to three junior fellowships immediately, for award to qualified medical men wishing to receive training with a view to careers in research work in tropical medicine. The fellowships will be tenable for three years. The first year will be spent at a school of tropical medicine; the second in doing research in the same or some other institution at home; and the third largely in work under direction at some centre in the tropics. The stipend will be at the rates of £300, £400 and £500 per annum in the successive years, with an additional allowance during service abroad and necessary expenses. In three years' time, at least one senior fellowship will be available for candidates who have held the junior fellowships. This will be awarded for a further period of three years, carrying stipend at the rate of £600–£750 per annum, with an additional allowance during service abroad and expenses. The time will be spent mainly in research work in the tropics. The Council is also prepared to consider immediate applications for senior fellowships from candidates who have had adequate experience in research work, whether already specially trained in tropical medicine or not. The Council further intends to establish in due course, as suitable investigators become available as the result of the fellowship scheme, permanent and pensionable appointments for research work in tropical medicine, including senior posts. Further information can be obtained from the Secretary, Tropical Medical Research Committee, 38 Old Queen Street, London, S.W.1.

Rich Display of the Aquarids

Mohammed A. R. Khan, Begumpet, Deccan, carried out observations of the η Aquarids on May 1–5, the total time of observation being $3^h\,45^m$. During this period he saw 37 Aquarids and 32 sporadic meteors. The Aquarids are described as moving with long, white, evanescent trains, and the maximum display took place on May 2. In 1935 the maximum occurred on May 5 and was not so rich as this year. An interesting and important note is added by the observer. In some cases, not only with the Aquarids, but also with the sporadic meteors, the meteors grew considerably brighter towards the end of their course. One Aquarid, starting with a scarcely visible nucleus, developed a long voluminous train, glowing with a beautiful apple-green luminescence, towards the end of its flight. A sporadic meteor which was moving rather slowly developed a bright coma of reddish-green colour, attaining a magnitude 3 at maximum. These facts are important in connexion with a photograph of a meteor shown by Mr. E. H. Collinson at the meeting of the British Astronomical Association on March 30. It was suggested by some members that the bright portion of the photograph was the beginning of the path, but those who were experienced in meteor work did not corroborate this view. The observations from Begumpet confirm the usually accepted fact—that meteors generally brighten up towards the end of their flight.

The Night Sky in June

The summer solstice on June 22 brings the shortest night lasting, in the northern latitude of Greenwich, less than $7\frac{1}{2}$ hours, according to the sun's setting and rising, and a little more than 3 hours if twilight (nautical) be taken into account. The moon is full on June $12^d\,23{\cdot}8^h$ and new on June $27^d\,21{\cdot}2^h$ U.T. A lunar conjunction takes place with Jupiter on June $19^d\,3^h$: with Saturn on June $22^d\,15^h$ and with Venus on June $30^d\,14^h$. Venus, a bright star in the evening western sky, sets at about $22\frac{1}{2}^h$, preceded by Mars. Jupiter rises before 0^h after June 10; its present stellar magnitude is about $-2{\cdot}1$, as compared with $-3{\cdot}4$ for Venus. Saturn is reappearing in the skies as a morning star, and in the middle of the month rises after 1^h. About 21^h in mid-June, Arcturus stands out conspicuously on the southern meridian. Lower in the south at this time will be found Spica just west of the meridian and Antares on the east. Antares, with a radius 450 times that of the sun's, has an average mean density of only 1/3,000 that of air at N.T.P. From a radiant not far from Antares come the slow-moving fireballs known as Scorpiids. Two interesting double stars in Bootes may be noted—ϵ Bootis, having the euphonious name of *Pulcherrima*, is a beautiful double the components of which, separated by $2\frac{1}{2}''$, are a 3rd magnitude yellow star and a blue star of magnitude $6\frac{1}{2}$. ξ Bootis, with a period of about 160 years and an orbit of great eccentricity, comprises a yellow star (mag. 4·7) and a purple star (mag. 6·6) separated by about $4\frac{1}{2}''$. α Herculis provides another finely coloured pair—a mag. 3·0 orange star and a blue green mag. 6·1 also separated by $4\frac{1}{2}''$. Between η and ζ Herculis may be seen a nebulous spot of light which is the well-known globular cluster in Hercules. The stellar population of this spherical system is not less than 50,000 stars; these occupy a volume of space (500 light years across) which would be able to contain the greater number of our naked-eye stars.

Announcements

The degree of doctor *honoris causa* has been conferred by the University of Athens on Sir James Frazer in recognition of his distinguished contributions to Greek classical learning.

Sir Frederick Hobday, formerly principal and dean of the Royal Veterinary College, will give a course of six lectures entitled "A Comparison of Diseases in Animals and Men" at St. George's Hospital Medical School, London, at 5 p.m. on Mondays from May 30. They will be open to medical and veterinary practitioners and students without fee.

The following Royal Society lectures have recently been announced: June 16, Bakerian Lecture by Prof. C. K. Ingold, professor of chemistry in the University of London, on "The Structure of Benzene"; June 30, Croonian Lecture by Prof. A. N.

Richards, professor of pharmacology in the University of Pennsylvania, on "Processes of Urine Formation"; November 10, Ferrier Lecture by Prof. E. D. Adrian, Foulerton research professor, on "Some Problems of Localisation in the Central Nervous System"; December 8, Pilgrim Trust Lecture by Dr. I. Langmuir, associate director of the General Electric Co., New York, on "Molecular Films". All lectures will commence at 4.30 p.m.

AT the anniversary meeting of the Linnean Society held on May 24, the following officers were elected for the year 1938–39: *President*, Dr. J. Ramsbottom; *Treasurer*, Mr. Francis Druce; *Secretaries*, Mr. M. A. C. Hinton (zoology) and Mr. I. H. Burkill (botany); *New Members of Council*, Prof. W. A. F. Balfour-Browne, Mr. R. H. Burne, Dr. G. R. de Beer, Dr. E. Marion Delf, Dr. Anna B. Hastings.

THE following have been elected to fill the vacancies on the board of the Institute of Physics which will occur on September 30: *President*, Dr. C. C. Paterson; *vice-president*, T. Smith; *honorary treasurer*, Major C. E. S. Phillips; *honorary secretary*, Prof. J. A. Crowther; *ordinary members of the board*, Dr. J. D. Cockcroft and E. B. Wedmore.

THE National Fitness Council for England and Wales (1 Queen Anne's Gate Buildings, Dartmouth Street, S.W.1) has set up a Medical Committee with the following terms of reference: (1) To take such action as may be found desirable in order to enlist the co-operation of the medical profession in promoting the policy of the Council; and (ii) To consider and report on the medical aspect of the Council's work. The chairman of the Committee is Lord Dawson of Penn, and the vice-chairman Sir Kaye le Fleming.

THE Minister of Finance of Northern Ireland has announced that the Government proposes to increase the annual grant to Queen's University, Belfast, by £20,000. The University receives at present from this source £40,000 annually for general purposes, and £7,000 for the Faculty of Agriculture. The Government also proposes to make a grant of £2,500 a year to Magee University College, Londonderry, which is affiliated to the University of Dublin, and to increase the annual grant to Armagh Observatory from £100 to £300, and to make to the observatory a special grant of £150 this year.

A LARGE earthquake was recorded at Kew Observatory on May 23. The first movement arrived at Kew at 7h. 31m. 11s. G.M.T. and the record indicates that the shock originated 5,900 miles away in Japan at 4.19 p.m. local time. The largest movements of the ground at Kew were about 1/50 of an inch.

THE tenth International Congress for Psychiatry will be held in Oxford on July 29–August 2 under the presidency of Prof. C. G. Jung of Kussnacht. Further information can be obtained from the secretary, Mr. H. Gibbs-Smith, 106 Brompton Road, London, S.W.3.

THE forty-third Annual Congress of the South-Eastern Union of Scientific Societies will be held at Worthing on June 21–25, under the presidency of Dr. Julian Huxley. The subject of Dr. Huxley's presidential address will be "Natural History—Taxonomy and General Biology". Further information can be obtained from the honorary general secretary, Mr. A. Farquharson, Le Play House, 35 Gordon Square, London, W.C.1.

THE second Conference of the International Guild of Hospital Librarians will be held in Berne on June 7–10, when the speakers will include Mrs. M. E. Roberts, Mrs. Beddington, Mrs. Raymond, Dr. Georges Duhamel of Paris, Prof. Walter Gut and Dr. Wyrsch. Further information can be obtained from the Secretary of the Guild, 48 Queen's Gardens, London, W.2.

AN institute for the study and prevention of occupational diseases has recently been established in Paris by the French Minister of Health. The institute, which is the first of its kind in France, includes an examination room, a laboratory for extensive chemical and toxicological research, a special photographic laboratory and a library of international literature dealing with occupational diseases. The organ of the institute is the *Archives des maladies professionnelles, d'hygiène et de toxicologie industrielles*, which will appear every two months. Further information can be obtained from the Secretary, Institut d'étude et de prévention des maladies professionnelles, 6 rue de la Douane, Paris X^e.

Under the joint auspices of the Institution of Naval Architects and of the Institute of Marine Engineers an International Conference of Naval Architects and Marine Engineers will be held in London on June 16–18. It is anticipated that some three hundred, including ladies, will attend from many parts of the world in addition to the British participation. Important delegations are expected from Belgium, France, Germany, Holland, Italy and the United States of America. Further information and a programme of papers can be obtained from the Secretary, Mr. C. V. Boys, 3 Robert Street, Adelphi, London, W.C.2

A SIXTH spectroscopy conference will be held at the George Eastman Research Laboratories of the Massachusetts Institute of Technology on July 18–20, repeating the type of programme presented at the conferences held during the past five summers. Morning and afternoon meetings will be held on three days. Papers and discussions on analysis of materials by the emission spectrum, absorption spectrophotometry, photographic photometry, biological and chemical effects of spectral radiation, and industrial applications of spectroscopy, are being prepared. The usual summer courses on practical and applied spectroscopy will be offered at the Institute between June 13 and July 23. Further information can be obtained from Prof. George R. Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 978.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nitrogen and Argon in the Earth's Crust

IN a recent letter[1], it was stated that various specimens of granite contain per gram about 10^{-6} c.c. of neon and 4×10^{-5} c.c. of argon. This makes the ratio neon/argon some thirteen times as great as in the atmosphere.

The same rocks and a considerable number of others have now been examined for nitrogen. The quantity found is remarkably uniform, and amounts to about 3×10^{-2} c.c. per gram. Various evidence indicates that the nitrogen is not occluded like the argon and neon, but is for the most part held in chemical combination.

The ratio argon/nitrogen comes out about $1{\cdot}3 \times 10^{-3}$. The atmospheric ratio is about $1{\cdot}2 \times 10^{-2}$, some nine times greater.

It appears from these nitrogen determinations that, contrary to what has been supposed, the total nitrogen in the earth is many times more than in the atmosphere. It has been estimated[2] that 0·65 of the earth's mass consists of rock. On this basis, it may be calculated that the rocks contain thirty-seven times as much nitrogen as the atmosphere.

Discussion of the cosmological bearing of these results is deferred.

RAYLEIGH.

69 Cadogan Square,
London, S.W.1.
May 12.

[1] NATURE, 141, 410 (March 5, 1938).

[2] See, for example, Russell, H. N., "The Solar System and Its Origin" (New York: The Macmillan Co., 1935), p 56.

Absorption Bands and Electron Transitions in Coloured Fluorites

THE absorption spectra of fluorites coloured by natural or artificial irradiation show, in general, principally two regions of strong absorption[1]: from 350 to 470 mμ and from 530 to 650 mμ. The latter has already been attributed to reduced calcium, either as isolated atoms or as colloidal particles; the former can now be attributed to the bivalent ions of the rare earth elements, which, as has been shown before[2], are responsible for the diffuse fluorescence bands of fluorites. The blue Eu++-band has its maximum of excitation[3] in the region of 350–390 mμ, the red band of Sm++ in CaF_2 most likely towards 430 mμ. The red Sm++-fluorescence of some natural fluorites is connected with absorption maxima between 420 and 470 mμ. The different colours of fluorites can now be explained by the varying intensities of the different absorption maxima: Eu++ alone gives a light yellow colour (for example, Derbyshire), Sm++ a deeper yellow brown (Wölsendorf and others), the bivalent rare earths together with the Ca-maxima give the green colours (Weardale), predominance of the Ca-maxima the blue and violet colours, violet corresponding to a more disturbed lattice (larger colloidal particles ?).

Various colour changes through heat or light can be attributed to the transfer of electrons from the bivalent rare earth ions to the calcium ions and back, for example, the 'improving' of the colour of greenish fluorites by exposure to sunlight[4], which gives deeper purple colours: reduction of calcium by electrons given off photo-electrically by the bivalent rare earths. In some yellow and green fluorites, this transfer is reversible at low temperatures[5]: irradiation with ultraviolet light in the rare earth maximum diminishes this and builds up the calcium maximum (violet colour); irradiation in this maximum by yellow light reproduces the original colour. This return is accompanied by luminescence and one can, in this case, regard the 'excited' state of fluorite as due to the transfer of electrons from the bivalent rare earths to the calcium, that is, to a chemically different constituent.

Another example of this electron transfer is perhaps given by certain fluorites that fluoresce red (Sm++) in their natural state. This red fluorescence is sometimes increased by heating the sample[6], the electrons returning from the Ca-atoms to the Sm+++-ions and reducing them to Sm++, an effect that can also be obtained by artificial radium treatment.

If circumstances allow, a more detailed account will be given elsewhere.

K. PRZIBRAM.

Vienna.
April 5.

[1] Yoshimura, J., *Sci. Pap. Inst. Phys. Chem. Res.*, **20**, 170 (1933) Mollwo, E., *Götting. Nachr.*, N.F., 1, 79 (1934); Eysank, E., *Wien. Ber.*, IIa, **145**, 387 (1936); and unpublished results by M. Belar.

[2] Przibram, K., NATURE, **139**, 329 (1937); and the summary in *Z. Phys.*, **102**, 331 (1936); **107**, 709 (1937).

[3] de Groot, W., *Arch. Neerland.*, IIIa, **7**, 207 (1924); and unpublished results by Eckstein, H. Ph. For the colour and absorption of the pure salts and solutions of the bivalent rare earths, see McCoy, H. N., *J. Amer. Chem. Soc.*, **58**, 1577 (1936); Butement, F. D. S., and Terry, H., *J. Chem. Soc.*, 1112 (1937); Ephraim, F., Jantsch, G., and Zapata, Cl., *Helv. chim. Acta*, 16, 261 (1933).

[4] Sweet, J. M., *Mineralog. Mag.*, **22**, 257 (1930).

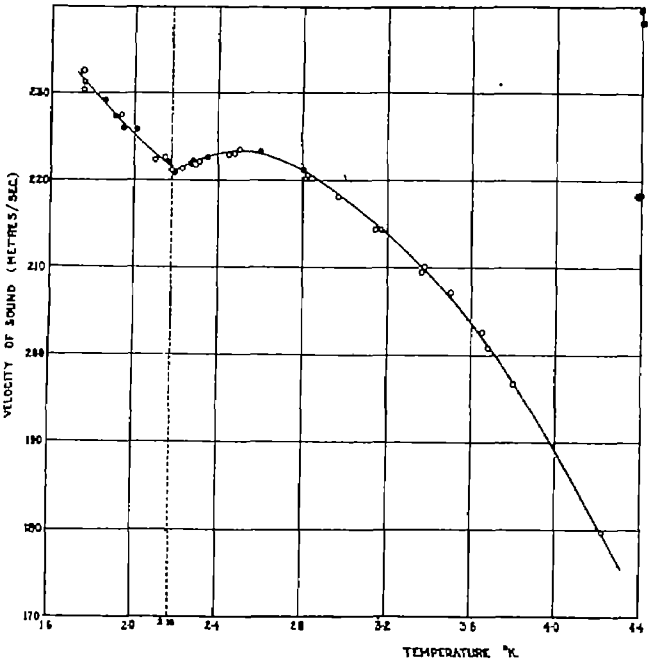
[5] Przibram, K., and Haberlandt, H., *Wien. Anz.*, (Dec. 6, 1934); Kellermann, E. W., *Wien. Ber.*, IIa, **146**, 115 (1937).

[6] Haberlandt, H., *Wien. Ber.*, IIa, **146**, 1 (1937).

Velocity of Sound in Liquid Helium

THE velocity of sound in helium I and helium II has been determined by a method similar to that used by Pitt and Jackson[1]. Standing waves were set up in the liquid between a vibrating quartz crystal and a brass reflecting plate. The crystal was driven near its natural resonance, at a frequency of 1,338 kilocycles per second, maintained constant by means of a quartz crystal master oscillator. The reflector was moved by means of a micrometer screw, and as it passed through the nodal positions, the existence of the standing waves was shown by the resonant reaction on the vibrating crystal. Sharp and easily measurable resonance peaks were obtained in both helium I and helium II, the wave-length being of the order of 0·16 mm. The temperature was controlled by means of the helium vapour pressure.

The accompanying graph shows the results, velocity in metres per second plotted against temperature in °K. The points marked by solid circles are considered less reliable than the open circles. For the remainder, the probable error is estimated to vary from about 0·1 per cent in helium I to about 0·25 per cent at the lower temperatures in helium II.



CURVE SHOWING RELATION BETWEEN TEMPERATURE OF LIQUID HELIUM AND THE VELOCITY OF SOUND IN IT.

The velocity at points not too close to the λ-point agrees approximately with the values calculated from the adiabatic elasticities estimated with the aid of the entropy relations[1]. It is doubtful whether the expected discontinuity in velocity at the λ-point occurs or not, and it is certainly less than 0·5 per cent. The change in elasticity calculated from Ehrenfest's relations for a phase change of the second order[3] would cause a decrease in the velocity from helium I to helium II of about 2·5 per cent. Other than this disagreement, there is no reason to suppose that the ordinary formula for the velocity of sound is not obeyed in both helium I and helium II, and it is hoped that the results may be used to adjust the entropy relations for liquid helium.

Profs. Grayson Smith, J. O. Wilhelm, A. Pitt and Mr. J. C. Findlay have co-operated in this work.

E. F. BURTON.
(Director).

McLennan Laboratory,
Department of Physics,
University of Toronto.
April 26.

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[1] Pitt, A., and Jackson, W. J., *Can. J. Research*, 12, 686 (1935).

[2] Keesom, W. H., and Keesom, Miss A. P., *Physica*, 1, 128 and 161 (1933). *Leiden Comm.*, Supp. No. 76 and earlier papers.

[3] Ehrenfest, P., *Kon. Akad. Wetenschappen*, 36, 153 (1933). *Leiden Comm.*, Supp. No. 75.

Absorption of Group *A* Neutrons in Silver

IN examining the details of the silver resonance level for Group *A* neutrons, it becomes important to know the self-absorption coefficient for very thin absorbers and detectors. This information is, for example, useful in the interpretation of experiments on the Doppler broadening of this level[1].

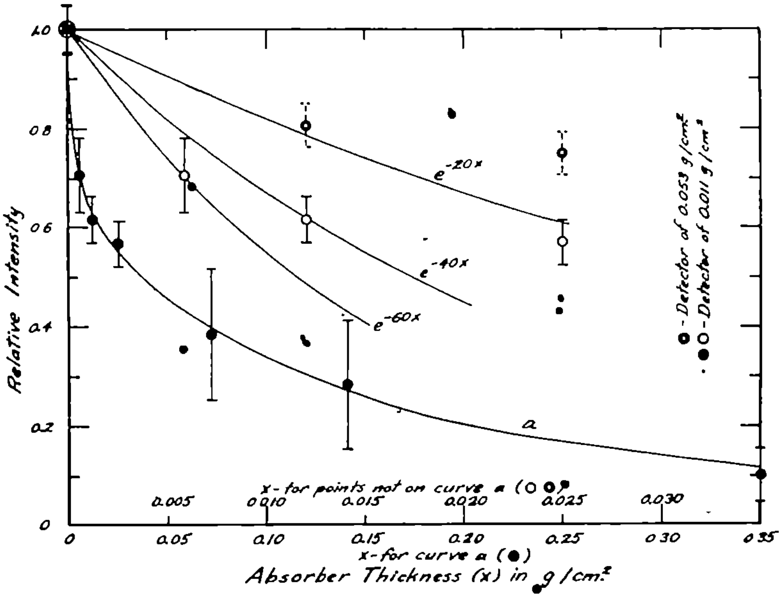
In their early survey of slow neutron effects, Amaldi and Fermi[2] found, with a detector of 0·057 gm./cm.^{2}, an average absorption coefficient of 20 cm.^{2}/gm. for group *A* neutrons in silver. Since the influence of self-reversal[3,4] should be important for a detector of this thickness, it was thought worth while to determine again the self-absorption curve for these neutrons with a thinner detector (0·011 gm./cm.^{2}), and with reasonably good geometry.

A hinged support allowed six silver foils (15 mm. diameter) to be activated simultaneously, and permitted their activities to be followed at one time with a single thin-walled Geiger-Muller counter. Collimating channels, in the equivalent of 0·7 gm./cm.^{2} of boron lined with 0·35 gm./cm.^{2} of silver, led to each detector, restricting the inclination of activating neutrons to 30° or less. Frisch[4] showed that in permitting such an angle of approach one would introduce an error independent of absorber thickness which would give activities corresponding to absorbers 7 per cent thicker than actually used.

The source of slow neutrons was 300–800 mc. of radon plus beryllium imbedded in paraffin. A cadmium filter of 0·83 gm./cm.^{2} was used to eliminate thermal neutrons. Scattering materials in the neighbourhood of the detectors were carefully avoided. The detectors were irradiated for 45 seconds, and measurements of one minute duration were begun 15 seconds later. All results were corrected for the presence of the 2·3 minute period and for the contribution of Group *B* neutrons.

The accompanying figure [see over] shows the final absorption curve for detectors of 0·0114 gm./cm.^{2} (Curve *a*), and, on a thickness scale ten times larger, the initial part of the same curve and corresponding points for detectors of 0·053 gm./cm.^{2}.

The absorption coefficient (20 cm.^{2}/gm.) for the thicker detectors agrees with the value of Amaldi and Fermi[2]. The points for zero and 0·0058 gm./cm.^{2} absorption, with thin detectors, give, however, an absorption coefficient of 59 ± 19 cm.^{2}/gm. This value represents a minimum, because even for the thin detector, self-reversal would be expected to make the absorption coefficient lower (possibly 25 per cent) than the true initial absorption coefficient. Also, the rather uncertain correction for the influence of Group *B* neutrons was made in such a way as to give the absorption coefficient too low a value. A minimum value for the contribution of this group was estimated by correcting to the amount of Group *A* to be expected with the thickest absorber used assuming resonance form for the line (Doppler broadening was neglected, making the value for the Group *A* component a maximum). As the self-absorption coefficient for Group *B* is unknown, the same correction was taken for all absorber thicknesses. The boron-silver shield for Group *A* was comparatively transparent for the less absorbable group; so the Group *B* correction was 50 per cent



as large as the initial intensity attributed to Group *A*. It is estimated that the error introduced by this correction would tend to make the apparent initial absorption coefficient 10–15 per cent too low.

Considering that only one of the two equally abundant silver isotopes should be effective in the resonance absorption of Group *A* neutrons, the absorption coefficient indicated above should be doubled, giving 120 cm.²/gm. This value, which represents by far the largest resonance cross-section measured to this time, cannot be used with activation values of Amaldi and Fermi[2,5,6] to determine the total width of the line because it leads to the following contradiction: the combined natural and Doppler width so determined is smaller than the Doppler width alone obtained directly from the energy of the line and the mass of the silver atom.

A discussion of this measurement as related to the Doppler effect[1] will appear in the *Journal de Physique*.

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April 9.

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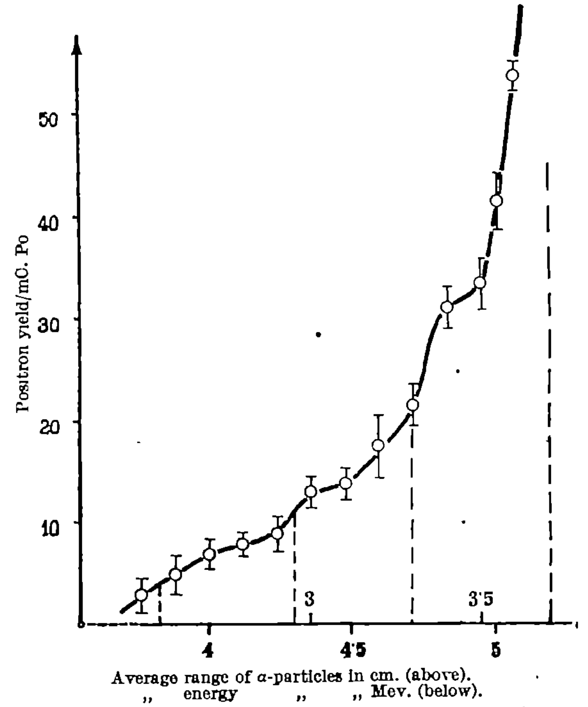
Fine Structure of the Yield-Curve of the Transmutation of Aluminium

THE yield-curve of the transmutation ^{27}Al (α ; ^{1}n)^{30}P is of theoretical importance in relation to that of the transmutation ^{27}Al(α ; ^{1}H)^{30}Si. Four very definite resonance levels have been observed for the proton emission[1,2] with α-particles of ranges 2·5–4·0 cm. In spite of this, one very broad, or some less definite levels have been observed for the neutron emission[3,4]; the yield-curves of the two transmutations seemed to be different.

Since the yield of the neutron emission is much smaller than the proton yield at these ranges, a larger solid angle of the α-particle beam was favoured by recent investigators on account of the uniformity of the ranges. It would be essential to bombard with α-particles of uniform range to resolve the levels.

In the present work, a target consisting of an aluminium hemisphere of 50 mm. diameter was bombarded from a polonium source of 3 mm. diameter at its centre[5] (strength about 10 mC.). This arrangement enabled us to obtain a solid angle of 2π, and the inhomogeneity due to different paths of the α-particles was not more than 1 mm., when retarded by a carbon dioxide atmosphere of 10 mm. air equivalent. An inhomogeneity of ± 1 mm. arose in a gold layer of 1 mm. air equivalent, covering the surface of the source. The large solid angle of the activation enabled us to obtain a reasonable yield although the source was weak. The target was activated to saturation of ^{30}P and was put over a counter which consisted of a hemisphere of aluminium (about 50 mgm./cm.²). The counter had a loop (platinum wire) of 3 mm. diameter in the centre and was filled with argon and alcohol vapour[4].

The graph below shows the integral yield (thick target) of positrons from ^{30}P per mC. polonium for infinite exposure as a function of the average ranges of the α-particles. At each α-range where levels have been observed for the proton emission



THE YIELD-CURVE OF THE TRANSFORMATION ^{27}AL (α; ^{1}n)^{30}P. NUMBER OF POSITRONS FROM ^{30}P PER MC. POLONIUM (THICK TARGET, INFINITE EXPOSURE) AS A FUNCTION OF THE ENERGY OF THE EXCITING α-PARTICLES. DOTTED VERTICAL LINES DENOTE RESONANCE LEVELS FOR THE PROTON EMISSION.

(dotted vertical lines at 2·55 cm., 2·95 cm., 3·3 cm. and 3·75 cm. average ranges), resonance levels exist for the neutron emission. The first process, the capture of the α-particle, is independent of the emitted particle (proton or neutron). There is a difference in the yield of the levels. All four levels give about the same yield for the proton emission ($3 \cdot 5 \times 10^{-7}$)[1]. A tentative determination of the yield of the neutron emission gives the following values, supposing that about 30 per cent of the positrons entered the counter :

Average range	^1n yield	$\frac{^1H \text{ yield}}{^1n \text{ yield}}$
2 55	$0\ 5 \times 10^{-8}$	70
2 95	$0\ 5 \times 10^{-8}$	70
3 3	$1\ 5 \times 10^{-8}$	23
3 75	$3\ 5 \times 10^{-8}$	10

It is interesting that the branching ratio, proton yield/neutron yield, decreases with increasing energy of the exciting α-particle. Differences in the change of energy at the two transformations give a very obvious explanation for this fact.

The apparatus has been built in the Institute of Physics, Debrecen, Hungary, by means of a financial grant from the Academy of Sciences, Budapest. I wish to thank Prof. Z. Gyulai for his kind interest, and also Prof. St. Meyer and Prof. G. Stetter for their valuable suggestions and for having allowed me to carry out the measurements in Vienna.

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Vienna. Feb. 16.

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Measurement of the Anærobic Glycolysis of the Regions of the Amphibian Gastrula by the Cartesian Diver Ultramicromanometer

THE use of the Cartesian diver as an extremely sensitive micromanometer was suggested in this journal last July by Linderstrøm-Lang[1], and the description of the technique was somewhat amplified in a subsequent note[2]. Since adequate micromethods are, for the embryologist, indispensable, we have employed ourselves since that time in the adaptation of the method for use with small pieces of tissue, and in particular with the regions of the amphibian gastrula dissected out by the Spemann glass needle technique.

The delicacy of the method in its present form may be gauged by the fact that whereas 1 cm. on the scale of the usual Warburg manometer corresponds to a gas change of about 20 c.mm., 1 cm. on the scale of the diver manometer corresponds to a gas change of 0·008 c.mm.

For our purpose, a number of special problems required solution. (1) Fragile embryonic tissue cannot be passed through an air-water interface, and the divers must therefore be submerged beside the tissue fragments in the medium to be used. In our experiments the medium used was Holtfreter solution containing an amount of bicarbonate sufficient to bring it into equilibrium with 5 per cent carbon dioxide in nitrogen. After the fragments have been pushed into the diver bulbs, a known amount of Holtfreter-bicarbonate solution is withdrawn from the divers. (2) Completely anærobic conditions within the divers are attained by handling them inside a special glass chamber with one or more pipettes mounted on glass universal joints. A stream of the nitrogen–carbon dioxide mixture passes through the chamber and the pipette. (3) As pieces of tissue of the order of 100 γ dry weight are used, a new Kjeldahl technique was devised for measuring the amount of total nitrogen present. The incineration vessels are so shaped that they may afterwards function as diffusion vessels analogous to those of the well-known Conway method. (4) Since total nitrogen was estimated, the ammonium sulphate proposed by Linderstrøm-Lang as the flotation fluid for the divers was replaced by lithium chloride at the same density, which has the further advantage of considerably lower gas solubility. (5) Since developing amphibian embryo tissue, unlike that of adult mammals, forms considerable quantities of ammonia, estimations of ammonia produced during the experimental period were necessary ; these were done following the method of Linderstrøm-Lang and Holter[3]. (6) The method of calibration of the divers was further investigated. A suitably modified Warburg equation was verified for divers of various volumes by direct comparison with Warburg manometers of the usual pattern, using reactions such as the decomposition of oxaloacetic acid and the autoxidation of cystein*. All these adaptations and special procedures will be fully described in forthcoming publications.

The importance of an understanding of the metabolism of the gastrula lies in the fact that the vertebrate axiation of normal development depends on the liberation of a chemical substance or substances at the dorsal lip of the blastopore and not elsewhere. It is known that glycogen disappears from the invaginating material[4], and there is evidence that glycogen may form part of the inactive organizer complex[5]. We now found, by an extensive set of measurements on the embryos of *Rana temporaria*, a substantial difference between the metabolism of the dorsal lip of the blastopore and that of the ventral ectoderm.

	$Q_L^{N_2}$	Ammonia (c.mm./γ dry weight/5 hr.)
Dorsal lip of blastopore	0·63	2·31
Ventral ectoderm	0·21	0·97

While noting the significance of these differences, we would prefer to postpone the discussion of them until data can be obtained for Q_{O_2}, $Q_L^{O_2}$ and *R.Q.*, in the investigation of which we are now engaged.

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* We find that although the oil seal greatly retards, it does not completely prevent, the escape of gas from the diver, but if the oil and the lithium chloride solution are previously saturated with the gas mixture, the error due to gas loss is reduced to negligible proportions.

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Ascorbigen in Plant and Animal Tissues

WE have previously given evidence[1,2] to show that cabbage contains ascorbic acid in a combined form from which ascorbic acid is released on heating. Chloroform extracts of dried cabbage, which were quite free from ascorbic acid as shown by the indophenol indicator, developed a marked dye-reducing value on heating. Treatment of cabbage with hydrogen sulphide in the hot and cold conditions also led to the same conclusion. Further, it was found by treatment with ascorbic acid oxidase, that 60–70 per cent of the indophenol reducing value of the chloroform extract of cabbage is to be attributed to combined ascorbic acid[3]. This work showed incidentally that, apart from combined ascorbic acid, which we called 'ascorbigen'[4], cabbage contains some non-specific reducing substance also in a combined form.

Biological experiments with guinea pigs confirmed the view that 60–70 per cent of the indophenol-reducing value of the dried chloroform extract of cabbage was due to ascorbigen. The guinea pigs were fed on a scorbutic diet and when they were falling in weight one group was given supplements of ascorbigen and the other group was fed with equivalent doses of ascorbic acid (varying from 2 mgm. to 4 mgm. in terms of ascorbic acid). The rates of growth in the two groups during the next ten days were comparable. Similar results have just been reported by Reedman and McHenry[5], who have given biological evidence for the presence of ascorbigen in potato. They have, however, fed the experimental guinea pigs with ascorbigen and ascorbic acid from the start of the experiment; but their results and ours are substantially in agreement. It has been possible to purify the ascorbigen of cabbage very considerably by extracting dried cabbage with chloroform, treating the dried chloroform extract with water, re-extracting with chloroform, again extracting with water and precipitating with alcohol. The substance is under further investigation.

We have observed the presence of ascorbigen and of some non-specific reducing substance in a combined form in the brain and liver tissues of the normally fed guinea pig. Similar results have also been obtained with urine by Mr. S. Bannerjee in this laboratory, which are confirmatory of the findings of Scarborough and Stewart[6]. It thus appears that the distribution of ascorbigen and some non-specific reducing substance in a combined form in plant and animal tissues is fairly general, though perhaps not universal.

In any estimation of ascorbic acid from the nutritional point of view, the foodstuff should be evaluated with reference to (1) free ascorbic acid, (2) dehydroascorbic acid, and (3) ascorbigen, as we pointed out elsewhere[7]. For this, a method has been developed involving treatment of the material with hydrogen sulphide in the hot condition, removing hydrogen sulphide in a current of carbon dioxide and treatment of an aliquot with ascorbic acid oxidase. This method appears to give the 'total' ascorbic acid of foodstuffs.

Details are being published in the *Journal of the Indian Chemical Society*.

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Action of Anol and its Derivatives on the Nipple of the Guinea Pig

Dodds and Lawson[1] have stated that anol will induce œstrus in rats. W. Jadassohn, Uehlinger and Margot[2] have investigated whether anol will cause enlargement of the nipples of guinea pigs by simple external application of the solution of this substance (nipple test with anol). The result was positive although not so strong as with œstrone. Later, Dodds and Lawson[3] found that pure anol in not very large doses failed to induce œstrus. We reinvestigated the action of pure anol in the nipple test and found it to be completely negative. (A solution of the same anol prepared a few months later showed a positive nipple test.)

We have examined by means of the nipple test substances which may have been responsible for the activity of the 'active anol solutions', that is, derivatives of them.

The demethylation of anethol, by means of a Grignard reaction (Serini and Steinruck[4]) gave rise to an anol that contained polymerization products; this polymerized material after acetylation boiled at 180–210° under 0·5 mm. pressure. Similar experiments were also made with isoanol[5] and its acetyl derivatives prepared by heating isoanethol with potassium hydroxide in a sealed tube under pressure (N. R. Campbell, E. C. Dodds and W. Lawson[5]).

All these preparations were active in the nipple test. However, the application of œstrone solution in a concentration of 0·003 γ per c.c. gives a definite effect, whereas these preparations in a concentration of 1 γ per c.c. were quite inactive; 10 γ per c.c. was weakly active and 60 γ per c.c. showed a strong effect.

So far as the nipple test is concerned, we must refer to our previous publications[2,6,7,8]. For the present, however, we shall briefly recall its principle. We have developed a simple method of measuring the enlargement of the nipple (male guinea pig). We have found that external application of very small doses of female sex hormones produces such an enlargement. This method has proved to be specific and quantitative.

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[2] *J. Invest. Derm.*, 1, 32 (1938).
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'Climbing Organs' in Insects

MANY insects possess adhesive organs (pulvilli, tarsal or tibial pads, etc.) which enable them to climb on perfectly clean glass. Presumably these organs function whenever the foot comes in contact with any surface, such as leaves or polished stones or the bodies of other insects, too smooth for the claws to grip. Miller has suggested[1] that the 'fossula spongiosa' of adult Reduviids may have been developed for the purpose of holding the bodies of their prey; Gillett and I[2] suggested that it might be of use in holding the other sex during copulation.

In unpublished observations on the bed-bug *Cimex*, we could obtain no evidence that the similarly placed organ will assist this insect in walking on glass; the 'fossula' appeared equally unsuited to this purpose in dried specimens of various Reduviids. It is only moderately efficient for this purpose in *Triatoma*[1]; but as anyone can satisfy himself in a few minutes, the adult *Rhodnius* is able to hold and climb on clean glass, even when nearly vertical, by means of this tibial organ. For that reason, it was described as a 'climbing organ'[2]. But since this type of 'climbing' is only a special case of adhesion, and since the natural purpose of such organs is not always clear, it might be preferable to refer to them simply as 'adhesive organs' without prejudice to the question of their normal function. Though very different in appearance from the homologous 'fossula spongiosa' of some other Reduviids, this highly efficient adhesive organ of *Rhodnius* is certainly not a vestigial structure.

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Viscosity of Monomolecular Films

Two letters by Harkins and Myers, and by Harkins and Kirkwood respectively, concerning a surface viscosimeter have recently appeared in NATURE[1]. We wish to direct attention to the previous results that we have obtained with a viscosimeter of the same type[2].

We have shown experimentally that the surface flow per second, Q, is in fact proportional to the difference of pressure and inversely proportional to the length of the channel, but we think it necessary to insist that there is no law analogous to Poiseuille's law concerning the width of the slit. The corresponding Poiseuille equation for a two-dimensional fluid should contain a factor d^3 (d = width of slit). The results of our systematic study with channels of different widths show clearly that the problem is much more complicated. There is no doubt that we have simultaneous entrainment of the water and that the viscosity of the substrate becomes the preponderant factor as soon as channel widths of the order of 1 cm. are reached, that is, the flows per unit time become independent of the nature of the fluid film as the diameter increases, finally reaching the same value. The relation with d^3 would be valid only as a limiting law for very narrow channels, since, as the diameter decreases, we find *linear* variation up to 5 mm., this variation gradually changing to d^3 at 0·5 mm.

We think that, even with corrective terms, one can hope to attain only the order of magnitude of the two-dimensional viscosity of the film. The calculation made by Kirkwood is valid only for a deep channel, which is not the case for the viscosimeters used by us and by Harkins. The theory introduced by Bresler and Talmud[3] would give results in better qualitative accord even for large channels, although it introduces arbitrarily a frictional term proportional to the speed in the differential equation. Unfortunately, an error in the integration prevented these authors from observing the accordance cited above.

The correct integrated form should be:

$$Q = \frac{2\varphi}{SA\varkappa}\left[R - \sqrt{\frac{\eta}{A\varkappa}}\tanh\sqrt{\frac{A\varkappa}{\eta}}\,R\right],$$

where φ is pressure gradient; S is surface per gram; A is a constant; $\varkappa$ is the viscosity of water; $R = d/2$; η is viscosity of the film. This gives for large channels the approximate expression:

$$Q = \frac{2\varphi R}{SA\varkappa},$$

and for infinitely small channels

$$Q = \frac{2\varphi R^3}{3S\eta}.$$

Nevertheless, in spite of this theoretical difficulty, one can, by using the experimental values of the flow for a given channel, detect very accurately changes of state in monolayers. We have shown[4], for example, that a liquid film of triolein exhibits at about 115 A.[2] a sharp change in the variation of the viscosity. In the same manner, a fluid film of stearic acid on 0·001 N hydrochloric acid gives changes at about 20·5 and 22 A.[2]. Thus, from this point of view alone, the measurements of surface viscosity constitute already a very promising new method of investigation.

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[2] Dervichian and Joly, *C.R.*, 204, 1318 (1937). See also Joly, M., *J Phys.*, vii, 8, 471 (1937).

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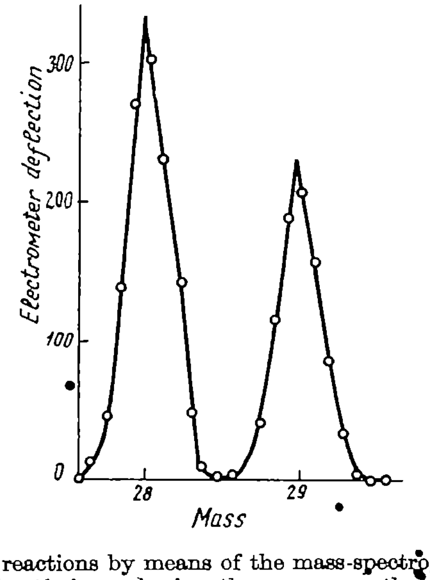
Direct Evidence for the N_2H^+ Ion in the Discharge Reaction between N_2 and H_2

So far as I am aware, no attempt has been made to study chemical reactions and in particular discharge reactions by means of the mass-spectrograph. Thus Lunt[1], in reviewing the numerous theories of discharge reactions including ion clusters, excited or



metastable molecules, kinetic ions, etc., considers that there are no direct grounds for assuming the existence of compound ion formation except in the case of H_3+.

Using a mass-spectrograph of the Dempster type. it has been found that N_2H+ is produced abundantly when a mixture of N_2 and H_2 is bombarded with electrons. The accompanying graph shows the type of curve obtained in $N_2 + 5H_2$ at a total pressure of about 8×10^{-3} mm. From the intensity-pressure curve it appears that N_2H+ owes its origin to N_2+ and not to H_2+, and from the ionization function curve, that the reaction starts at the ionization potential of N_2.

Since compound ions of higher and lower mass were found in only very small quantities, it may be concluded that the formation of N_2H+ is only the first stage in the production of NH_3. The second stage presumably takes place at the walls in the presence of atomic hydrogen, in agreement with the results of Mochan and Gelbert[2].

The probability of the formation of N_2H+ is even higher than that of H_3+. Thus the ratio N_2H+/N_2+ is 4·3 times the ratio H_3+/H_2+ in that part of the pressure range which is free from selective absorption effects.

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[2] Mochan and Gelbert, *Acta Phys. chim*, 7, 767 (1937).

Connexion between Electromagnetic and Neutrino Fields

As previously stated, one arrives at the formulation of specific 'coherence' (parallel motion) of two neutrino particles forming a photon, if both neutrino mass μ and neutrino 'charge' ε (non-electromagnetic) are put equal to zero but their relation to one another is kept constant[1], $\left(\frac{\varepsilon}{\mu} = \pi\sqrt{\frac{2c^3}{h}}\right)$.

Developing the consequent neutrino theory of light, one must now establish the expressions connecting all components of the electro-magnetic field $\Phi_{\mu\mu'}$ with neutrino wave functions ψ.

All requirements (that is, Maxwell's equations and the commutation rules) are fulfilled if one defines the antisymmetric field tensor by the following equation :

$$\Phi_{\mu\mu'} = i\varepsilon\left(S_v \frac{\partial}{\partial x_v}\right)^2 \Box^{-1}\varphi + \alpha_\mu \varsigma_2 \alpha_{\mu'}\varphi,$$

where $S_v \frac{\partial\varphi}{\partial x_v} = \psi$; α_μ, ς_2 are Dirac matrices and (S_μ) is an auxiliary constant vector, the direction of which corresponds to the definite choice of gauge for electromagnetic potentials[2].

From the neutrino wave function we can further construct two scalars defined by the formula :

$$\Phi = \varepsilon\, S_v \frac{\partial}{\partial x_v}\, \Box^{-1}\varphi + S_\mu \beta_\mu \varphi,$$

where (1) $\beta_\mu = \alpha_\mu$ and (2) $\beta_\mu = \varsigma_1 \alpha_\mu$.

These latter quantities are connected with the longitudinal component of the electromagnetic field.

The above relations yield Coulomb's law for the static case, if the distance between interacting electrons is less than $h/\mu c$, so that Maxwell's electrodynamics is limited from this point of view on the side of very great wave-lengths, which magnitudes depend from the mass of neutrino.

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March 26.

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IN Jordan's form of the neutrino theory of light[1], the emission of a photon appears as the absorption and re-emission of a neutrino, or the simultaneous emission of a neutrino and an antineutrino, with identical directions. If the energy E and the momentum $\mathbf{p}$ transferred in the process are related by the equation

$$E = c|\mathbf{p}|,$$

as required by the usual theory, the mass of the neutrino must be assumed zero.

The angular momentum of a photon, in the direction of propagation, is either $\hbar$ or $-\hbar$. Assuming the neutrino to have spin $\frac{1}{2}\hbar$, this implies that the neutrino reverses its spin in the first kind of process, and that in the second kind the two particles have parallel spins.

From the mathematical point of view, the aim of the theory is to express the photon amplitudes, satisfying the commutation relations of the Bose-Einstein statistics, in terms of the neutrino amplitudes, satisfying the commutation relations of the Fermi-Dirac statistics, in a manner consistent with these physical assumptions. This can be shown to be impossible. The impossibility arises from the contradictory requirements of the conservation of angular momentum and the commutation relations. Certain pairs of two-rowed matrices occur, which by the first condition are required to be of the form

$$\begin{pmatrix} 0 & a \\ b & 0 \end{pmatrix}, \begin{pmatrix} 0 & -ia \\ ib & 0 \end{pmatrix};$$

the second condition requires that a and b should be different from zero and that the matrices should commute with one another, and this is easily seen to be impossible. No special form for the Hamiltonian function of the neutrinos need be assumed. A more detailed account has just appeared in the *Proceedings of the Royal Society of London*[2].

The three-dimensional neutrino theory proposed by Kronig[3], which at first seemed to offer a complete solution of the problem, is seen, on closer inspection, not to be invariant against changes of co-ordinates. It also violates the conservation law for angular momentum.

This result does not apply to the theory of Sokolow (cf. previous letter). The main difference between the theories of Sokolow and Jordan is in the mass of the neutrino. In the former it is essential that the rest-mass, however small, should be finite, whereas in the latter it is zero. It seems, if the neutrino theory is to be retained, that some deviation from Jordan's hypothesis, such as Sokolow's, must be tried.

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[1] Jordan, P., *Z. Phys.*, **93**, 464 (1935).

[2] Pryce, M. H. L., *Proc. Roy. Soc. A*, **165**, 247 (1938).

[3] Kronig, R. de L., *Physica*, **3**, 1120 (1936).

Science, Logic and Philosophy

My attention has been directed by Mr. John Bradley of Christ's Hospital, Horsham, to a passage by Prof. J. H. Muirhead[1], containing the words: "The truth is that what is called a natural law is itself not so much a statement of fact as of a standard or type to which facts have been found more or less to approximate. This is true even in inorganic nature." My statement[2] that the variation of observations from a mathematical formula is quite unknown to philosophical critics has therefore at least one exception, which I am glad to acknowledge. But much in philosophical works would receive additional force from its recognition; for example, in the later parts of Prof. L. S. Stebbing's "Philosophy and the Physicists". Mr. Bradley directs attention also to a passage in Plato: "I have never been able to find out anything for certain and have had to be content with the probable." Locke said the same thing at greater length, and W. E. Johnson made important constructive contributions to the quantitative theory; so I did not intend to disparage the contributions of philosophers to this side of the question.

My opening passage should have been expressed somewhat differently, and should be read in conjunction with the closing one. Two correspondents have referred to it as a refutation of idealism, but it is only a refutation of a particular form of it. I show in the course of the article that the scientific use of generalization can permit even an idealist to escape from solipsism, and my final conclusion is that there are forms of realism and idealism that are scientifically equally valid. My own preference is for the realist one, but I admit that that is pure prejudice. On the other hand, I am not sufficiently familiar with idealist literature to say whether any actual idealist would accept the form of idealism that I consider tenable.

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[1] "The Elements of Ethics" (1910), pp. 37–38

[2] Nature, 141, 672–676, 716–719 (1938)

A Binocular Illusion

The interesting binocular illusion described by Prof. Dixon[1] is usually called the wall-paper experiment in England and *Tapetenbilder* in Germany. It has frequently been rediscovered—often by children—and I know of a number of people who have found it out for themselves.

Exactly two hundred years ago Robert Smith[2], afterwards Master of Trinity College, Cambridge, described the illusion of binocularly fusing two candle flames by converging the visual axes on a nearer point. The effect was that of a smaller candle closer to the observer. H. Meyer[3] in 1842 published a detailed account of the phenomenon as seen in patterned wall-papers. Two years later it was seen by D. Brewster[4] in wall-papers, carpets, and other patterned objects. He described the curious unreality of the appearance—a semi-transparent object suspended in the air and moving with every movement of the observer. He always claimed to be the original discoverer, and made no reference to Smith or Meyer.

The chief physiological interest of the illusion is that it has seemed to several writers to indicate that the amount of convergence of the eyes necessary to avoid diplopia is an important datum in the visual judgment of distance. It is possible, however, that the illusory closeness of the percept is mainly due to the fused pattern being judged to be at about the known distance from the observer of the fixation point, or of other objects the images of which fall on corresponding points of the two retinas.

R. S. Creed.

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Oxford.
May 4.

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[1] Dixon, H. H., Nature, 141, 792 (1938)

[2] Smith, R., "A Compleat System of Opticks" (Cambridge, 1738), vol 2, Remarks, p. 86 and Fig. 161.

[3] *Arch. physiol Heilk.*, 1, 316–326 (1842).

[4] *Trans. Roy. Soc. Edin*, 15, 663–675 (1844); *Phil. Mag.*, 30, 305–308 (1847); "The Stereoscope" (London, 1856), Chap. vi.

Ounce Molecular Weight of a Gas

The useful equivalence, gm. per litre = oz. per cub. ft. (approx.), as a practical connecting link between metric and British weight-volume relationships, referred to by Dr. H. D. H. Drane in Nature of April 30 (p. 791) is well known to industrial chemists and engineers, and appears in Woodward's "Logs and Tables for Chemists" (1917), p. 62.

The much older expression of the same equivalence, pounds per cub. ft. × 16 = kgm. per cub. metre has appeared in various engineers' handbooks for more than twenty-five years (for example, Frye's "Civil Engineers' Pocket-Book" (1912), p. 89). Easily remembered equivalents of this kind constitute one of the first lessons learned by a laboratory worker when he goes into industry.

In the case of gases, where we generally deal with large volumes, Lunge's simple calculation ("Alkali Maker's Handbook" (1891) p. 26) based on the same equivalence of gram and ounce molecular weights, is most useful. The molecular weight of a gas divided by 4 gives the approximate weight in cwt. of 10,000 cubic feet. This may also be applied to mixtures of gases. For example, the average molecular weight of dry air, calculated as one fifth oxygen and four fifths nitrogen, is 28·8, and $\frac{28\cdot 8}{4} = 7\cdot 2$ cwt. per 10,000 cub. ft. The precise figure at N.T.P. is 7·206 cwt.

The volume of an ounce molecular weight of oxygen as visualized approximately by Dr. Drane is 22·5 cub. ft. weighing approximately 2 lb. The actual weight at N.T.P. is 2·008 lb. and calculated by Lunge's method is 2·016 lb.

I entirely agree with Dr. Drane that notes of such relationships between metric and British units might well appear in the text-books.

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April 30.

* * *

The fact that the molecular weight of a gas or vapour in ounces occupies 22·4 cub. ft. at S.T.P. seems to have been pointed out first by Prof. J. W. Richards in an article on "Some Abridgments in Chemical Calculations", published in the *Journal of the Franklin Institute*, 152, 109 (1901). It is quoted as far back as the 1912 edition of Dr. J. W. Mellor's "Modern Inorganic Chemistry".

Apropos of abridgments, it does not appear to be generally known that the conversion factor from Calories per cub. m. to B.Th.U. per cub. ft., namely, 0·11236, can be represented by 1/9 + 1/800 to an accuracy of better than one part in 100 thousand.

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Science Subjects at External Arts Examinations

IT will be generally agreed that workers in the field of pure science should be recruited so far as possible from the educated population as a whole and not from particular social or economic classes within this whole: where the range of intellects is wider, the resultant products are likely to be more varied and richer. Equally it is agreed that the primary aim of science is the advancement of pure knowledge as a whole, not merely of highly developed branches demanding equipment, the expense of which will tend increasingly to place originally disinterested workers in the power of less disinterested 'patrons'.

If we admit this, shall we not be the more insistent in requiring that regulations for examinations be drawn up so far as possible upon lines tending to offer wide scope to individual talent, and not upon lines which only too often seem to have *elimination*—stressing the negative sense of the word—as their principle? Referring specifically to conditions in the University of London, the arbitrary and highly undesirable selection of workers which the expense of a science degree at present often renders unavoidable might be compensated for in some measure by a far-reaching extension and broadening of the regulations for external degrees *in Arts*, and should include a relaxing of certain present restrictions as regards special fees or a transferring of these to other subjects, a knowledge of which is not so much sought after or so socially urgent.

I make the following preliminary suggestions:

(1) Sociology should be included as a subject for the B.A. General Examination. (2) Anthropology should be forthwith freed from its special fee of an *additional* five guineas. (3) Honours candidates who are prohibited by expense from taking subjects where a practical examination is necessary, should be allowed to take sociology without having to show a knowledge of Kant's "Critics". (4) Students of languages (who often show as marked an aptitude for science as they do little capacity for literary appreciation) should be offered more attractive and varied syllabuses: optional papers on the geography, history, ethnology, sociology of the country, etc.; on the lines of the present Slavonic syllabuses. (5) Some attempt should be made to separate such parts of a science as are capable of purely theoretical and critical treatment and to form these into material for the creation of additional science subjects, which may be taken by those unable to take the practical work at ordinary science examinations. It seems, in this latter case at any rate, time that such a promising division of labour were given further consideration.

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Points from Foregoing Letters

LORD RAYLEIGH finds that igneous rocks in general contain about 3×10^{-2} c.c. of nitrogen per gram, mostly held in chemical combination. The ratio argon/nitrogen is much less in the earth's crust than in the atmosphere. The total nitrogen content of the rocks is many times greater than that of the atmosphere.

Prof. K. Przibram states that the different colorations of fluorites are due to the varying intensities of the absorption maxima of the bivalent rare earth ions and of the reduced calcium, and explains various colour and luminescence effects by electron transfer from the bivalent rare earth ions to the calcium and back.

Prof. E. F. Burton reports the results of experiments on the velocity of sound in the two forms of liquid helium, helium I and helium II. A graph is submitted giving the variation of this velocity with temperature; the slopes of the curves are different in the two liquids and there is an indication of a slight discontinuity at the λ-point. The value at the λ-point is 221 metres per second.

An absorption curve for Group *A* neutrons in silver with thin detectors (0·01 gm./cm.^{2}) and with thin absorbing foils (down to 0·006 gm./cm.^{2} has been obtained by Dr. H. Paxton. The absorption coefficient of 60 cm.^{2}/gm. determined from the beginning of this curve is supposed to set a lower limit for the value which would be measured with negligibly thin absorbers and detectors.

A graph showing the yield of positrons from radio-phosphorus of mass 30 (obtained by the action of polonium α-rays upon aluminium), as a function of the average range of the exciting α-particles, is given by A. Szalay.

By using a Cartesian diver method for detecting minute pressure variations, so that a change of one millionth of a c.c. of gas can be observed, Dr. J. Needham, E. J. Boell and Veronica Rogers are investigating the chemical changes in different parts of the developing amphibian embryo (gastrula).

Prof. B. C. Guha and P. N. Sen-Gupta bring further evidence in support of the view that cabbage, and also certain animal tissues, contain ascorbic acid in combined form (ascorbigen) and in addition a non-specific reducing substance in combined form. The authors outline a method for the estimation of the 'total' ascorbic acid.

D. G. Dervichian and M. Joly point out that while the flow of surface monolayers is proportional directly to the difference in pressure and inversely to the length of the channel, the dependence of the flow upon the width of the slit is complicated owing to the entrainment of water. The rate of flow gives useful information concerning change of state in monolayers.

A. Sokolow derives a connexion between electromagnetic and neutrino fields for the three-dimensional case in relativistically invariant form by assuming that the rest-mass of the neutrino is zero.

Research Items

Albanian Gypsies

Mrs. Margaret Hasluck has prepared an account of the gypsies of Albania, based partly on literary sources, and partly on her observations, of which the first instalment has appeared (*J. Gypsy Lore Soc.*, Ser. 3, **17**, 2; 1938). In Albania there are, broadly speaking, two classes of gypsies, readily distinguishable as nomads living in tents and speaking Romani as their mother tongue, and the sedentaries who live in houses and huts, and have forgotten Romani. The gypsies form a relatively large proportion of the Albanian population, as they number some 20,000 out of a total of one million. The two classes of gypsies are given different names by the Albanians, and these also vary in form and meaning according to locality. Several of these names are to be traced to the root seen in the English word "Egyptian". The houses of the sedentaries, like those of the poor Albanians, are one-storied cottages, with living-room and kitchen. They contain little furniture. In the towns the gypsies form a separate quarter. Sometimes nomads may live in a house for a period, possibly some months, and then revert to tent life. The huts are of wattle and daub, about seven feet high, and, unlike the houses, have no furniture. The tents are usually of the simplest type, the tent being thrown around the pole like a cloak, with an ever-open door. Occasionally a tent with a ridge-pole on two forked uprights is used. Quilts and straw-mats are the only bedding carried, leaves and branches serving for mattresses. The chief utensils are a pot and frying-pan. Thus at need a donkey can transport all the goods of a family. No cradles are used, and small children are carried in a sling thrown over one shoulder, which allows the child's feet to rest on the mother's hip. As linguists, the nomads surpass the sedentaries. The average nomad is taller than his sedentary counterpart, and has a lither body and darker complexion. So dark are they that a nomad woman is sometimes styled "as black as the kitchen crook". Owing to this their tongue appears unusually red and their teeth very white. Hence the Albanian belief that the gypsies have a redder tongue and better teeth than themselves. Some of the sedentary gypsies have fair hair and skin and blue eyes. This colouring others endeavour to obtain by sympathetic magic, putting a silver coin in the milk on St. George's Day and then hanging it round their necks to prevent sunburn.

Emotion and the Secretion of Urine

The fact that emotional stress and muscular exercise can inhibit the secretion of urine has been known for many years, but its cause has remained obscure. Rydin and Verney (*Quart. J. Exp. Physiol.*, 27, 343; 1938) have now carefully analysed this phenomenon. They find that the nerve supply of the kidney is not concerned in the effect, but that it is due to some circulating substance, other than adrenaline, reaching the kidney through its blood vessels. The inhibition produced by emotion can be imitated with considerable exactness by the intravenous injection of minute quantities of the active principle of the posterior lobe of the pituitary gland, and this has led the authors to suggest that a discharge into the blood stream of the anti-diuretic principle of the pituitary is the normal accompaniment of such emotional stress. The existence of nervous connexions between the hypothalamic nuclei and the pituitary body adds cogency to this suggestion, and the probability that it is a normal physiological event is supported by the extraordinary potency of very minute amounts of posterior pituitary extract. The authors calculate that an effective dose would mean the exposure of the cells of the kidney to only 30 molecules each of the anti-diuretic principle.

Density of Small Living Organisms

The *Proceedings of the Linnean Society*, 1937–38, Part 2, contains a very clear description, by Mr. A. G. Lowndes, of an experimental method by which the density of small living organisms may be determined, using the normal specific gravity bottles, in which the organisms are weighed in their natural fluid. The volume of the organism is determined by immersing it either in sea water, if a marine organism, or in a glucose solution and afterwards determining the volume of fluid displaced by the organism by a titration. A certain number of densities are given and also results of experimental test of the accuracy of the method by a comparison of the density of glass beads determined by this method and by direct determination of volume displacement and of weight. The table of densities shows that the stickleback is always denser than its natural medium, and must continually keep itself up by its own muscular effort; a more striking result is that the sinking factor in the stickleback is less at 20° C. than at 10° C. so that the higher the temperature the less the muscular effort required to keep afloat. It is argued cogently that, with small organisms of low density, surface area is the dominating factor so far as body orientation is concerned, rather than the position of the centre of gravity, so that spines or plumose setæ increasing the surface will have considerable significance in relation to orientation. (See also Nature, Feb. 12, p. 289.)

Non-Setting of Pears

Certain varieties of good quality pears blossom profusely, but are most irregular in setting their fruit. D. N. Srivastava (*J. Pom. and Hort. Sci.*, 16, 39; 1938) has investigated the problem at East Malling, using one free-cropping variety (Conference) and two shy-cropping varieties (Doyenné du Comice and Pitmaston Duchess). Two waves of dropping were observed, (1) a very early shedding of non-fertilized flowers, (2) a late and comparatively light dropping of partially developed fruits, popularly known as 'June drop'. The main cause of June drop did not appear to be lack of fertilization, since plenty of apparently healthy seeds were found in most of the fruits dropped. Individual fruit size was correlated with length of life on the tree, the larger fruits remaining attached longest, from which it is inferred that dropping is due to competition for nutrients. Cutting back the main branches to eight year old wood increased the set of fruit the same year, but reduced the number of fruit buds the following year. Ringing increased fruit-bud formation but did not improve the set of fruit, whilst bending over and tying down the main branches gave variable results both for fruit-bud formation and for fruit set. It is thought that the problem is a nutritional one.

Geological History of Indian Rivers

IN the symposium which followed the presidential address to the National Institute of Sciences of India (NATURE, 141, 797, April 30, 1938), Mr. D. N. Wadia of the Geological Survey reinforced Prof. M. N. Saha's plea for detailed investigations of Indian rivers by emphasizing how many important changes have taken place within historic times. In common with Saha, he accepts the hypothesis of a great river in early Pleistocene times (the Indobrahm of Pascoe or the Siwalik River of Pilgrim) which flowed from the east—somewhere in eastern Assam or China—along the courses of the present Middle Brahmaputra, the Ganges and the Indus to discharge into the Arabian Sea Wadia considers that tectonic movements are still taking place in the Himalayan foredeep. After the separation of the Indus and Ganges groups, the Jumna continued for long a tributary of the Punjab rivers. So late as the twelfth or thirteenth centuries A.D. the Sutlej appears to have flowed as a great river (the Hakra) into the Rann of Cutch. Wadia points out that the Himalayan rivers are cutting back and that there is a real danger of the Kali Gandak tapping the head waters of the Brahmaputra in Tibet and bringing that river—with consequences which can scarcely be even imagined—into the Gandak and Ganges. Another example of rapid changes is afforded by Rennell's map of Bengal (1786) and utterly different from the present. Dr. S. L. Hora of the Zoological Survey of India finds the hypothesis of the Indobrahm supported by the distribution of fish and that the Indus and Ganges were only separated at a very late period geologically. If such major changes are still taking place, it is clear how modern engineering works may be jeopardized without the nature of the changes being thoroughly understood.

Local Variations of Temperature

AN account of local variations of temperature within an area of a few square miles in the neighbourhood of Nottingham was read before the Royal Meteorological Society by A. B. Tinn on April 27. There were eight observation stations with a range of height above mean sea-level of only 130 ft., yet it was found that the daily minimum temperature showed local differences of more than 4° F. in the monthly mean and of 10° F. on individual days. The records of four of the stations were analysed over a period of two years—April 1935–March 1937—to discover the conditions most favourable for large differences. For minimum temperature these were winds from between north and east, fine weather, a high barometer and low humidity, although the conditions giving low minima did not always result in large differences. Rainy and windy conditions bring the differences to a minimum. Daily maximum temperatures show large differences less often, but such differences are occasionally found to amount to between 4° and 6° even in summer and to 8° or 9° in winter, extreme differences being most likely when some places remain in fog while others are in sunshine. The topography of the region does not contain any remarkable features, the high ground consisting of irregular spurs extending north-north-east from Nottingham Castle while the lowest ground is to the south bordering the River Trent. Its share in producing the observed differences did not show very clearly, doubtless owing to the limited number of stations compared with the variety of topographical nature. Attenborough, only 89 ft. above sea-level, showed the most Continental climate.

Condensation on Board Ship

A RECENT lecture before the Royal Society of Arts by J. S. Duly on "Condensation on Board Ship" contained several interesting illustrations of how well-known physical principles may be applied to large-scale commercial undertakings. He pointed out that cargoes in unrefrigerated holds have such considerable heat capacity that the temperature alters but little, even during a relatively prolonged voyage. Consequently in the tropics, the cargo is at a temperature below the dew point of the warm moist sea-air, and it follows that condensation can best be avoided, not by ventilation, as is usually assumed, but by its opposite, that is, by preventing the entrance of this air. A second point made by Mr. Duly was that for each commodity, the equilibrium moisture content is a function of the relative humidity of the air and (to a small extent) of its temperature. Consequently, in a closed space, a condition is reached in which the moisture content and the atmospheric humidity are in equilibrium. In other words, each commodity maintains around itself an atmosphere of appropriate humidity. Further, the outer layers of a cargo in bulk tend to protect the main mass from changes in moisture content, since any alteration on the outside affects the atmospheric humidity in such a direction as to oppose further change. On Mr. Duly's views, these facts account for damage by condensation being so small as is found in practice. He deduces, besides the conclusion mentioned above, that care should be taken in ship design to avoid either very hot or very cold surfaces anywhere on the walls of the cargo space, and also that the choice of the material from which containers are made is not a matter of indifference.

Orbits of Double Stars

DR. HENRY NORRIS RUSSELL has recently described a method for the rapid determination of visual binary orbits (*Mon. Not. Roy. Astro. Soc.*, 93, 8, June 1933). This graphical method was so easy to apply that two complete orbits could be computed in one day. Dr. R. v. d. Woolley has modified Russell's method for cases where the eccentricity is high, and by assuming that this is unity his graphical method is simple and capable of rapid application ("A Parabolic Double-Star Orbit", *Mon. Not. Roy. Astro. Soc.*, 98, 5, March 1938). This is applied to the double star Σ 1639. The values of the position angle and separation deduced from the elements are compared with nine normal places, and there is a very good agreement in both co-ordinates. It is not, of course, implied that the orbit is definitive, but if the object is carefully observed for a few years it is possible that the eccentricity can be determined. It is also suggested that σ_2 *UMa*, to which Halpern fitted a parabolic orbit about six years ago, should be observed for some years in order that its eccentricity may be computed.

Progress in Physics

Tributes to Max Planck

THE recent issue of the *Annalen der Physik* has been dedicated to Prof. Max Planck in honour of his eightieth birthday on April 23 (see NATURE, April 23, p. 720). Some of the twenty-two papers offered to him by his friends, colleagues and pupils may be picked out for mention here.

(1) The first paper is by N. Bohr on the quantum of action and atomic nuclei. Bohr contrasts the situation in the early days of interpretation of atomic spectra with the present situation of nuclear theory. In the atom, the weak and long-range Coulomb forces between the particles made possible the successful application of the correspondence principle. This failed only at an advanced stage of interpretation, when it was superseded by a fundamental revision of the laws governing observation in physics.

The nucleus, on the other hand, is held together by strong short-range forces with saturation properties, which couple the constituent parts to form an indivisible system. Gamow's theory of α-ray spectra gave an indication of the energy levels of this system. These cannot be explained on the assumption of individual particles moving in a fixed field of force as of the Coulomb type. The strong coupling of the particles and easy transfer of energy between them is revealed in the transformation processes of nuclei under neutron bombardment.

Fermi showed that the impinging energy of the neutron is spread over the whole nucleus, with formation of an unstable nucleus. This strong coupling thus makes a nucleus similar to an elastic system in dynamics, in which the effect of a shock will be distributed over a great number of proper frequencies forming an extended and finely graded spectrum. The energy of the bombarding particle 'heats' the nucleus and an 'evaporation' of some of the nuclear constituents may follow this process (cf. NATURE, **137**, 344 and 351 (1936).

(2) In the second paper, W. Heisenberg discusses the relevancy of the length $r_0 = e^2/mc^2 = 2{\cdot}81 \times 10^{-13}$ cm., which he considers to be one of the 'primary universal constants'. By this term are designated universal constants implying some kind of invariance of the physical laws. Examples are c, determining the Lorentz-invariance and h, determining the interchange relations and the invariance of the quantum laws against rotation in the Hilbert space. These 'primary universal constants' indicate the limits where the laws formulated for our initial domain of experience break down ($v \approx c$, $E \approx h\nu$). The length r_0 may be taken to indicate the limit down to but not beyond which the usual quantum mechanics hold. The new laws governing physics at distances less than r_0 may be expected to manifest themselves in the following phenomena:

(*a*) Self-energy and radius of the electron, Sommerfeld's fine structure constant, $\alpha = e^2/hc$. (Since $e < \sqrt{hc}$, classical explanations for these are not to be expected.)

(*b*) β-Disintegration. The present difficulties arise from imposing arbitrary limits on certain integrations; this treatment may be considered as a kind of correspondence to the treatment taking account of the new laws below r_0.

(*c*) Masses of elementary particles may be hoped to follow from r_0 in a similar way as the term values of hydrogen from h by way of the Rydberg constant.

(*d*) Interaction of particles provided the energy implied is of the order hc/r_0. This will be the case for the ordinary interaction in nuclei and for collision between particles rich in energy. Disintegration by 'explosion' may be expected if the nuclear field 'separates' from the nucleus on approaching another nucleus by less than r_0.

(*e*) Lengths less than r_0 will not be measurable, even by the γ-ray microscope, since the act of measuring would lead to nuclear explosions.

(*f*) A clue to the ultimate invariance property connected with r_0 will perhaps be obtained from relations between the observable values such as cross-sections for cosmic ray processes.

(3) R. A. Millikan discusses the "1938-values" of the fundamental constants. Acknowledging fully the importance of recent X-ray measurements by DuMond and Bollmann and by von Friesen, he arrives at:

$$e = 4{\cdot}796 \pm 5 \times 10^{-10} \text{ E.S.U.}, \; h = 6{\cdot}610 \pm 12 \times 10^{-27} \text{ erg. sec.}, \; N = 6{\cdot}097 \pm 6 \times 10^{23}.$$

(4) Two papers deal with the influence of conditions imposed on the solutions of the Schrodinger equation. E. Schrödinger finds that ψ need not necessarily be limited to single-valued functions in order to obtain unambiguous physical predictions. It is not possible, however, to have more than double-valued functions, of opposite sign in the two branches, and the same problem admits of either mono- or divalent functions only for all its states.

A. Sommerfeld and H. Welker surround an hydrogen atom by an infinitely high and steep spherical potential wall, and show that the ground state for this 'enclosed hydrogen atom' is expressed by confluent hypergeometric functions. With decreasing radius of the wall, the energy rises from its normal negative value and becomes positive when the available distance of the electron from the centre is limited to 1·835 times the normal ground state radius.

(5). Several papers are devoted to thermodynamical and statistical problems. W. Meissner goes into the details of the growth of solid carbon dioxide into liquid carbon dioxide as realized in the 'Agefko' process. A very large heat gradient exists over a boundary layer of 0·1 mm. in thickness which is traversed by capillaries 1 μ in diameter. General equations for stationary thermodynamical processes at the moving boundary between two phases are given.

Statistical considerations initiated by Gibbs and Vollmer for problems of condensation are applied by R. Becker to the segregation of the constituents of a mixed crystal. The rate of formation of crystal nuclei for further growth can be determined as a function of under-cooling for a crystal in which the binding forces act between neighbouring atoms only. This compares well with the measurements.

M. v. Laue gives a study of the thermodynamics of supra-conductors, F. Hund the theory of diamagnetic properties of very small pieces of metal at low temperatures. The heat anomalies found for alums at very low temperatures by Simon and his co-workers are attributed to the internal electric and magnetic fields of the crystal acting on the trivalent metal ion by P. Debye in a paper on cooling by adiabatic demagnetization. A detailed discussion of the iron-ammonium alum gives the Curie point at 0·038° K. as against the value 0·034° K. given by Simon from his observations. The magnetic coupling of the atoms leads to the formation of spontaneous order below a temperature of some thousandths of a degree, and prohibits a further cooling by demagnetization, which therefore will only be possible by action on the magnetic moments of the nuclei.

(6) Limitations of space forbid mention of further papers, save one by K. Schmeise and W. Bothe on a new kind of ultra-hard cosmic ray shower which seems to originate in the hard component of the primary cosmic rays. These showers scatter over an angle of about 10°, half that of normal showers, and are transformed into the ordinary soft showers on passing through matter.

The Problem of Stellar Energy

THE problem of stellar energy was the subject of discussion of the Fourth Annual Conference on Theoretical Physics sponsored by the George Washington University and the Carnegie Institution of Washington, and held in Washington, D.C., on March 21–23. The Conference was attended by astrophysicists studying the internal constitution of the stars (S. Chandrasekhar, B. Strömgren, T. Sterne, D. Menzel and others) as well as by physicists working on different branches of nuclear physics (H. Bethe, G. Breit, G. Gamow, J. v. Neumann, E. Teller, M. Tuve, L. Hafstad, N. Heydenburg and others).

On the fundamental problem concerning the nuclear transformations as the source of energy of stars, some interesting conclusions have been reached. According to the so-called "aufbauhypothese", the process of the building up of the heavier elements from hydrogen is continually taking place in stellar interiors. Further, it is assumed that such processes liberate sufficient amounts of energy to account for the radiation of the stars. However, it seems that the model scheme proposed by von Weizsäcker (${}^{4}_{2}\mathrm{He} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{5}_{3}\mathrm{Li} \rightarrow {}^{5}_{2}\mathrm{He} + \beta^{+}$) is contradicted by recent experimental evidence, according to which the nuclei ${}^{5}_{3}\mathrm{Li}$ and ${}^{5}_{2}\mathrm{He}$ are both unstable, emitting heavy particles in a very short time. Another possible chain of reactions for the synthesis of the heavier elements from hydrogen and helium would require the stability of ${}^{8}_{4}\mathrm{Be}$, which is again very doubtful according to recent experimental evidence. It appears, then, that the only course not excluded by present evidence on the binding energies of the light nuclei is the formation of ${}^{6}_{4}\mathrm{Be}$ in triple collisions involving an α-particle and two protons.

Although the existence of ${}^{6}_{4}\mathrm{Be}$ has not yet been established experimentally, there are some indications that it might be a stable nucleus. If so, the chain of reactions leading to the synthesis of the heavier nuclei from hydrogen can be traced. The estimate of the probability of such reactions involving triple collisions shows that, under the conditions in the stellar interiors, the rate of liberation of energy will be sufficient to account for the radiation of the stars.

As another possibility the reaction ${}^{1}_{1}\mathrm{H} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{2}_{1}\mathrm{H} + \beta^{+}$ was suggested. It seems that the rate of such a reaction under the conditions in stellar interiors would be just enough to account for the radiation of the sun, though for stars much brighter than the sun other more effective sources of energy are required.

Special attention was directed to the possibility of resonance effects for nuclear reactions occurring in the interior of the stars; in such cases it would be necessary to consider that some light nuclei have virtual levels in the region of 10 kv. (corresponding to temperatures of the order 4×10^7 degrees Kelvin). The presence of resonance levels would not only increase the rate of liberation of energy of the reaction in question, but also would at the same time require a rather different type of stellar model. The rate of ordinary nuclear reactions increases exponentially with temperature, leading effectively to a point-source model in which the energy sources are concentrated at the centre. The selectivity with respect to temperature which would arise from resonance levels at about 10 kv. would, on the other hand, suggest a shell-source model with the maximum liberation of energy in a spherical shell surrounding the centre. It seems that this new model has a number of advantages over the point-source model.

The possibility of an extremely dense neutron core at the centre of the star (as proposed by L. Landau) was also discussed. The study of a number of known stars does not indicate a central condensation of more than what corresponds to 90 per cent of the total mass within half the radius. Thus, so far as astrophysical evidence is concerned, the model of a star with a heavy 'stellar nucleus' at the centre is *not* confirmed, except possibly for supergiants (for example, the *M*-component of vv Cephei, the infra-red component of ε Aurigæ), for which cases the observational evidence allows one to infer a high degree of central condensation corresponding to 90 per cent of the mass within less than ten per cent of the radius. Further, a stellar model with a 'nucleus' would require extremely high temperatures and densities ($\sim 10^9$ degrees and $\sim 10^9$ gm./cm.^{3}) at the surface of the core. In such physical circumstances *all* nuclear reactions would occur at extremely high rates and the total liberation of energy would lead to predicted luminosities for stars of altogether different orders of magnitude from those observed. It was therefore concluded that stellar models with a concentrated nuclear core cannot represent real stars.

S. Chandrasekhar (Yerkes Observatory).

G. Gamow (George Washington University).

M. A. Tuve (Carnegie Institution of Washington).

Elliot Smith Memorial

ON Tuesday, May 3, in the Thane Library of the Faculty of Medical Sciences, University College, London, a bust in bronze of the late Sir Grafton Elliot Smith, professor of anatomy in the College from 1919 until 1936, was unveiled by Prof. J. T. Wilson and presented by him on behalf of the subscribers to the chairman of the College Committee (the Right Hon. Viscount Sankey of Moreton). Prof. J. P. Hill reported on behalf of the Committee that the subscribers to the Fund included old friends, colleagues and pupils of Elliot Smith from all the continents, and most of the countries of the world. The execution of the memorial was entrusted to Mr. A. H. Gerrard of the Slade School, and the bust is a striking portrayal of a man of vigorous personality and great intellectual capacity.

In making the presentation, Prof. Wilson, in a short speech of singular charm and warmth of feeling, remarked that Elliot Smith's best memorial is not material but spiritual and is to be found in the impressive record of his lifelong activity and in his influence on innumerable people besides his pupils, colleagues and friends. The qualities that his friends have recognized have been an extraordinarily penetrating vision and a capacity for interpretation, together with a striking vigour and clarity of exposition. Prof. Wilson made mention of the very varied character of Elliot Smith's career as an anatomist, first in Sydney, then in Cambridge, followed by Cairo, Manchester and finally London, and of how all these manifold experiences influenced the trends of his remarkable activities. He recalled that some forty-five years ago, Elliot Smith had been his pupil in the University of Sydney and afterwards his demonstrator, and speaking as the representative of his Alma Mater, he further recalled with pleasure that he had had the honour of recommending him for one of his first distinctions, the Gold Medal awarded for his thesis for the doctorate.

Lord Sankey, in accepting the bust on behalf of the College, said it was a remarkable memorial to a remarkable man and yet another treasure to the gallery of great and distinguished men who by their life and learning have contributed to the prestige of University College.

The Provost of the College, Sir Allen Mawer, in thanking Prof. Wilson and the subscribers, spoke of the part played by Elliot Smith in the negotiations with the Rockefeller Foundation which resulted in the munificent benefaction through which it was possible to build and equip the existing Department of Anatomy, and of his influence in promoting the close association which exists between the College and the universities of the Dominions and more particularly of Australia.

Immunological Reactions of the Filterable Viruses

ONE of the greatest services which a group of investigators can give to the larger scientific public is the compilation of a sound and detailed résumé of their own particular field of research. F. M. Burnet, E. V. Keogh and Dora Lush have done this for the immunological reactions of the filterable viruses (*Aus. J. Exp. Biol. and Med. Sci.*, 15, Pt. 3 (supplement), pp. 231–368; 1937: also published separately, price 10*s*. 0*d*., from the Librarian, Univ. of Adelaide, South Australia, or Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street, London, W.C.1). The specialist contribution of these workers lies mainly in their quantitative study of the immunity reactions of numerous animal viruses, using a method which produces discrete pock marks upon the chorioallantoic membrane of a developing egg. Their present monograph contains a short reference to the serology of plant viruses, but is otherwise devoted in detail to those which attack bacteria and mammalian animals. Chapter I contains a useful comparison of animal viruses with bacteriophages. The latter can be regarded as virus diseases of bacteria, and have particle-sizes commensurate with the small size of their hosts. They range from 10 to 65 mμ in diameter, where animal viruses vary between 10 and 300 mμ. Both are composed mainly of nucleoprotein, with traces of ether-extractable substances and salts, whilst carbohydrates are lost during washing.

The section describing the immunology of bacteriophage is, of necessity, more general than that setting forth the comparable reactions of animal viruses. Specificity of bacteriophage inactivation by immune sera, differences in antigenicity among bacteriophages, and the antigenicity of inactivated phage, are some of the main lines of discussion, whilst the details of typical phage-antiserum reactions are given at considerable length.

It is possible to be much more specific in the sections which deal with the immunology of animal viruses. The causal agents of influenza, cow-pox (vaccinia), louping-ill, rift valley fever, equine encephalomyelitis, Newcastle disease, infectious laryngotracheitis and myxomatosis, are each given a particular chapter, wherein their immunology is adequately portrayed. Chapters upon virus immunity from a biological point of view, on the site of formation of virus antibodies, on the principles of active immunization against virus infections, and on modern views upon the antigen-antibody reaction, minister to the more general reader in search of biological background.

Considerable lists of references to the literature are given, and if the Australian investigations are emphasized somewhat, workers in the northern hemisphere can only be grateful for their concomitant availability, and be glad of such fundamental contributions. It would indeed be difficult to over-emphasize the value of such monographs as the one under review; it serves to nullify any incipient bewilderment at the increasing volume of modern knowledge in its particular sphere.

Science News a Century Ago

Geographical Exploration

ON May 28, 1838, at a meeting of the Royal Geographical Society, six communications were read. These referred to the discovery of the outlet of the River Murray in Australia; the expedition of Thomson D'Abbadie to Abyssinia; a journey in north-west Persia by Lieut.-Colonel Shiel; some observations from Bagdad by Lieut. Lynch, who had examined the banks of the Tigris from its source to that city; a proposal from G. A. Hoskins sent in the name of the Society of Egyptian Travellers suggesting sending a native of Dongola to explore the western branch of the Nile, and a communication from Schomburgk in British Guiana dated November 18, 1837. Ascending the Rivers Essequibo, Rewa and Quitaro "we halted," wrote Schomburgk, "on the 7th Nov. in order to visit the Atáraipú, a natural pyramid, of which I had heard so many and such contradictory reports. Our road to it led through thick woods, until after a scramble of two hours we stood at the foot of a hill of gniess, barren with the exception of a few parasitic plants as Orchideæ, Cacti, Chusia, which draw their scanty nourishment from a thin layer of vegetable mould lying in the clefts of the rocks. After ascending for 300 feet, the view opened to the west, and from the abyss below rose the far-famed Atáraipú, one of the greatest natural wonders of Guayana. Its base is wooded for about 350 feet high from thence rises the mass of granite, devoid of all vegetation, in a pyramidical form, for about 550 feet more, making its whole height 900 feet above the plain . . . a little to the south of it another, almost similar of gneiss, of which, when we consider that all beyond was unknown ground, it might well be said, in the words of the poet, that they

"Like giants stand
To sentinel enchanted land."

Blowing up of a Sunken Vessel

CONSIDERABLE interest was taken in the blowing up by means of gunpowder, on May 28, 1838, of the coal brig *William*, which in 1836 had sunk in the River Thames off Gravesend, with about 300 tons of coal aboard. According to the *Mechanics' Magazine*, this was the first attempt to destroy a vessel under water. The task of destruction was entrusted to Colonel (afterwards General Sir) C. W. Pasley (1781–1861), director-of the Royal Engineers' Establishment at Chatham. Two leaden cylinders each containing 2,500 lb. of gunpowder were made. These were completely enclosed in wooden cylinders of 3 in. timber, 4 ft. in diameter and 10 ft. long, bound with hoop iron. One of the cylinders was placed in position by divers and the charge was exploded by means of a fine powder hose in a flexible leaden pipe attached to the cylinder, the upper end of which was moored to a red buoy. The gunpowder train was connected with a small tin canister in the centre of the great charge. A sapper with a lighted taper set fire to the fuse, which burnt five minutes, allowing him to row out of danger. The explosion raised a dome of water 800 ft. in diameter 70 ft. high. Much the same methods were used by Pasley a year or two later in destroying the *Royal George*, except that electricity was used for firing the charge.

The Greenwich Lunar Observations

"ON May 31, 1838, the Treasury assented to the undertaking of the Lunar Reductions and allotted £2,000 for it; preparations were made, and in the autumn 7 computers were employed upon it" (Airy). "The reduction of the Greenwich lunar observations from 1750 to 1830," says Grant, "was undertaken at the public expense in consequence of a representation to that effect having been made to the Government by the British Association, agreeably to a suggestion of Sir John Lubbock's on the occasion of the meeting of the Association, which was held in Liverpool in 1837. The organization of the plan of reduction, as well as the superintendence of its execution, was confided to Mr. Airy. In consequence of the multitude of inequalities by which the moon's motion is affected, the undertaking was one of stupendous magnitude. In order to form some idea of the labour expended in its execution, it may be mentioned that upwards of 8,000 places of the moon were deduced from the observations, and compared with the corresponding places calculated from the tables. . . . The calculations connected with this great undertaking were superintended by Mr. Hugh Breen, who had the melancholy satisfaction of just living to see its completion. Mr. Airy, who bears honourable testimony to his skill and accuracy, states, at the beginning of the first volume of the published results, that after a short illness he expired on the morning of April 1, 1848, only a few hours having elapsed after the last supplementary tables had been sent to the press."

Influence of Nitrogen on Growth of Plants

AT a meeting of the Royal Society on May 31, 1838, Robert Rigg read a paper entitled "An Experimental Inquiry into the Influence of Nitrogen on the Growth of Plants". After alluding to a previous paper describing the chemical changes which occur during the germination of seeds, the author proceeded to trace the connexion between the phenomena exhibited during the growth of plants and the direct agency of nitrogen. The results of his experiments were arranged in tables indicating in about 120 different vegetable substances, not only the quantities of carbon, oxygen, hydrogen, nitrogen and residual matter, but also the quantity of nitrogen in each compound, when compared with 1,000 parts by weight of carbon in the same substance. The most important tables were those which exhibited the chemical constitution of the germs, cotyledons, and rootlets of seeds; the elements of the roots and trunks of trees, and the character of the various parts of plants, especially of the leaves at different periods of their growth. From his observations it appeared that nitrogen and residual matter are invariably the most abundant in those parts of plants which perform the most important offices in plant physiology, and the author was disposed to infer that nitrogen (being the element which more than any other is permanent in its character) when combining with residual matter, is the moving agent, acting under the living principle of the plant, and moulding into shape the other elements.

Spanish Bells

THE issue of the *Gentleman's Magazine* for May 1838 contains the following information: "In consequence of the difficulties to which the existing government of Spain has been reduced in the war with Don Carlos, a large quantity of bells, which were the property of the convents and were transferred from them for the relief of the Queen's cause, were sent to Marseilles and sold as old metal. About sixty were purchased by an American gentleman and shipped to New York, where the most experienced bell-founders examined them and pronounced that they are such that cannot be made in America, nor probably anywhere at this time. It is well known that the ancient Spanish bells and indeed all the old bells cast in Catholic countries were considered as sacred; the more precious their metal, the greater their sanctity, and nearly all of them are thought to have more or less silver in their composition. The art of compounding silver with the other metals entering into the composition of bells is now entirely lost. The tones are said to be inimitably beautiful; and it is stated that one of these bells weighing 100 pounds has as much power and strength of tone as an ordinary bell weighing 300. They weigh from 100 to 1700 pounds each; and are often highly ornamented with figures of the Cross, royal Arms of Spain and various devices *in alto relievo.* After being a certain time on view at New York, they were dispersed by public sale, and will now be scattered about in every quarter of the States. . . . The largest weighing 1700 pounds is already doing duty on the top of the New York City Hall."

University Events

BELFAST.—Mr. A. H. Naylor has been appointed professor of engineering as from October 1, in succession to Prof. F. Hummel, who is retiring. Mr. Naylor is at present research officer of the Institution of Civil Engineers.

LEEDS.—Dr. D. T. A. Townend has been appointed Livesey professor of coal gas and fuel industries, to take office from October next, in succession to Prof. J. W. Cobb (see p. 964).

LONDON.—Prof. H. H. Read has been appointed, as from January 1, 1939, to the University chair of geology tenable at the Imperial College of Science and Technology. Since 1931 he has been George Herdman professor of geology in the University of Liverpool.

Dr. G. R. de Beer has been appointed to the University readership in embryology tenable at University College. For the last eleven years he has been Jenkinson lecturer in embryology and senior demonstrator in zoology and comparative anatomy in the University of Oxford.

The title of professor of natural philosophy in the University has been conferred on Dr. Herbert Dingle, in respect of the post held by him at the Imperial College—Royal College of Science.

The following doctorates have been conferred: D.Sc. in biochemistry on W. T. J. Morgan, of Queen Mary College, Lister Institute of Preventive Medicine, and West Ham Municipal College; D.Sc. in botany on A. E. Muskett, of the Imperial College—Royal College of Science; D.Sc. in chemistry on H. N. Rydon, of the Imperial College—Royal College of Science.

The Dunn exhibitions in anatomy and physiology for 1938 have been awarded to Mr. S. D. V. Weller (of University College) and Mr. J. W. L. Doust (of King's College) respectively.

Societies and Academies

London

Royal Society (*Proc.*, B, 125, 187–290, April 27, 1938).

D. KEILIN and T. MANN: Polyphenol oxidase: purification, nature and properties.

J. MELLANBY and C. L. G. PRATT: The coagulation of plasma by trypsin.

A. S. PARKES and I. W. ROWLANDS: Studies on the hypophysectomized ferret. (10) Growth and skeletal development.

E. C. DODDS and W. LAWSON: Molecular structure in relation to œstrogenic activity. Compounds without a phenanthrene nucleus.

P. N. MARTINOVITCH: The development *in vitro* of the mammalian gonad: ovary and ovogenesis.

H. G. SMITH: The receptive mechanism of the background response in chromatic behaviour of Crustacea.

H. WARING: Chromatic behaviour of elasmobranchs.

LORD ROTHSCHILD: The polarization of a calomel electrode.

Dublin

Royal Irish Academy, April 25.

A. FARRINGTON: The glaciers of Mount Leinster and Blackstairs Mountain. The moraines of the local glaciers are described and their relations to one another discussed. The level of the snow-line during the late glacial period is estimated at 1,650 feet O.D.

Edinburgh

Royal Society, May 2, 1938.

R. CARRICK: The life-history and development of *Agriolimax agrestis* L., the grey field slug. Seasonal activity, copulation, oviposition, hatching and growth of *Agriolimax agrestis* are dealt with. There is no seasonal sexual cycle, but reproductive activity is controlled directly by weather conditions and is most evident during August-November. Under field conditions, the incubation period varies from 21 to 96 days. Embryological points of interest are fusion of the third tentacles, development of large contractile sacs, direct transition of blastopore into mouth, and the composite structure of larval nephridia from mesodermal bands and ectodermal invaginations. The structure and function of the modified larva, associated with development within the albuminous egg-capsule on land, are compared with less specialized gasteropods.

EDITH A. T. NICOL: The brackish-water lochs of Orkney. The brackish-water lochs of Orkney are the only Scottish localities where *Neritina fluviatilis* L. is found. The Loch of Stenness is entered by spring tides and has a salinity varying between 10·2 and 26·8 per cent. Its fauna and flora are mainly brackish in character, but many marine forms occur. The Loch of Stenness flows into the other and has a low salinity, 0·8–4·3 per cent, and many freshwater species occur along with brackish ones. The calcium contents in both lochs varies between 56 and 139 mgm. per litre, which partially accounts for the presence of *Neritina.*

MARIE E. CAMPBELL: An investigation of the Mucorales in the soil. Fifteen soil samples were taken from seven distinct soil types and the species of *Mucor* were isolated in pure culture. The results show that there is no well-marked *Mucor* association for the soil types. Certain species such as *Mucor hiemalis* and *M. racemosus* occur in almost all soils. The proportion of positive to negative forms of *M. hiemalis* in the soil was found to be 25 : 4. By experiment it has been shown that the positive hyphæ of *M. hiemalis* are more resistant to drying than the negative hyphæ. Hybrid zygospores have been obtained between different species of the same genus and also between different genera of the Mucorales.

D. Meksyn : Green's function for an ellipse and its application to the motion of a point vortex. Green's Function for the space external to an infinitely long elliptic cylinder, and for the space enclosed between two such confocal cylinders are evaluated. The stream lines and the motion of a rectilinear vortex outside an elliptic cylinder are found.

Paris

Academy of Sciences, March 28 (*C.R.*, 206, 961–1064).

Charles Eugène Guye : Relativity, resonance and molecular diffusion.

Jean Bosler : Earth currents and magnetic disturbances. From a study of the records of the Parc Saint-Maur Observatory it is shown that the variations of the N–S earth currents follow those of the magnetic declination and those of the E–W current those of the horizontal force. A general principle is enunciated: when two phenomena are such that the curves which represent them as a function of the time are parallel, the two are related by a law of proportionality.

Jean Ville : A continuous game. Discussion of a problem in probability.

Aryeh Dvoretzky : The abscissæ of holomorphy and meromorphy of analytical functions represented by Dirichlet series.

Jean Legras : An integral equation with principal part.

Hubert Delange : The domain of absolute convergence of multiple series of powers.

V. A. Kostitzin : The singular points of the differential equations of the problem of natural selection.

Chi Tai Chuang : The behaviour of a holomorph function in a circle.

Michel Kiveliovitch : Hydrodynamic equations and quantic statistics.

René Anthouard : Some characters of sparks submitted to an air current.

Mlle. Edith Couillaud : Concerning physical tests for cement. Tests on cement in different laboratories, made in every detail in accordance with a rigorous specification, show differences of 4–15 per cent. Replacement of hand mixing by mechanical mixing in the preparation of the test pieces is suggested as likely to lead to greater concordance in the results.

Pierre Dive : Analyticity of the square of the angular velocity of a fluid star.

Santiago Antunez de Mayolo : The principle of the critical velocity in the materialization of the photon.

Gérard Petiau : A form of the solutions of the Dirac equations and the equations of the photon.

Jean Guastalla : A new technique for the measurement of very small surface pressures.

Pierre Vernotte : The practical determination of the relative values of the thermal conductivity of metals.

Jean Savard and Marc de Hemptinne : The simple critical potentials of carbon monoxide.

Robert Guillien : The dielectric constant of carbon disulphide at a low temperature. The experiments of Mazur indicated an anomaly for the dielectric constant at about − 90° C., pointing to the existence of two different liquid states of carbon disulphide. The author has been unable to confirm this; provided that the liquid is efficiently stirred no anomaly exists between + 20° C. and − 110° C.

Bruno Pontecorvo : The diffusion of monokinetic neutrons by protons.

René Audubert and J. Mattler : The influence of vapours on the curve of spectral sensibility of photo-electric counters.

Pierre Lambert and Jean Lecomte : The application of infra-red absorption spectra to the determination of the position of the ethylene linkage in a fatty carbon chain.

François Gans : The spectral distribution of the white light obtained by electrical stimulation of xenon. The tubes studied contained either xenon or a mixture of xenon and neon. The energy distribution of the continuous spectrum was very nearly the same as that of a black body at 3,800° C. The lines showing were xenon lines only; no neon lines were seen.

Jules Farineau : The *L* spectrum of iron.

Marcel Frilley : The spectrography by diffraction of the γ-rays of actinium and of its derivatives.

André Moussa and Mlle. Hélène Laurent : The periods of disintegration of the radio-silvers.

Yves Deux : The semihydrobenzoin transposition of phenylmethylvinylglycol by dehydration and by the isomerization of the corresponding epoxide.

Marcel Tuot : The secondary reactions observed in the course of the organo-magnesium condensation of ketones in the fatty series. Study of two secondary reactions produced by the enolization of the ketone by the action of the Grignard reagent.

François Salmon-Legagneur : A new structural isomer of campholic acid : β-campholic acid.

Jean Décombe and Clément Duval : The double formula of organo-magnesium compounds. Support for the hypothesis of the double formula for organo-magnesium compounds is given by the formation of a zinc-magnesium complex compound by the action of a zinc-magnesium alloy on methyl iodide in ethyl acetate solution.

Maurice Métra, Lucien Lesage and Fernand Descatoire : The detection of small quantities of isopropanol in alcohols. The method described has been applied to the examination of more than a hundred specimens of ethyl alcohol from various sources : in no case was isopropyl alcohol detected.

Raymond Paul : The influence of the nature of the cycle on the physical properties of some 1,4 and 1,5 isomeric epoxides.

Paul Gaubert : Role of the foreign matter in the structure of liquid crystals.

Jacques Flandrin : The relations of the deposits with Medjano-Numidian facies and of the Oligocene with Lepidocyclines in the littoral and tellian chains of the Department of Algiers and the adjacent regions.

Jean Cuvillier: The presence of Miogypsines in the Egyptian Miocene.

Jean Bricard: Study of the coronas of the natural fogs at the summit of the Puy de Dôme.

André Mirimanoff: Ascorbic acid and the carotenoid pigments. The meaning of the Molisch reaction and attempt at the localization of ascorbic acid.

Joseph Lefèvre: Polarity problems produced on plant cuttings by various substances.

Victor Vincent, Jean Herviaux and Yves Coic: Liming acid soils by natural limestones and agricultural lime.

Georges Deloffre: The influence of some organic acids on nuclear metabolism and on amylogenesis in the lupin.

Maurice Piettre: Mechanical treatment of defibrinated blood or blood rendered incoagulable.

Mme. Andrée Drilhon: The alexic power the sera of the Teleosteans.

Mme. Yvonne Jérome-Lévy: Cultures of the lower plants such as *Aspergillus niger*, *Aspergillus repens* and *Penicillium glaucum* in the presence of carbon. A marked increase in the development of *Aspergillus niger* is shown when carbon is added to the culture fluid (Raulin). With *Aspergillus repens* there is a slight increase of growth; no increase of weight is shown by *Penicillium glaucum*.

Mme. Paulette Chaix: The influence of treated cystine on the Pasteur effect in washed *Propionibacterium pentosaceum*.

Jean Lavollay and Mme. Françoise Laborey: The circumstances in which yellow pigments appear in the culture fluid of *Aspergillus niger*. The production of the yellow pigment is due to a deficiency of magnesium.

André Donatien and Fernand Lestoquard: The evolution of the agent of Rickettsian conjunctivitis of ruminants.

Michel Machebœuf, Joseph Dieryck and Mme. Blanche Dieryck: The comparative study of the phagocytal reaction of guinea pigs with intraperitoneal injection of dead tubercle bacilli and of bacilli partially deprived of lipids (chemicovaccine).

Daniel Florentin: The coli bacillus flora of cheese and food poisoning. The presence of coli bacilli in various cheeses was proved, one of which, containing the largest number of bacilli per gram, had been the cause of food poisoning. It is regarded as rather alarming that, whilst the coli bacillus is prohibited in water, oysters, etc., the consumption of certain cheeses leads to the absorption of considerable quantities.

Spiro Livierato, Marino Vagliano and Nearchos Kokaraki: Two new antigens for the sero-reaction of paludism according to Henry's method.

Moscow

Academy of Sciences (*C.R.*, 18, No. 3, 1938).

I. M. Rapoport: The inverse problem of the variation calculus.

A. Bermant: Some properties of regular functions.

M. Ielchin: Problem of oscillation for the linear differential equations of second order.

E. R. Mustel: The problem of radioactive equilibrium of a stellar atmosphere when the coefficient of absorption depends on the frequency.

V. Stepanoff: The definition of probability of stability.

M. Bebоutoff: Dynamic systems which are stable in the sense of Liapounoff.

I. Malkin: On the stability of movement in the first approximation.

I. Malkin: Generalization of the fundamental theorem of Liapounoff on the stability of movements.

P. Novikoff: The inverse problem of the potential.

B. G. Špakovskij: Propagation of supersonic waves in liquids. (1) Dispersion in some pure liquids and aqueous solutions. (2) Dispersion in acetic acid.

E. Reichrudel and G. Spivak: Influence of magnetic field on the potential gradient in plasma.

A. Filippov, A. Gdanow and I. Gurevich: The disintegration of nuclei by cosmic rays.

A. A. Trapeznikov and P. Rehbinder: Mechanical properties (viscosity, rigidity and strength) of adsorption layers and their relation to the area per molecule and nature of underlying liquid.

A. A. Sapeghin: The course of the development of wheat ear.

G. N. Eremejev: Drought resistance and dehydration resistance of plants.

G. Abolina: The significance of mineral elements in the process of vernalization.

M. S. Jakovlev: The endosperm structure of the principal selection varieties of wheat of the U.S.S.R.

A. A. Yatsenko-Khmelevsky: The discoloration of beech wood.

L. N. Žinkin: Stimulation of metamorphosis in Ascidian larvæ.

Rome

National Academy of the Lincei (*Atti*, 26, 129–191; 1937).

G. Fano: Observations on some finite geometries (2).

O. Scarpa: Formation of pseudo single crystals in the electro-deposition of copper.

C. Agostinelli: Resolution by means of definite integrals of the equation

$$\frac{\delta^2 u}{\delta x^2} + \frac{\delta^2 u}{\delta y^2} + \frac{\delta^2 u}{\delta z^2} + \frac{1}{x}\frac{\delta u}{\delta x} = f,$$

and a problem analogous to that of Dirichlet for a hemispherical field.

G. Gherardelli: Cayley groups of points above an elliptical curve.

I. Popa: Projective-differential geometry of singularities. The point of inflexion of any surface whatsoever.

M. Schonberg: The function $\delta(x)$ of Dirac (2).

A. Terracini: A possible particularity of the principal lines of a surface (2).

E. Medi: Researches on the ionization produced by the evaporation of water.

R. Manzoni Ansidei: Raman spectrum of hydrocarbons with condensed nuclei (2). 9-10-dihydroanthracene, acenaphthene, fluorene.

G. Charrier and M. Iorio: 8-substituted 2-3 pyridinotriazoles.

G. Tedeschi: Rate of dissolution of lead in acids (2).

G. Scoz and E. Tria: Ascorbic acid content of the frog's liver under various experimental conditions.

E. Tria: Electrometric determination of peptic activity.

Forthcoming Events

Tuesday, May 31

Fuel Research Station, Greenwich, S.E.10, at 2–6.—Annual Visitation.

Royal Anthropological Institute, at 8.30.—Prof. F. Weidenreich: "Did *Sinanthropus* Practise Cannibalism?"

Institution of Gas Engineers, May 31–June 3.—Annual General Meeting.

Association of Teachers in Technical Institutions, June 4–7.—Annual Conference to be held at Leeds.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Assistant Lecturer in Chemistry in the Bradford Technical College—The Principal (May 31).

Geologists in the Geological Survey and Museum of Practical Geology—The Director, Geological Survey and Museum, Exhibition Road, South Kensington, S.W.7 (May 31).

Lecturer in Electrical Engineering in the Carlisle Technical School—The Director of Education, Education Offices, Fisher Street, Carlisle (June 1).

Lecturer (woman) in Mathematics in the Bingley Training College—The Education Officer, County Hall, Wakefield (June 2).

Lecturer (woman) in Mathematics in the Avery Hill Training College—The Education Officer (H. 2/1), County Hall, London, S.E.1 (June 8).

Lecturers in Building, Production Engineering and Workshops Practice in the Central Technical College, Birmingham, 1—The Principal (June 11).

Analytical Chemist in the Government Chemical Laboratories, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, London, S.W.1 (June 11).

Principal of the Scarborough Evening Institutes—The Secretary, Education Offices, County Hall, Northallerton (June 11).

Assistant Lecturer in Mathematics in the Royal Holloway College, Englefield Green, Surrey—The Principal (June 11).

Demonstrator in Civil and Mechanical Engineering in the University of Leeds—The Registrar (June 13)

Demonstrator in Bacteriology in the University of Leeds—The Registrar (June 13)

General Secretary of the Society for the Protection of Science and Learning—Prof. C. S. Gibson, Guy's Hospital, London, S.E.1 (June 15).

Curator of the Verulamium Museum—The Town Clerk, Municipal Offices, 38 St. Peter's Street, St Albans (June 28).

Medical Secretary and Registrar to the Clinical Cancer Research Committee of the British Empire Cancer Campaign—The General Secretary, 11 Grosvenor Crescent, London, S.W.1 (June 30)

Lecturer in Mechanical Engineering in the School of Engineering at Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (July 1).

Principal of the Imperial College of Tropical Agriculture, Trinidad—The Secretary, Imperial College of Tropical Agriculture, 14 Trinity Square, London, E C 3 (July 9).

Professor of Metallurgy and Assaying and Director of the Minerals Research Laboratory in the University of the Witwatersrand—The Secretary, South Africa House, Trafalgar Square, London, W.C.2 (July 30).

Assistant Keeper on the Higher Technical Staff of the Industrial Engineering Division of the Science Museum—The Director, Science Museum, South Kensington, London, S.W.7.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial College of Science and Technology Warington Smyth Memorial Lecture, 1938: Metal-Mining Enterprise. By Prof. S. J. Truscott. Pp 88+2 plates. (London: Macmillan and Co., Ltd.) 1*s*. net. [45

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 9, No. 3, December 1937 Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies. Pp. v+191–280 (London: H.M. Stationery Office.) 4*s*. 6*d*. net. [55

Air Ministry: Meteorological Office. Averages of Humidity for the British Isles. (M.O.421.) Pp. 42+1 plate. (London: H.M Stationery Office.) 9*d*. net. [55

City and County of Bristol: Bristol Museum and Art Gallery. Report of the Committee for the Two Years ended 31 December 1937. Pp. 40+8 plates. (Bristol: Museum and Art Gallery) [55

Guide to the Argyll National Forest Park. Edited by Prof. John Walton. Pp. 29+2 plates. (London: H M. Stationery Office.) 6*d* net [55

Other Countries

Tanganyika Territory. Department of Lands and Mines, Geological Division. Short Paper No 17: An Explanation of Degree Sheet No. 52 (Dodoma). Compiled by F. B. Wade and F. Oates. Pp. 60+4 plates. (Dar es Salaam: Government Printer.) 3*s*. [55

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Report of the Aeronautical Research Institute, Tôkyô Imperial University No. 161. On the Influence of Chromium upon the Oxidizing Property of Tungsten at High Temperatures. By Siro Isida, Hirosi Asada and Saburo Higasimura. Pp. 196–210+2 plates. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 0.40 yen. [95

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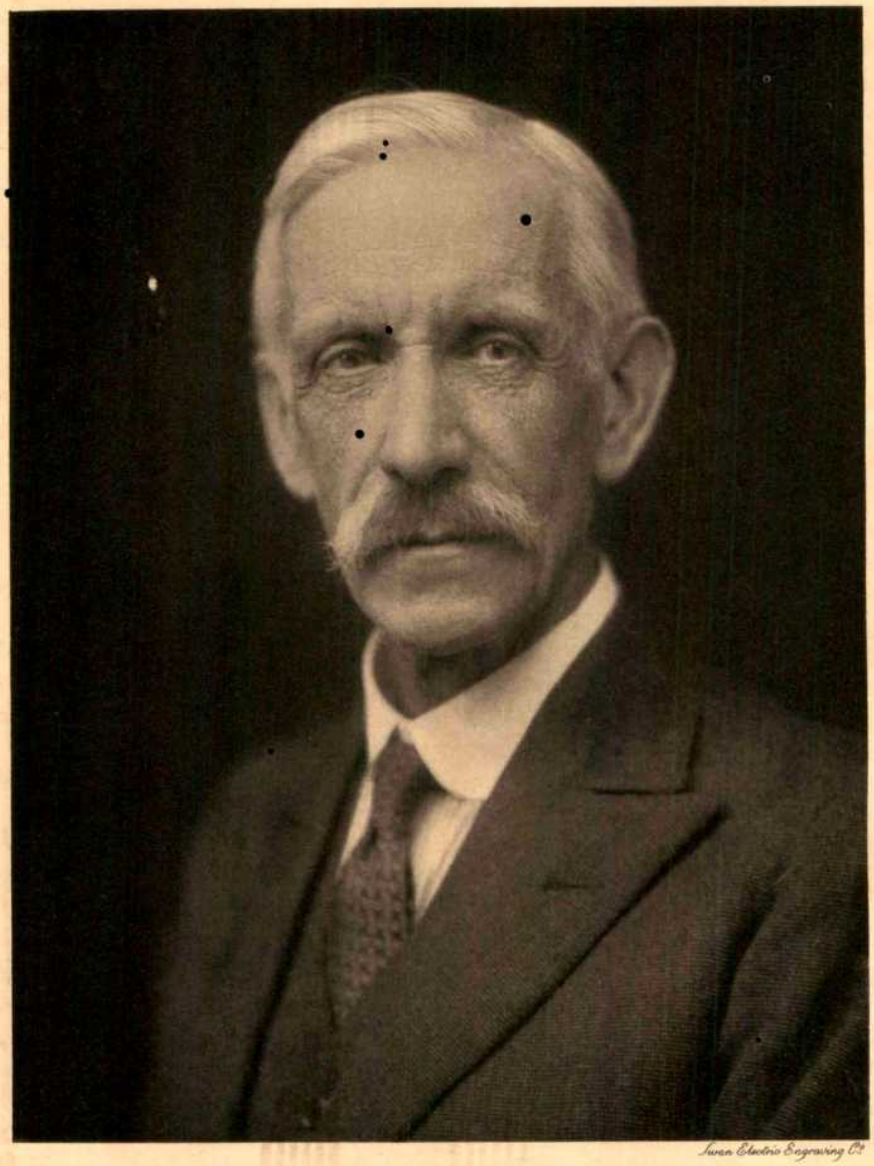

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Scientific Worthies

XLVIII. Sir Frederick Gowland Hopkins, O.M., F.R.S.

If we consider the development of organic chemistry from its early beginnings to the present day, we may come to the conclusion that progress has in some measure taken place in a circle. In the early days the substances offered by Nature and occurring in the metabolism of plants and animals were the objects of investigation, and the isolation, purification and analysis of such substances have added lustre to the names of many chemists. Interest in the chemical elucidation of 'natural products' did not indeed decline during the past century (we need only mention the investigations of Emil Fischer on the purines, carbohydrates and proteins), but relatively this work absorbed less energy and yielded fewer results in comparison with the great problems of structural chemistry and the classification of organic compounds based thereon.

The building of the edifice of organic chemistry in the second half of the nineteenth century was an experimental achievement almost unequalled. Although important theoretical and practical problems still remain to be solved by organic chemistry, we can, nevertheless, recognize that since the beginning of the present century many leading representatives of the discipline are desirous of applying the experience and systematic knowledge already gained to a still more important problem, the elucidation of vital processes.

The trickle which a hundred years ago supplied the stimulus for the chemical investigation of animals and plants, has swollen to a mighty stream, and in the same measure the methods and the experimental resources of the modern chemist have multiplied. Whilst round about the year 1820 only two or three dozen organic compounds were known (naturally those which are most abundant and most easily isolated), there is to-day an ordered system among the very diverse materials which build up the plant and the animal, and the individual substances composing them have been separated. The perfection of micro-methods, both preparative and analytical, has enabled the investigator to enter a field previously inaccessible, to tackle substances which previously eluded him on account of their minute concentration. At the same time, the application of the resources of classical organic chemistry has made possible the synthesis of highly complicated natural products ; the importance of this work is obvious when compared with the first 'bio-synthesis', of urea, more than a hundred years ago.

We should, however, clearly grasp that the development of organic chemistry during the present century, thus briefly indicated, is only preliminary to the investigation of the chemical reactions which take place in the living cell. Yet for the study of these reactions such a preliminary was quite indispensable. Without accurate chemical knowledge of all the substances taking part in metabolism, the greatest problem of biological research, the elucidation of vital processes, entirely lacks foundation. We have only to imagine how far the study of the biological degradation of polysaccharides would have proceeded without the most complete knowledge of the constitution and configuration of the substances formed in this process.

The analytical branch of biochemical research is itself only a subsidiary science, albeit very important and indeed indispensable, yet ancillary to that discipline which for purposes of classification should be separated off as physiological chemistry or dynamic biochemistry. The methods of the analytical branch are essentially the same as those of the pure organic chemistry, and hence it does not seem expedient, for example, to describe as a biochemist one who is engaged in the elucidation of the constitution of an alkaloid or of a vegetable colouring matter. His work differs neither in nature nor in purpose from that of a chemist who aims at explaining the constitution of a constituent of coal tar or of some condensation product produced *in vitro*.

The elementary chemical foundations of the physiology of nutrition were the first to be laid down. The three chief divisions of food materials—the carbohydrates, the fats and the proteins—were already fairly well known, when in the last quarter of the nineteenth century the processes of digestion were studied and when, especially with the aid of the heats of combustion, the energy balance of warm-blooded animals could be drawn up. The physiological problem of nutrition seemed to have been solved. The administration of the requisite number of calories, calculated from the total metabolism and supplied in the form of the three main groups, with due regard to the protein requirements indicated by the nitrogen metabolism, was thought to be the practical solution of the problem, verifiable by animal experiment. This was a time when restaurants in many countries listed on their bills of fare the calorie value of the dishes supplied to their patrons.

It was about this time that Frederick Gowland Hopkins entered the scientific arena. Born in 1861, he did not take up the study of medicine until rather late—at twenty-seven years of age. Chemistry he had taught himself, and it is indicative of his leaning towards this subject that one of his first scientific investigations was devoted to a quite difficult chemical problem, that of the white wing-pigments of butterflies (Pieridæ). Among other leading results of his purely chemical work the isolation of tryptophane and of glutathione deserve special mention. They show at the same time where the centre of Hopkins' biochemical interests lies, namely, in protein.

Hopkins' most important achievement, which led to the discovery of the vitamins, developed from that phase of nutritional physiology which was briefly indicated above. He was the first to show that carbohydrate, fat, protein and inorganic salts, even when supplied in adequate amounts, do not suffice to maintain metabolic equilibrium. His experiments, planned on an extensive scale, we the first to be carried out with rats as experimen animals, and showed that other substances besid the above categories must be present in the food these, the accessory food factors, were later name vitamins as the result of a less happy suggestio by C. Funk.

It may be worth while to consider more closel this second period of nutritional physiology. There is scarcely a great scientific discovery which has emerged suddenly, without portent, from the brain of the investigator, as did Athene from the head of Zeus. As a rule, we become aware of forebodings, felt here or there, indications and observations, which create the atmosphere for the great discovery. That man does not live by bread alone—we may slightly vary the Biblical phrase—was already indicated more than fifty years ago (1881) by work from the Basle Physiological Institute. Lundin, a pupil of Gustav Bunge, was the first to show that mice could not be kept alive on a diet which had been compounded from the previously isolated constituents of milk, that is, from its carbohydrates, fats, proteins and inorganic salts. This important observation, which was confirmed ten years later by Socin, also working in Bunge's institute, was not followed by further research in the same direction. Impressed by the nutritional importance of inorganic salts, investigators were inclined to attribute the observed deficiency phenomena to a disturbance of the combination between these salts and the organic material, as a result of working up the milk.

In his Nobel Lecture, Hopkins acknowledges the merit of the Dutch physiologist Pekelharing in having attributed the nutritional insufficiency of the milk, thus separated into its main constituents, to the absence of unknown substances present also in other food materials; thus the vitamin concept was first clearly expressed. Pekelharing's paper, published in a somewhat inaccessible journal, only became known after vitamin research had already become extensive. The most important foundation for the development of such research was laid by the well-known work of Christian Eijkman on the causation of beriberi disease (1903). It was somewhere about this time that Hopkins began his investigations of the vitamin problem, investigations planned on an ample scale and based on clear theoretical conceptions. The great advance which they brought consisted in an experimental proof of the main idea, that the deficient nutrition resulting from the administration of the necessary calories, proteins and salts in the form of a 'synthetic' diet, is caused by the absence of factors necessary for life. Thus the concept of accessory nutritional factors was formulated by Hopkins, and so the vitamins became recognized as a new and indispensable group of foodstuffs.

Although Hopkins did not himself isolate any of the vitamins, of which he studied the effects—chiefly A and B—we are yet fully justified in regarding him as the spiritual father of vitamin chemistry. It was only by his clear physiological characterization of this group of substances that the field was prepared for the intervention of the analytical biochemist, to whom we now owe so extensive a knowledge of the vitamins hitherto isolated, knowledge gained in a remarkably short time. Closely connected with the study of the deficiency diseases due to the lack of vitamins, there are a number of similar investigations on the need for individual amino-acids formed in the hydrolysis of proteins. These researches Hopkins carried out by means of the same experimental methods; it might be said that they were ushered in by that chemical showpiece, the isolation and purification of tryptophane by means of its mercury compound. How important it is to have absolutely pure substances for physiological experiments is shown by the history of the discovery of vitamin D, which for a long time was identified as irradiated cholesterol, until Windaus and Rosenheim recognized that ergosterol was also present in apparently pure cholesterol preparations.

The work of P. Löwi and E. Abderhalden had shown that the mixture of amino-acids represented by artificially digested protein is just as suitable for nutrition as protein itself. By chemical methods it is possible to remove from the mixture one or other amino-acid, and Hopkins utilized this possibility to test the nutritional importance of individual constituents, by administering to animals the residue (together with non-nitrogenous foodstuffs) remaining in each case after removal of the amino-acid to be tested. The absence of the aliphatic amino-acids such as alanine, leucine and glutamic acid, does not adversely affect growth. If, however, tryptophane, or cystine, or histidine, or arginine has been removed from the mixture, a sharp decline in the weight of the animal is observed. These experiments give some idea of the synthetic powers of the mammalian organism, which is evidently able to build up the simple amino-acids, but fails in respect of the heterocylic. It has been suggested that histidine and arginine can replace one another mutually, and in that case the cell would be able to change arginine into histidine, a process which is not yet susceptible of chemical explanation. Likewise we have no understanding of the mechanism of the conversion of these amino-acids into nucleo-purines, which Hopkins' experiments rendered extremely probable.

Notwithstanding his preference for the biochemistry of protein and of other nitrogenous metabolites of the cell, Hopkins some thirty years ago made a singularly successful excursion into the field of carbohydrates. In conjunction with Walter Fletcher, he carried out a careful quantitative study of the formation of lactic acid in muscle. Conditions were discovered under which lactic acid is formed and again disappears; thus a solid foundation was laid for later and very successful work by others in this important field.

A few years after the end of the Great War, a generous benefaction enabled Hopkins to build a modern research institute at Cambridge, where he had occupied a chair of biochemistry since 1914. The group of workers who were collected here under his leadership developed in the course of a few years into a most successful centre of biochemical research, into a *universitas* of the discipline. A large number of young investigators—some with medical, some with chemical training, foreigners as well as natives—are at work there, almost exclusively in the field which we have described above as dynamic biochemistry. Many striving young biochemists, from all over the world, have sought instruction and stimulus in this important centre of research.

The close connexion between the investigation of vital processes and the analytical branch of biochemistry may be illustrated by reference to two natural products, both discovered at Cambridge, namely *glutathione* and *cytochrome*. The isolation of glutathione by Hopkins, a brilliant chemical achievement, brought in its train a very full programme of work in physiological chemistry, which occupied the Institute for several years. The history of the discovery of this tripeptide, composed of cysteine, glutamic acid and glycine, is characteristic. At first it was regarded as the dipeptide glutaminyl cysteine, until after a few years it was recognized that, by the original method of isolation, the glycine component was lost. A more delicate method of isolation then furnished the native product, which is actually present in most cells. Glutathione combines in its mode of reaction the role of hydrogen acceptor with that of hydrogen donator according to the scheme

$$2\ \mathrm{Gl{-}SH} \underset{+2H}{\overset{-2H}{\rightleftarrows}} \mathrm{Gl{-}S.S{-}Gl},$$

and is probably able, in consequence of this reversible function, to act as an intermediary in the chain of biochemical dehydrogenation processes. It is certain that it functions as an activator of animal proteases and of the enzyme methyl glyoxalase. Here there is doubtless a catalytic transference of hydrogen, in which process glutathione is probably concerned according to the equation:

$$\mathrm{CH_3.CO.CH(OH)_2 + Gl.S.S.Gl \rightarrow CH_3.CO.CO_2H + 2Gl\ SH}$$

$$\text{hydrate form of methyl glyoxal} \rightarrow \mathrm{CH_3\ CHOH.COOH + GlS.SGl}$$

Cytochrome is even much more closely concerned with the transference of hydrogen in intracellular oxidative processes.

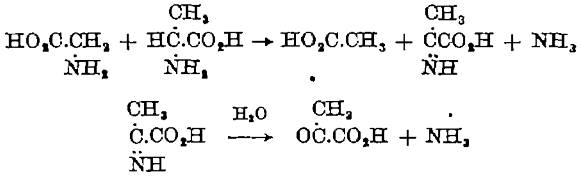
During the last fifteen years or thereabouts, research in the Institute under Hopkins' direction has been centred on vital oxidation processes. The purification of the dehydrogenating enzyme of milk (Schardinger's enzyme) and a study of its mode of action have occupied much attention. An important result has been the demonstration (by Dixon) that in the aerobic degradation of hypoxanthine and xanthine to uric acid by this enzyme, hydrogen peroxide is formed. Whilst on one hand the intermediate occurrence of hydrogen peroxide in cellular metabolism was thereby rendered probable, it was shown on the other (by Elliott) that peroxidative ferments also occur in the cell.

The principle of the hydrogen shift (dismutation), which governs the mechanism of alcoholic fermentation, has been carefully studied, especially in the metabolism of bacteria and other micro-organisms (by Quastel). The significance of intermolecular hydrogen transport in relation to the oxidative degradation of food material has already been mentioned in connexion with glutathione. The Institute at Cambridge has taken a prominent part in the modern development of the theory of vital oxidation, according to which hydrogen, the principal fuel of the cell, becomes combined with oxygen *via* several intermediate stages, not unlike a mountain torrent which finds its level over several waterfalls. The importance of this regulatory mechanism had already been pointed out by Hopkins in 1926 in his lecture to the International Physiological Congress at Stockholm.

The most important experimental result in this field was furnished by the work on cytochrome, which shows that this colouring matter, related to hæmin, possesses in its C-component the capacity to combine with the hydrogen of succinic and lactic acids when this hydrogen is activated by a specific dehydrogenase; then, again under the influence of an enzyme, the hydrogen is given up to molecular oxygen (Keilin, Green).

Succinic acid is dehydrogenated in this way to fumaric acid. With fumaric acid as hydrogen acceptor, *Bacterium coli* is liable to 'burn' *d*-glucose anærobically, as rapidly as in the presence of molecular oxygen (Krebs). Since the great power of fumarates (and, according to Krebs, also of pyruvates) to transfer hydrogen has also been demonstrated in animal tissues (Szent-Györgyi), we have already some insight into the chemical possibilities and the devious ways open to hydrogen when activated by enzymes either ærobically or anærobically.

Further light has been thrown on the biochemistry of hydrogen by the careful study of micro-organisms capable of using the element itself for purposes of hydrogenation or for the formation of water. These organisms may be contrasted with those which eliminate molecular hydrogen (Stephenson, Stickland). A particularly interesting example of this elimination, caused by the hitherto unknown enzyme hydrogenlyase, results in a novel transformation of amino-acids. Thus, for example, the hydrogen activated in the dehydrogenation of alanine is capable of splitting glycine into acetic acid and ammonia, according to the equation:



$$\underset{\dot{\mathrm{N}}\mathrm{H_2}}{\mathrm{HO_2C.CH_2}} + \overset{\mathrm{CH_3}}{\underset{\dot{\mathrm{N}}\mathrm{H_2}}{\mathrm{H\dot{C}.CO_2H}}} \rightarrow \mathrm{HO_2C.CH_3} + \overset{\mathrm{CH_3}}{\underset{\ddot{\mathrm{N}}\mathrm{H}}{\mathrm{\dot{C}CO_2H}}} + \mathrm{NH_3}$$

$$\overset{\mathrm{CH_3}}{\underset{\ddot{\mathrm{N}}\mathrm{H}}{\mathrm{\dot{C}.CO_2H}}} \xrightarrow{\mathrm{H_2O}} \overset{\mathrm{CH_3}}{\mathrm{O\dot{C}.CO_2H}} + \mathrm{NH_3}$$

There is scarcely a section of physiological chemistry which during the last fifteen years has not engaged the attention of the Cambridge Institute under Hopkins' direction. The output of papers, revealing the influence of the master in all directions, amounts to more than six hundred. In them we find vitamin studies continued in the direction of nutritional physiology, fundamental work on general, and especially on embryonic metabolism (Needham), and also papers on the virus problem (Pirie), to mention but a few of the principal topics.

This exemplary organization of research, which has brought the Cambridge School into the van of biochemical progress, has had a powerful influence on the development of the subject in all countries in which it is studied. In addition, the personal efforts of the leader, who on many occasions has insisted on the claims of biochemical studies and has pleaded for their intensive prosecution, have had an enduring effect on the status of the discipline.

H. WIELAND.

The Naming of Plants

The "Critica Botanica" of Linnæus

Translated by the late Sir Arthur Hort. Revised by Miss M. L. Green. (Ray Society Series, No. 124.) Pp. xxvii+239. (London: Bernard Quaritch, Ltd., 1938.) 12*s.* 6*d.*

THE publication of Sir Arthur Hort's scholarly translation of Linnæus's "Critica Botanica" is not only a very useful contribution to botanical science but also its appearance at the present time is singularly appropriate, since two hundred years have just elapsed since the Latin original was published in Leyden in 1737.

The late Sir Arthur Hort's manuscript was handed by Lady Hort to Sir Arthur Hill, who warmly recommended it to the Ray Society for publication, after it had been carefully checked and collated with the Latin text by Miss M. L. Green. She also translated the dedication to Dillenius, Sherardian professor of botany in the University of Oxford, for whom Linnæus entertained the highest esteem. Indeed he attributes to Dillenius some of the stimulus which encouraged him to undertake the task. "It was you", he says, "who, accustomed to weighing everything in the scales of sane reason and principle, opened to me the path, which albeit with hesitant steps I now seek to tread." Needless to say, there is no hesitancy to be found in the vigorous language in which Linnæus deals with the difficulties, which botanists were encountering at the time, owing to the absence of any rules governing the naming of plants.

In the "Critica Botanica", as the title-page indicates, the author examines the names of plants, generic, specific and varietal, retaining the better ones and rejecting the unworthy. This book forms part 4 of the "Fundamenta Botanica", which was published in the preceding year and constitutes the principles of botanical nomenclature. It is indeed the precursor of our modern international rules, which are discussed and amended at the successive International Congresses of Botany. That may suggest that the "Critica Botanica" will be dull reading. But this is far from being the case. Those interested in the history of botany will be delighted to find that it contains Linnæus's personal estimate of his botanical contemporaries and predecessors. The "Critica" may be usefully recommended to all students of botany and more particularly to those interested in systematic botany, as it will impress upon them the need there was in Linnæus's time for the adoption of the binomial nomenclature of plants, which he introduced and here defends. He also lays down the rules which should govern the choice of generic and specific names. But he is by no means dogmatic. "I submit the rules", he says, "which I have laid down for myself and in accordance with which I intend to walk. If they seem to you worthy, let them be used by you also; if not please propound something better."

In the first part of the volume, Linnæus deals with generic names, indicating those which he considers suitable for retention and those which should be rejected. Among these he includes particularly the hybrid words compounded from Greek and Latin roots, and he expresses his strong dislike of those formed by adding the suffix -oides to an existing generic name. He prefers those which have a Greek root and is antipathetic to compound words, though he is prepared to retain some like *Sempervivum* and *Saxifraga*. He rejects as generic names those of saints and miscellaneous public characters but retains those taken from mythology and the consecrated names of kings. He has a particularly soft spot for the names given to preserve the memory of botanists who have deserved well of science. After describing how kings and emperors and many brave and gallant men have wished their names to be handed down to posterity, he adds:

> "Why should it not be the same with botanists, whose venture has been quite as daring? What toils, what science would be more wearisome and painful than botany, did not some singular spell of desire, which I myself cannot define, often hurry us into this pursuit. Good God! When I observe the fate of botanists, upon my word, I doubt whether to call them sane or mad in their devotion to plants. I will adduce some instances."

Then he gives particulars of his own journeys and privations and those of other well-known botanists.

In this way, the lists of generic names and his critical remarks on the same are interspersed with entertaining passages and good-humoured remarks about botanists and would-be botanists. Thus our perusal of the "Critica" reveals Linnæus not only as the constructive systematist but we also get a glimpse of the man himself, with that twinkle in his eye which his portraits reproduce.

The second part of the volume dealing with the specific names of plants is equally interesting. The specific name, according to Linnæus, should sum up in one word the chief diagnostic character of the species and should not be descriptive of the locality in which the plant is found nor embody the name of the discoverer. Still less should it consist of a trope or metaphor such as melancholy or humble. But it is essential to read through this part of the book to realize how many specific names are really inappropriate. We also gain an insight into the methodical simplification introduced by Linnæus in comparison with the string of adjectives used by many of his predecessors in naming plants.

We close the book with feelings of respect and gratitude touched with affection for the author, with profound thanks to the translator and with due appreciation of the labours of all those who have lent their assistance to the production of this volume.

From Science to Fantasy

Horizons of Immortality:
a Quest for Reality. By Erik Palmstierna. Pp. viii+366. (London: Constable and Co., Ltd., 1937.) 10*s*. net.

TO those who view with some disquietude the changing attitude of the modern temper with regard to science, this book will come with no surprise. It would seem that there is an increasing tendency among the public to demand of science what it never sets out to give, and then to blame it for giving stones where bread is craved. The aim of the scientific worker is not to provide consolation and spiritual certainty for distressed souls: it is to try to enlarge the extent of human experience and to bring it into some kind of orderly sequence.

The general drift of human thought to-day cannot be said to be wholly or even partially satisfying to many people whose type of mental activity leads rather to artistic or mystical expression than to scientific effort. For in these days much of science itself seems unintelligible; and the paradoxes of physics and the principle of indeterminism are not helpful to those who desire absolute certainty both here and hereafter. Hence the retreat into fantasy is to be understood even if it is to be deplored.

The substance of the volume under notice consists of 'messages' spelt out by the familiar method of the glass and letters. The greater part of the material has been obtained through the instrumentality of the violinist Adila Fachiri, but the earliest messages were received by her sister, Miss Jelly d'Arànyi, and a friend.

The general purport of the messages, which claim to proceed from spirits, and as such are accepted by the author of the book, is of a kind familiar to students of automatisms, and consists of spiritual advice, information and religious teaching. What is, however, of considerable interest, showing the tendency of the flight from science, is the insistence throughout the messages on the necessity for faith, and contempt for anything savouring of curiosity and intellectual criticism. "What we object to and definitely repulse," one message reads, "is curiosity and the wish to explain everything through and with your perishable brain. It is in every case a drifting again from the Great One, ergo renewed sinnings and why, because you do not want to admit nor allow that only God knows everything", etc.

Although Baron Palmstierna and the automatists apparently accept these very unevidential messages at their face value, it would seem that they suspect that the public would like something better, and thus at the end of the book occur a few cases inserted to suggest that some form of supernormal activity is clearly to be seen. Were it not for one of these cases, that of the Schumann Concerto, popularized by the British Broadcasting Corporation, it is possible that the book would have received no more attention than any other collection of automatic scripts.

It appears that in March or April 1933 Miss Jelly d'Arànyi was receiving messages by the glass and letters when Robert Schumann professed to communicate. A posthumous work of his for the violin was mentioned and some hope was expressed that Miss d'Arànyi would find and play it. At the time, Miss d'Arànyi did not remember any such work and inquiries failed to locate it. Finally, after a number of messages insisting on the search had been received, but without revealing the location, the manuscripts were found to have been deposited in the Prussian State Library, where they were duly preserved. The facts were quite simple and there was no mystery about them, but they were treated as spiritualistic propaganda and it was asserted that a long-lost manuscript had been located by psychic means, whereas the truth was that it had been acquired by the Prussian State

Library and was preserved there along with hundreds of other manuscripts. It is true that the place of preservation may not have been generally known, but this place was never revealed by the messages, excuses always being offered when the question was asked. Now, assuming the non-psychic nature of the material, how was it that Miss Jelly d'Arànyi's mind was directed in March or April 1933 to Schumann and his unpublished manuscripts ?

In assessing the value of automatic productions, one of the main difficulties is to discover the sources of the information given. How can we trace the association of ideas when the life of the automatists is so complicated and open to so many influences ? Very often it is clearly impossible, but in the present instance two factors may be thought to have been relevant. In February 1933 the popular cheap edition of Bedford's "Robert Schumann" was published, which was originally issued in 1925 in the "Masters of Music" series. In this work the unpublished concerto was mentioned. Now in March of the same year it was announced in Great Britain that six new Schumann polonaises had been discovered in the archives of the Vienna Gesellschaft der Musikfreunde. Further, in Moser's "Joseph Joachim", where the concerto is also mentioned, we are told that the last movement "is written as a polonaise in three-quarter time". Since Miss Jelly d'Arànyi is related to Joachim, we may presume that at one time she may have looked at Moser's book, and the news of the discovery of the six unpublished polonaises in Vienna may have been the trigger which set the automatism in motion, or at least it may be regarded as the kind of mechanism which we should expect when searching for the origin of such subliminal activity.

Baron Palmstierna attempts to discredit the evidence for the theory of subconscious mental processes in *Bulletin* 4 of the International Institute for Psychical Research Ltd. (London, 1937), although his arguments can scarcely be called convincing. Space is lacking to discuss these, but it may be said that the author is of such transparent honesty and sincerity that efforts to shake his conviction are not likely to succeed. It is clear that a critical analysis of the messages is not desired, for in them he thinks that many would say that "we are near the State which Saints and Mystics call the Communion of Saints". Whatever we may think of the flight from science into fantasy, it is clearly satisfying to those who have undertaken it.

The Soviet Polar Station

On the Top of the World:
The Soviet Expedition to the North Pole, 1937. By L. Brontman. Edited by Academician O. J. Schmidt. Pp. 287 + 25 plates. (London: Victor Gollancz, Ltd., 1938.) 16*s*. net.

THE acclaim which greets a polar expedition is too often measured by the accidents with which it has been beset, and nothing gives greater popularity than disaster. But the Soviet expedition to the North Pole gained no fame on these grounds. It was the sheer audacity of the venture that brought it to notice. The use of aeroplanes in polar exploration was not new ; many daring and successful flights had already been made in both arctic and antarctic regions. But so far no party of explorers had voluntarily submitted to living on the floating pack-ice with no obvious line of retreat. Here was no hurried journey across the sea-ice, but a stay of uncertain duration on a floe of uncertain stability and unknown destination. It was not, however, a reckless project, for certain movements of the arctic pack were known and could be anticipated, and aeroplanes and ice-breakers were all the time held in readiness for the rescue.

The book under notice gives an account of the preparations and equipment of the expedition by one of the Moscow newspaper correspondents who was present at its start in the vicinity of the Pole. The scheme was part of the widely planned exploration and development of Soviet Arctic territory, although by a touch of irony the entire course of the floe was outside the Soviet sphere. An advanced flying base was chosen on Rudolf Island, one of the Franz Josef Islands in lat. 81° 50′ N. Thither an icebreaker and another steamer carried supplies and material for a station, and when all was ready, five aeroplanes set out from Moscow and, after a relatively uneventful journey via Novaya Zemlya, reached the base on April 19. There the aeroplanes were refuelled and overhauled and after a reconnaissance flight and a wait on account of bad weather, the Pole was reached on May 26 and the work of the observatory began.

There was abundant food, carefully chosen. Clothing and tents were well designed and scientific equipment was admirable. In a few days the aeroplanes returned to Europe and left the four men to their own resources.

The book is full of detail up to this time and recounts also the return flight. Then follow some of the wireless messages sent out for two months and there the book ends, for it was compiled too early to record the last months of precarious drift, the prospective dangers off the Greenland coast and the rescue in the depths of the Arctic winter. No striking discoveries were made or indeed expected: the Arctic has yielded its chief secrets. The thrills of flying abound in every chapter, but the speed of air transport has robbed the polar narrative of its sustained interest and tended to make it solely a record of mechanical triumph.

Beyond this, two aspects of the expedition are notable. One is the extraordinary efficiency of the organization and equipment: everything worked to plan; nothing went amiss; no life nor aeroplane was lost. The other feature is the boundless enthusiasm of all who participated in the venture. One expects polar explorers to have enthusiasm for their work, but few have so persistently recorded their feelings of enthusiasm and devotion to their national ideals. There is no criticism of plan, equipment or accomplishment: an endless song of praise and congratulation permeates the book, but there is little laughter or high spirits. The valuable scientific results receive little attention, as might be expected in a book written before the expedition had ended.

However, the new methods of polar technique which flying has introduced are well expounded, and there are useful lists of equipment, stores and instruments. Not the least interesting chapter gives the biographies of the four men. All had considerable previous polar experience and all had that longing for polar regions that once acquired is so hard to overcome. There are many excellent illustrations and two adequate maps.

R. N. RUDMOSE BROWN.

Economists Arraigned

Lament for Economics

By Barbara Wootton. Pp. 322. (London: George Allen and Unwin, Ltd., 1938.) 6*s*. net.

THE indictment is that "the economic theory of to-day is useless because it is unintelligible; because, after all their arduous studies, the economists cannot be relied upon not to give diametrically opposite diagnoses and prognoses of the same situation . . . ; because the economists feed on their own tails by busying themselves with the analysis of imaginary worlds which they themselves have invented; and because they are passing off as the result of purely scientific inquiry what is in reality no more than a partisan advocacy of particular social policies".

The charge of unintelligibility having been dismissed, in Chapter ii the author examines "the relation of economic theory to the actual world", and the question why economic theory has not contributed more than it has to the solution of practical economic problems. The next two chapters discuss the claim of economics to be a science, and the accusation that economics is mere apologetics for contemporary institutions. Chapter v considers how far market equilibrium correctly interprets the optimum distribution of resources, and finally, in the light of all these discussions, the author puts forward her views as to the lines along which economics should be developed in the future.

It must now be stated that the writer of this review is one of "the economists" as defined by Mrs. Wootton. Having made every effort to overcome the resulting bias, I cannot persuade myself that this is a very useful book or one worthy of its author. The trouble is that it attempts to combine (1) an apologia to the man in the street on behalf of economics and "the economists", (2) an attack on "the economists" and on one economist in particular, who incidentally will probably be astounded to find himself deemed so representative of the general thought of economists to-day, and (3) proposals which, however admirable in themselves, are not exactly novel and do not seem to have much logical connexion with the preceding chapters. The result is that this book is neither a deadly attack on "the economists" nor a serious contribution to the future development of economics. Most, if not all, economists will find many pages and some conclusions with which they can heartily agree and much with which they will disagree, but they will find little of which they are not perfectly well aware. The general reader may gain a better knowledge of much of which he is imperfectly aware, but at the end his ideas as to "the economists", their aims and the sort of work they do will probably be even more curious and less exact than they are at present. Even the general lines of the proposals in the concluding chapter can be and have been argued more forcibly on very different premises.

As Mrs. Wootton knows, and in part admits, self-satisfaction is not a besetting sin of "the economists", and many fully share her troubles and sorrows. But this book seems to have been written in something very like mere exasperation, and, however pardonable, exasperation is not conducive to well-balanced and constructive thought or to enlightened vision.

J. W. F. ROWE.

Tables Annuelles Internationales de Constantes et Données numériques:

International Annual Tables of Constants and Numerical Data. Vol. 11 (Years 1931–1934.) Part 1 (Sections 1–25). Pp. xvi+492+xv–xxv. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1937.)

These sections contain very complete numerical data on molecular spectra of diatomic and of polyatomic molecules. In addition, the derived quantities—electronic levels, fundamental vibration frequencies, anharmonic coefficients, moments of inertia, atomic distances, linkage force constants, and dissociation energies—are presented in an accessible and systematic way, and many of the relationships explained by potential energy curves. The tables will prove invaluable to both physicists and chemists interested in the problems of molecular structure, and the simplicity of the arrangement will give confidence to those who may hesitate before attempting to seek the solution to a query in the complexities of the original literature. To the critical survey of molecular spectra is appended a bibliography and element-index of the numerous papers on atomic spectra which have appeared in the period 1931–34.

Peter Kürten:

a Study in Sadism. By George Godwin. Pp. 60. (London: The Acorn Press, 1938.) 5s. net.

In "Peter Kürten", George Godwin has given us an account of one of the most horrible series of crimes in history. Peter Kürten, who was a sadist of the worst type, kept Düsseldorf in a state of terror. His record of crime went back to his childhood, when he pushed two boy friends off a raft on the river and drowned them. When tried, he was charged with ten murders and convicted of nine of them. The medico-legal experts came to the conclusion that the Dusseldorf 'monster' was suffering from no organic mental disease or from any functional mental disease, and was therefore responsible in law for his crimes.

Reading, Writing and Speech Problems in Children:

a Presentation of Certain Types of Disorders in the Development of the Language Faculty. By Prof. Samuel Torrey Orton. (Thomas W. Salmon Memorial Lectures.) Pp. 215. (London: Chapman and Hall, Ltd., 1937.) 10s. 6d. net.

This book contains the third of the Thomas W. Salmon Memorial Lectures. The writer gives an account of his well-known work on disorders of the language faculty in children. He discusses the various disorders of language found in the adult as a basis for considering the language disorders of children. The work is based on his very wide clinical experience of ten years, combined with pathological material. He also gives the results of therapeutic efforts based on this work, and shows that many children with speech defects have derived benefit. The work is a most valuable addition to our knowledge of speech defects not only in children but also in adults.

An Elementary Treatise on Statically Indeterminate Stresses

By Prof. J. I. Parcel and Prof. G. A. Maney. Second edition. Pp. xvi+432. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25s. net.

The continuous attack made during recent years on the problems of indeterminate structures and the heavy labours involved in all rational computations of such types necessitate the careful study of the scope and function of different methods, with a view to effective selection. The first edition of this book was finely characterized by a well-balanced consideration of the various methods of attack, and this second edition incorporates extensions that include the new and useful Cross method, and special adaptations of the slope deflection method. The re-written chapter on rigid frames includes a good treatment of the multi-storied building, but does not refer to the work of the British Steel Structures Research Committee. All illustrative examples are worked with great clearness, and in its scope and arrangement the book is excellently designed for the student who intends to use structural theory.

Plato's Conception of Philosophy

By Dr. H. Gauss. Pp. xxii+272. (London: Macmillan and Co., Ltd., 1937.) 6s. net.

The author of this ably written book is right in considering philosophy less as a body of results than as a mode of life. Owing probably to his wish to defend this conception, he restricts his inquiry into Plato's doctrines to his attitude towards epistomology, ethics and life in general. On these points Dr. Gauss has many useful suggestions to make which may serve to complete the traditional interpretation of Plato that has become part of British philosophy. Besides the scholarly interest of this work, to which Prof. Taylor contributes a striking preface, there is an attempt to show that philosophy is not a purely academic pursuit. The success of this plea will depend in large measure on the use of the author's method for the interpretation of other aspects of philosophy and of its history.

T. G.

The Definition of Psychology:

an Introduction to Psychological Systems. By Dr. Fred S. Keller. (Century Psychology Series.) Pp. viii+111. (New York and London: D. Appleton-Century Co., Inc., 1937.) 4s. 6d. net.

This volume gives a very good account of the growth of the conception of psychology through the years, from the early days through the work of Titchener and up to the most recent work of the behaviourists and finally the *Gestalt* school. Psychology is becoming more objective and standing more on its own feet with less dependence on physiology. It is more genetic and comparative, and occupies itself more with individual differences, and with abnormal psychology. There is a strong flavour of behaviourism about the author's views, tinged with a respect for the *Gestalt* school.

The Concept of Species in Biology

THE one hundredth and fiftieth anniversary meeting of the Linnean Society of London took place on May 24, when the presidential address was delivered by Dr. John Ramsbottom, and on the two following days symposia were held in which a number of distinguished British and foreign zoologists and botanists took part. The meetings, which were attended by a large concourse of fellows and foreign members of the Society and by delegates from many cognate societies and institutions in Great Britain and overseas, were held in the lecture theatre of the Royal Institution and were planned to provide for a discussion of the various aspects of the 'species problem' in biology. The address of the president dealt with "Linnæus and the Species Concept" and the subjects of the two symposia were, respectively, "The Concept of Species from Linnæus to the Present Day" and "Geographical Isolation as a Factor in Species Formation".

LINNÆUS'S CONCEPT OF SPECIES

In his address, Dr. Ramsbottom pointed out that, in studying the works of Linnæus, it must not be assumed that his opinions remained unchanged throughout the whole of his career, from his first book in 1737 to his last in 1767; incidental observations must be interpreted in their relation to the particular subject under discussion; and we must guard against reading into some isolated sentence the germ of a theory formulated at a later date. The doctrine of the fixity of species, so far as it was accepted by the predecessors and contemporaries of Linnæus, was a deduction from the Mosaic account of the Creation, an account which some at least of the early Fathers of the Church did not accept as conveying scientific as distinguished from moral and spiritual truth. The doctrine was enunciated by Linnæus in an often-quoted passage in his "Philosophia Botanica" in 1751: "Of species of plants we reckon so many as there were different forms created in the beginning by the Infinite Being; and these forms, according to the appointed laws of generation, have always produced offspring like themselves."

It is clear, however, that even when this categorical statement was printed, Linnæus had some mental reservations and qualifications. He was already engaged upon his "Species Plantarum", published two years later. Scattered through this work are passages difficult to reconcile with the dogmatism of the "Philosophia". For example, under *Rosa indica* he writes: "The species of *Rosa* are difficult to distinguish and more difficult to determine; it seems to me that Nature has intermingled several or in sport formed several from one". After describing four species of *Scorpiurus* he adds, "It is beyond doubt that all these formerly arose from a single species", and of certain species of *Geranium* he says, "The flower and habit of the last three species show that at the beginning they were one". In this respect, evidently, his didactic aphorisms lagged behind his practice.

So early as 1744 Linnæus had discussed the possibility that new species of plants might arise by hybridization, and in the later years of his life he gave much attention to this subject. Dr. Ramsbottom quoted many passages on this subject. Perhaps the most striking was from a work published in 1761 where, after discussing such possibilities as that "a genus is nothing else than a number of plants sprung from the same mother by different fathers", Linnæus concludes, "But whether all these species be the offspring of time, whether in the beginning of all things the Creator limited the number of future species, I dare not presume to determine".

In the light of these and many other passages, Sachs's assertion that Linnæus "held fast to the end of his life" to the dogma of the fixity of species is simply untrue.

For a century after Linnæus, botanists and zoologists were hard at work accumulating and naming collections. The Linnæan systems of classification and nomenclature afforded, to the botanists at least, the only hope of grappling effectively with the rapidly growing masses of material. They dreaded the confusion that would result if these were interfered with. Hence the vehement opposition that was at first offered to attempts to introduce a natural system of classification; hence, also, the tradition that Linnæus was an inflexible upholder of the permanence of species.

DEVELOPMENT OF SPECIES CONCEPT

In the two symposia on May 25 and 26 a large number of speakers took part either by reading papers or in the course of the subsequent discussion.

Space does not permit of our giving more than brief summaries of a few of the papers, and the following must not be taken to represent more than the impressions of one member of the audience. A full report will appear in due course in the *Proceedings* of the Society.

The first symposium was opened by Sir Edward Poulton, who said that, in his opinion, a species must be regarded primarily as an interbreeding or syngamic community. Proof of this syngamy is often difficult to obtain and long delayed, but it is conclusive and brings release from the need for regarding the species as merely an artificial grouping for purposes of convenience. Continuity or transition of characters between two groups is held to prove that one is a variety of the other, discontinuity that they are distinct species. Discontinuity, however, is not enough, as is shown in the case of polymorphic species. The splendid collections bequeathed to the nation by the late Lord Rothschild bring into prominence the conception of sub-specific groups fused by syngamy into single species but ever ready, by preferential mating or the effects of isolation, to break up into separate species.

Prof. E. W. MacBride said that since Darwin's time it has been shown that the minute variations on which he rested his case were not inherited. Mutations, on which the whole of modern genetics depends, are characterized by a loss of viability as compared with the type, and can never have survived in the wild state. The cytological basis of genetics is unstable and some of its assumptions are demonstrably false. There remain only acquired habits, asserted by Lamarck in 1809 to be the cause of the differentiation of species, and this has now been experimentally proved.

Prof. Ö. Winge (Copenhagen) while regarding the genetic nature of specific differences as beyond discussion, said that it is often difficult to decide in any given case how many genes are involved and whether the cytoplasm, as well as the nucleus, plays a part in the inheritance of such differences. It was discussed whether the differences between species, genera, families, etc., are of a special nature, and three possibilities were considered; (1) that the taxonomically important genes are polymerically present in several or all of the chromosomes; (2) that "vital genes" (the alleles to "lethal genes") are of particular taxonomic significance; and (3) that the genes in question are stable, non-mutable, and hence escape our analysis.

Sir Arthur Smith Woodward said that our increasing knowledge of extinct animals is making the use of the Linnæan method of classification very difficult. Instead of classes, orders, families and genera, the palæontologist is concerned with phyla, lineages, branches and grades. Related lineages pass through the same orderly succession of changes, by which the same—or nearly the same—result is eventually obtained. Examples of parallel evolution and polyphyly were described in Graptolites, Elasmobranchs and Holostean fishes, and others were mentioned in reptiles, birds and mammals. Sir Arthur considers, however, that it is premature to attempt to introduce new principles for naming species, genera and families, and that it is convenient to retain the old system as a provisional expedient until we are more sure of our facts.

Dr. Karl Jordan (Tring Museum) pointed out that, although geographical variations were known at the time when the Linnean Society was founded, the fact that the area of most species is subdivided into smaller areas each populated by a subspecies is a comparatively modern discovery the significance of which is not generally grasped by biologists. The subspecies are the real units on which research in systematics is based, and he emphasized the importance for research of large collections like those in the Tring Museum brought together with this end in view.

Other speakers who took part in this symposium were Dr. E. Stensiö (Stockholm), Prof. H. J. Lam (Leyden), Prof. M. J. Sirks (Groningen), Prof. H. Boschma (Leyden), Prof. B. Němec (Prague) and Prof. W. Robyns (Brussels).

GEOGRAPHICAL ISOLATION AND SPECIES FORMATION

The subject of the second symposium was introduced by an address by Dr. Julian Huxley, summarizing the present state of knowledge on geographical differentiation. He said that species inhabiting large but continuous areas tend to show gradations of character from one part of their range to another. For these continuous graded changes he has introduced the term "phenocline". Gaps may be produced in this continuity by obstacles to interbreeding, spatial (topographical), ecological, genetical, physiological, or psychological. Subspecies might thus be produced by segregation of non-adaptive mutations or by the beginnings of adaptive radiation.

Prof. P. A. Buxton spoke on the insect fauna of oceanic islands. He said that although the fauna and flora of such islands are impoverished it must not be assumed that competition is therefore less severe. In the absence of many predatory groups of animals the struggle for existence may be less hard and there may be more freedom of evolution. This would explain the extreme variability of some species of insects (of which examples were described) and the formation of "endemic complexes" of closely related species.

It is less easy to account for the appearance of many monotypic endemic genera.

Dr. E. Fischer-Piette (Paris) gave an account of his work on the limpets of the North Atlantic. These form a complex capable of splitting into several species. This splitting is realized, morphologically and ecologically, in certain districts of the coastline, but not in others. In these last districts there is much variation, leading to unaccustomed types each special to a locality. Geographical isolation is not necessary for the formation of new species of limpets, although their formation is greatly favoured by it.

Dr. Bernard Rensch (Münster) opposed the view put forward by Goldschmidt, among others, that the transformation of species is governed by special laws, whereas geographical races only result from a secondary splitting up of species. He considers that geographical isolation of large populations is the first step not only towards new races but also towards new species, and that such a differentiation gives rise also to the higher systematic categories The separation of new species by isolation from race-complexes (*Rassenkreise*) is the chief method of evolution. Examples of other methods are not numerous. Sometimes ecological isolation has been at work and, more rarely, a dominant mutation arises and spreads until it replaces the original form. In other cases, selection by external factors, especially climatic ones, is evident, leading to parallelism among geographical races. Prof. Karl Skottsberg discussed the flora of the Juan Fernandez group of islands and of the Hawaiian group.

In both symposia, more especially the first, the various speakers approached the problem of the nature and origin of species from very diverse points of view—systematic, palæontological, ecological, genetic, cytological. There resulted a certain appearance of discontinuity in the discussion, which, as one of the speakers remarked, emphasized the desirability of combined and detailed exploration of the field towards which all these lines of research converge. For such exploration, no more fitting place could be found than the Linnean Society.

Molecular Migration under the Influence of Centrifugal, Osmotic and Electric Forces*

OUR knowledge of the mass movements of large molecules in various fields of force has its foundation in the early researches of Svedberg, and consists in large part in contributions from the Uppsala School. Since the occasion of Svedberg's recent lectures at Oxford†, further improvements in experimental technique have been made, and the scope of these physical investigations, particularly where they touch on biological problems, has been greatly enlarged.

Studies of the resolving power of centrifuge rotors reveal that, in general, rotors of large diameter rotating at low speeds are preferable to smaller rotors at higher speeds. The resolving power is slightly higher and greater accuracy of optical observation is possible with the larger rotors. For rotor construction, steel is still to be preferred to light metal alloys, in spite of the greater ratio of strength to density offered by the newer aircraft alloys. This is due to the fact that around the cell holes, about one half of the total stress arises from the outward thrust of the cell, and the cell weight in modern constructions is reduced to a minimum. By reducing the bearing diameter from 18 mm. to 10 mm., the power dissipated in bearing friction has been reduced to some 300 watts at 60,000 revolutions per minute, or about one seventh of the earlier value. Rotors with such low bearing friction take an inconveniently long time to come to rest, and to reduce this time a magnetic brake system has been introduced. In spite of the much lower frictional losses in the air turbine ultracentrifuge, the energy required to drive this type is now actually greater than in the case of the oil turbine machine, owing mainly to the much lower efficiency of the air turbines. A new type of divided centrifuge cell, the inner chamber of which is made from the British transparent plastic 'Perspex', is available which enables the observation and separation in substance of ultracentrifuge fractions at the end of an experiment.

The study of molecular migrations in the electric field has been facilitated by the development of an improved electrophoresis apparatus by Tiselius in Svedberg's laboratory. It is possible with this apparatus to observe the migration of the components of a mixture and to isolate these for subsequent chemical or biological investigation.

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* An account of three lectures delivered by Prof The Svedberg, of Uppsala, at University College, London, on April 29, May 2 and 3.

† Summarized in a supplement to NATURE of June 19, 1937

By application of the methods of sedimentation, osmotic and electrophoretic analysis to many naturally occurring substances, much valuable information has been obtained, and certain general conclusions may be drawn regarding the molecular state of substances in Nature. Of the proteins it may be said that Nature prefers to manufacture these in a homogeneous form, that is, with molecules all of the same size. Good examples of homogeneous proteins are the albumin of the hen's egg, the crystalline globulin of milk, and the coloured respiratory proteins. A protein is only homogeneous within certain limits of hydrogen ion concentration of its solution. Outside these limits, associations and dissociations of the molecules take place. In the case of the hæmocyanin pigment from the snail *Helix pomatia*, for example, dissociation of the large parent molecule occurs into fragments of one half, one eighth and one sixteenth of the molecular weight of the original. Numerous other factors cause similar step-wise degradation of protein molecules, the changes being often of an irreversible nature. Of special interest is a form of specific degradation which is, however, reversible. It appears that in a mixture of proteins the larger molecules are frequently split up by the influence of the smaller molecules. Blood serum affords an important illustration of this, the concentration of smaller molecules in the undiluted serum being increased markedly by dissociation of the larger globulin molecules into fragments of the approximate weight of serum albumin, namely, 69,000. It is not possible to give a complete explanation of this phenomenon, which must be of great importance in the living organism.

Proteins which are homogeneous in the centrifuge are frequently also homogeneous in the electrophoresis apparatus. A notable exception is the globulin of blood serum, the molecules of which are approximately uniform in size with a weight in the neighbourhood of 160,000. In the electric field these molecules separate into three distinct groups of different mobilities. Tiselius has been able to isolate these globulins and to characterize them as protein entities.

Various diseases alter the state of the serum proteins, and it is well known that in the majority of cases the alteration affects only the globulin part of the serum. These new methods show that in the serum obtained by immunizing the rabbit with egg albumin, only one of the three normal globulins is increased. Separation of this globulin results in a considerable concentration of specifically precipitable protein. Immunization of the rabbit with type III pneumococcus results in the appearance of a new serum protein with the same molecular weight as the normal rabbit globulins but electrochemically different from these. On absorption of the serum with the type specific carbohydrate, this new fraction can be removed quantitatively from the electrophoresis photograph. On the other hand, immunization of the horse with type I pneumococcus produces a fraction which is different both in respect of molecular weight and electrophoretic mobility from the normal globulins. These and other phenomena demonstrate that the changes in the serum proteins which accompany the development of immunity are of a diverse nature and are not at the moment amenable to any simple explanation.

In the important field of the respiratory proteins, cytochrome *C* and myoglobin have been found to have the same molecular weight, namely 17,000, or approximately one fourth of the weight of hæmoglobin. The yellow enzyme, on the other hand, has a molecular weight of 80,000 and one prosthetic group in the molecule. All the enzymes so far isolated in a pure state have been proved to be proteins. Pepsin is a well-defined protein of molecular weight 37,000. The catalase molecule has recently been shown to contain four atoms of iron in the molecule, like hæmoglobin, but to have a molecular weight approximately four times as great, namely, 248,000. The largest enzyme molecule so far measured is that of crystalline urease, which has a weight of 483,000.

In recent years, more attention has been devoted to systems containing linear macromolecules. This field includes the carbohydrates, particularly cellulose, starch and glycogen; synthetic polymers such as the polystyrenes; and hydrocarbons such as rubber. In general these systems are far from homogeneous, the chain length varying from one molecule to another. The main object of study, therefore, is the size-distribution curve, which is best obtained from measurements of sedimentation velocity. Suitable solvents are often difficult to find, and the interpretation of the results is complicated by the asymmetry of the molecules, by the interactions of neighbouring molecules, and by solvation. The molecular state of starch is much influenced by the past history of the preparation. Acid-treated solutions show an amylose fraction of mean molecular weight about 60,000 and an amylo pectin of approximately 200,000; both are polydisperse. Glycogen and its methylated derivatives are highly polymerized, and also polydisperse. The specific polysaccharide of type I pneumococcus is polydisperse with an average weight of approximately 225,000. Recently, however, a homogeneous polysaccharide of low molecular weight, namely, 9,000, has been isolated by Dr. Florence Seibert from filtrates of tubercle bacillus cultures.

A. S. McFarlane.

News and Views

Sir D'Arcy Thompson, C.B., F.R.S.

At the anniversary meeting of the Linnean Society held on May 24, the Linnean Gold Medal was presented to Sir D'Arcy Wentworth Thompson. In handing the medal to him, Dr. J. Ramsbottom, the president, said: "Since its foundation, the Linnean Society, while maintaining the traditions associated with the great Swedish naturalist whose name it bears, has always welcomed to its fellowship the disciples of the newer schools whose studies of the organic world have led them into fields of knowledge Linnæus never knew. It seemed to our Council, therefore, especially fitting that on this, our one hundred and fiftieth anniversary meeting, the highest honour in our gift should be conferred on a naturalist who, more than any other of our time, has shown himself to be at home in both the fields of the old and of the newer learning. The founders of our Society were, most of them, classical scholars as well as men of science, and we can well imagine Bishop Goodenough and Sir James Edward Smith exchanging snuff-boxes while they discussed and approved the ripe scholarship of your 'Glossary of Greek Birds' and your translation of Aristotle's 'Historia Animalium'. But, if these works are in the eighteenth century tradition, your 'Growth and Form' is no less distinctively in that of the twentieth. Published in war-time, it was one of the first scientific books some of us read when we came back to civil and scientific life in 1919. It is already something of a classic on the shelves of the younger biologists of the experimental school, and we turn to it again and again, not only for information but for inspiration and delight. In selecting you, sir, as the recipient of the Linnean medal, we have no doubt that our choice is one that would have pleased Linnæus himself."

Cases of the Linnæan Collections

During the Great War, the herbarium formed by Linnæus and now in the possession of the Linnean Society of London, was removed from the three wooden cases which had contained it since the time of Linnæus and placed for greater safety in steel cabinets. The Council of the Society recently decided that the one hundred and fiftieth anniversary of the Society would be a fitting occasion for returning two of the cases to their original home by presenting one to the Swedish Linnean Society and one to the Linnæus Museum at Hammarby. At the anniversary meeting of May 24, the keys of the cases were handed by the president to Prof. Robert Fries, president of the Swedish Linnean Society. Prof. Fries, in expressing thanks for the gift, said that all Swedish naturalists are grateful to the Linnean Society of London for the great care it has always taken of the priceless treasures in its custody.

Prof. R. H. Fowler, F.R.S.

The Lord President of the Council has appointed Prof. R. H. Fowler to be director of the National Physical Laboratory with effect as from October 1 next, in succession to Dr. W. H. Bragg, who has been elected to the Cavendish professorship of experimental physics in the University of Cambridge. Prof. Fowler, who is now forty-nine years of age, has had a brilliant career at Cambridge. So long ago as 1914 he was elected a fellow of Trinity College, and he received the Adams Prize in 1925 for an essay on "The Physical State of Matter at High Temperature". In 1932 he was appointed to one of the John Humphrey Plummer professorships established at Cambridge in the previous year, namely, that of mathematical physics. His election to the Royal Society came in 1925, and he was awarded one of the Society's Royal Medals in 1936. Prof. Fowler's scientific work includes the development of a general theory of statistical mechanics, with applications of outstanding importance to the equilibrium of mixed crystals and to the theory of semi-conductors. His work on the photo-electric effect led to a means of determining the true threshold frequencies. He has also developed new aspects of the quantum theory of energy exchange between gases and solids. Finally, by his application of the developing quantum theory to the solution of problems under investigation by groups of experimental physicists working in close association with him at Cambridge, he has made contributions of fundamental importance to both theoretical and practical physics.

Sir Thomas Middleton, K.C.I.E., F.R.S.

The Committee of the Privy Council for the Organization and Development of Agricultural Research, after consultation with the members of the Agricultural Research Council and the president of the Royal Society, has appointed Sir Thomas H. Middleton to be chairman of the Agricultural Research Council as from July 1. On that date the Right Hon. Lord Richard Cavendish, who has been chairman of the Council since its inception in June 1931, retires from membership of the Council. Sir Thomas Middleton, who is vice-chairman of the Development Commission, an office which he has held since 1929, has been a member of the Agricultural Research Council since its establishment. He is chairman of one Standing Committee of the Council on Soils and Plant Nutrition and of the Committee on the Estimates of Research Institutions. Sir Thomas has been successively professor of agriculture in Baroda College, India, lecturer in agriculture in the University College of Wales, Aberystwyth, professor of agriculture in Durham College of Science, and professor of agriculture at Cambridge. In 1906 he joined the staff of the Board of Agriculture and

Fisheries as assistant secretary, and in 1917–19 was deputy director-general of the Food Production Department. He was a member of the Royal Commission on Agriculture in India, which sat in 1926–28. He was the first recipient of the Gold Medal of the Royal Agricultural Society of England, awarded for services to agriculture.

A Tribute to Sir John McFadyean

It was a happy thought that prompted some of his colleagues to obtain Sir John McFadyean's consent to allow them to design and edit the December (1937) number of the *Journal of Comparative Pathology and Therapeutics* as a jubilee number and *Festschrift*. This number forms the conclusion of the fiftieth volume of the journal, which was founded by Sir John McFadyean in 1888, and has since been edited by him almost entirely single-handed, and this unique occasion has been utilized to issue this number as a *Festschrift* in honour of Sir John's outstanding contributions to veterinary science during his long career. These have been mainly confined to problems concerning the control of tuberculosis, contagious abortion and glanders among farm animals, the etiology and occurrence of Johne's disease in Great Britain, and the discovery that the virus of horse sickness is a filterable one. The esteem in which Sir John is held is manifest from the contributions contained in this number, which come from all parts of the world. Appreciations of the man and his work are contributed by many, including Sir John Kelland of the Ministry of Agriculture and Fisheries; Sir Robert Muir; Sir John Ledingham; Prof. von Ostertag, Tubingen; Dr. Schmaltz, Berlin; Prof. Leclainche, Paris; Dr. Mohler, United States; and Dr. Hilton, Canada. Several excellent portraits of Sir John are reproduced.

Dr. H. J. Gough, M.B.E., F.R.S.

Dr. H. J. Gough, superintendent of the Engineering Department of the National Physical Laboratory, has been appointed to the new post of director of scientific research at the War Office. Dr. Gough will be directly responsible to the director-general of munitions production for the general direction and organization of research work for War Office purposes; for advising as to the programme of research work to be undertaken and as to proposals for specific investigations; and for the efficiency of the organization for research and experimental purposes of the various research organizations under the War Office. He will represent that Department on the various interdepartmental research organizations.

Tercentenary of Two French Botanists

The year 1638 saw the birth of two notable French botanists, Guy-Crescent Fagon, who was born in Paris on May 11, 1638, and Pierre Magnol, who was born at Montpellier on June 8, 1638. Both were physicians, both were connected with botanical gardens and both were members of the Paris Academy of Sciences. Fagon was a nephew of Guy de la Brosse (died 1641) who first suggested and eventually, in 1626, laid out the "Jardin Royal de herbes médicinales" in Paris, the site of which was a piece of waste ground where the refuse of centuries had collected. It is now the Jardin des Plantes. After taking his degree in medicine in 1664, Fagon offered to procure plants for the garden, and through Antoine Vallot (1594–1671) the superintendent, who was also physician to the King, was appointed to travel in the Alps, Pyrenees, Auvergne and other parts. He afterwards became professor of botany and chemistry in the garden and in 1698 was made director. It was through him that two famous botanists, Joseph Tournefort (1661–1708) and Charles Plumier (1646–1704) were sent on collecting expeditions, one to the Levant and the other to America. He wrote on tobacco, cinchona and other matters, and held high office as a doctor. He died in Paris on March 11, 1718. Magnol was associated with Montpellier all his life. He took his degree there, assisted the professor of botany, in 1694 was given the chair of medicine and three years later was made director of the botanic garden, which had been founded about 1558. His writings referred mainly to the plants which grew in the neighbourhood of his native city. He died on May 21, 1715, leaving a son, Antoine, who followed in his footsteps. The genus *Magnolia* was named after him, by his countryman Plumier.

International Ornithological Congress

The ninth International Ornithological Congress was held in Rouen during the second week in May under the presidency of Prof. A. Ghigi, rector of the University of Bologna, with M. Jean Delacour as secretary. Among the papers contributed which attracted most interest was that on his recent discovery of the Congo peacock (*Afropavo*) by Dr. J. Chapin, followed by a report on the anatomy of the bird by Mr. Percy R. Lowe. A large number of films of high merit were displayed by ornithologists of various nationalities, which showed how greatly Nature photography has advanced during recent years. Particular mention must be made of Prof. A. Allen's sound film, partly in colour, of rare and disappearing American birds and of Captain C. W. R. Knight's excerpts of the film he made when leading the National Geographic Society's 1937–38 expedition to South Africa, in which he showed three birds never filmed before—the hammerhead stork, crowned hawk eagle and secretary bird. It was agreed that the tenth International Congress should be held in America in 1942, and Dr. A. Wetmore of Washington was elected president.

International Committee for Bird Preservation

The meetings of the International Committee for Bird Preservation, which were held in Rouen immediately preceding the Ornithological Congress, were attended by the official delegates of the national sections of fourteen different countries. The main subjects of discussion were the status of the Anatidæ throughout the world and the protection of the quail; a number of reports on progress in bird preservation in various countries were contributed. The destruction of sea-birds by waste oil was also discussed and, on the proposal of Prof. Einar Lönnberg of Sweden, a sub-committee was appointed to expedite means of diminishing this serious evil. A further sub-committee was appointed to collate information with regard to Nature reserves throughout Europe with the view of promoting the establishment of further areas for this purpose. M. Jean Delacour (France) was elected president of the International Committee, Mr. Hoyes Lloyd (Canada) and Dr. P. G. van Tienhoven (Holland) vice-presidents, Mr. Percy R. Lowe (Great Britain) Chairman of the national sections of Europe, and M. Leon Lippens (Belgium) and Miss Phyllis Barclay-Smith (Great Britain) were re-appointed secretaries. A message expressing his interest and wishing success to the meeting was received from the Prime Minister of Great Britain.

Pre-Folsom Man in America

SHOULD preliminary accounts of the discovery of stone implements in Lake County, California, be confirmed in detail, it may be regarded as established that man existed in America in a period prior to that of the Folsom implements of the south-western United States, hitherto generally accepted as the earliest handiwork of man yet found on the American continent. According to a statement circulated by Science Service, of Washington, D.C., a joint expedition of the Carnegie Institution of Washington and the South-West Museum, Los Angeles, under the direction of Mr. M. R. Harrington, has found in ground disturbed by the plough on the shore of a brackish pond, Folsom implements in association with others of the Mohave type—a type recently found at Lake Mohave and another site, but of which the relation to the Folsom industry was in doubt. Further excavation on the Lake County site revealed the existence of a camp deposit, in which the Mohave type of implement occurred definitely below and antedating the Folsom implements. At about the same level was a new type of spear-head, to which the name of Borax Lake type has been given. Even more remarkable, however, was the discovery at a still lower level of older and cruder implements, mainly large scrapers and hand axes, belonging to a people "as yet an entirely unknown quantity in American archæology". It is calculated that on a conservative estimate this discovery would allow man on the American continent an antiquity of at least fifteen thousand years, as against the seven to twelve thousand years variously accepted for Folsom man.

Early Hebrew Script at Lachish

ON the return to England of the members of the Marston-Wellcome Archæological Expedition to Lachish at the close of excavations for the season 1937–38, further discoveries of examples of early Hebrew script on this site are reported (*The Times*, May 26). Three fragments of pottery have been found, which are inscribed in the Phenician-Hebrew script used in the famous Lachish letters, as well as scribings on the steps of the Lachish palace. The first of the three sherds shows five names of persons, followed by numerals, which probably represent quantities of wheat, oil or other commodity. The second sherd was found in a room with the remains of the pot from which it was broken, and is thought to be a receipt. The inscription begins with the phrase "In the ninth year", serving to recall the fact that it was in the ninth year of the reign of Zedekiah that Nebuchadnezzar came to Jerusalem and besieged it. As the house in which this sherd was found shows signs of having been burnt, it is thought possible that the receipt may have been written immediately before Nebuchadnezzar's second attack on Lachish in 588 B.C. The third inscription presents a certain similarity to the Lachish letters. It is very small, but there is writing on both sides, and it is evidently a letter, beginning "To my Lord". These inscriptions have been submitted to Prof. H. Torczyner, who was responsible for the decipherment of the series of eighteen letters discovered in 1935. The scribings on the face of one of the steps of the Palace, which the expedition is now beginning to excavate, are thought to have been the work of a schoolboy. With a rectangular drawing with lines across, and the picture of a lion, are the first five letters of the Phenician-Hebrew alphabet. These, reading from left to right, are in the same order as our alphabet, and are the earliest evidence for that order. They date from before Nebuchadnezzar's earlier destruction of Lachish in 597 B.C. From these discoveries the inference is drawn that the Phenician-Hebrew script was in general use in the kingdom of Judah and was being taught in the schools before the Captivity. After the Captivity the Assyrian-Hebrew script was employed.

Infestation of Grain by Insects

DESTRUCTION of stored grain and grain products by insects causes great loss to many sections of industry, probably amounting annually to not less than £500,000. More information is required before the problem can be completely tackled. The first step is a scientific survey which is to be made at once, during the period of seasonal activity of the insects. This survey has been organized on the initiative of the various sections of industry concerned, and the major part of its cost will be met by their contributions. It is to be carried out, under the auspices of the Department of Scientific and Industrial Research, by the Stored Products Laboratory of the Imperial College of Science and Technology. A conference has been formed of the representatives of interested bodies which have already agreed to co-operate in this work and its first meeting was held on May 26 in the offices of the Department of Scientific and Industrial Research. The co-operation of all sections of industry affected is essential to the success of any organized attack on these insect pests. The neglect of one section to play its part will jeopardize the success of the efforts of all the rest. The Conference, therefore, viewed with satisfaction the extent of the support so far accorded. Any organization or undertaking wishing to co-operate in this work should communicate with the Secretary of the Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, London, S.W.1.

Institute of Physics

THE annual report of the Institute of Physics for the year 1937, which has just been published, shows that its membership continues to increase in a most satisfactory way. It was just over a thousand at the end of the year, and is now considered to be representative of British physicists both at home and overseas. The most important activity of the Institute during the year covered by the report was the Second Conference on Industrial Physics held in the University of Birmingham in March 1937, the subject being "Optical Devices in Research and Industry" (see NATURE of April 3, 1937, p. 600). The various branches of the Institute in Great Britain held a number of meetings during the year and the committees of the overseas branches did valuable work in various ways. The report states that there was a further increase in the number of vacancies for physicists of which the Institute was notified, the figure being 197 for the year. Some vacancies for laboratory assistants were filled from among those holding the Institute's certificate in laboratory arts. The report states that the scope of the *Journal of Scientific Instruments*, which is produced by the Institute in co-operation with the National Physical Laboratory, has been enlarged to include items dealing with the applications of physics to industry.

A Proposed Scientific Film Society

A SCIENTIFIC FILM GROUP of the Association of Scientific Workers was formed about a year ago to encourage the growth of good instructional and documentary films, dealing both with 'pure science' and, perhaps even more important, with science as a social force. The Group has accordingly given shows of approved scientific films in London, Cambridge, Oxford and elsewhere, which have demonstrated that there is a considerable public for such films. To enable this work to continue on a more ample scale in London, however, while complying with L.C.C. regulations, it has now become necessary to consider forming a Scientific Film Society. Such a Society would be open to all interested persons, whether members of the Association of Scientific Workers or not, and would give at least four film shows a year in a London cinema on Sunday afternoons. It would not be possible to sell tickets for such shows to the general public, but a limited number of guest tickets would be available to members. Any profits arising from the Society's work would be devoted exclusively to non-commercial purposes such as the making and adapting of scientific films. Further particulars about the proposed Society can be obtained from the honorary secretary of the Scientific Films Committee, Association of Scientific Workers, Kelvin House, 28 Hogarth Road, London, S.W.7.

Joint Committee on Materials and their Testing

UNDER the above title, an interesting new form of collaboration between twenty-five of the major scientific societies and technical institutions of Great Britain has been effected: the Committee has now issued its first annual report, rendered to the councils of the collaborating institutions concerned. The principal objects of the Joint Committee are threefold: (1) to promote joint discussions on the wider aspects of the subjects of materials and their testing; (2) to assist a co-operating institution or society in the presentation of a paper or group of papers dealing with a more detailed aspect of one of these subjects; and (3) to undertake those duties with regard to international matters which properly devolve on the Joint Committee in accordance with its terms of reference. The main activity in the period reviewed by the report was the organization of a general discussion on "Notched Bar Testing" held in Manchester on October 29, 1937, in which this interesting subject was reviewed in relation to research and opinion at home and abroad. Four comprehensive papers were submitted and these papers, together with a record of the most informative discussion which resulted, are now available in pamphlet form, obtainable on application to the secretary of the Manchester Association of Engineers. The Committee is now organizing a second general discussion on various aspects of "Non-destructive Testing", which will centre around papers presented by selected experts in Germany, Holland, the United States and Great Britain, on the use of X-ray, gamma-ray, magnetic, electrical, aeronautical and other more general methods: this discussion will take place in London in October or November of the present year. The pooling of the efforts of technical bodies in promoting discussions in the wide and most important fields of the materials of construction should go a long way towards satisfying a long-felt want, and the further activities of the Joint Committee will be followed with much interest in scientific and technical centres.

Magnetic Recording in Broadcasting

IN a paper read by A. E. Barrett and J. C. F. Tweed to the Institution of Electrical Engineers on December 1, some of the methods of recording sound, especially those in connexion with their applications to Empire broadcasting, were considered. In Great Britain, very little information has been published on the subject of magnetic recording on steel tape. Dr. Stille, a German engineer, was the first to use steel tape for recording, and he made notable advances in the necessary technique. The British Broadcasting Company first tested the system in 1930 when the Empire broadcasting service was being inaugurated. Extracts from the home programmes were recorded and afterwards reproduced in the Empire transmission. The first important programme to be radiated to the Empire by this means was that on Christmas Day 1932. It included a speech by King George V. Early in 1933, Marconi's Wireless Telegraph Co., Ltd., designed a machine in which many of the mechanical difficulties experienced with earlier models were successfully overcome. It has been developed further by both the Company and the B.B.C. Magnetic recording in its simplest form can be carried out by passing a length of steel tape at constant velocity through an electromagnetic device, called a recording head, which produces variations in the magnetism of the tape. Reproduction is effected by passing the magnetized tape at the same velocity through a device called the reproducing head, which is sensitive to the changes in the magnetism in the tape. In the ideal case these correspond to the original alternations applied to the recording head. When a new record is wanted, it is necessary to remove the previous variations in the magnetism before recording. This is done by passing the tape through a 'wiping head' which strongly magnetizes the tape. The wiping, recording and reproducing heads used in the experiments described by the authors have different types of coils and pole-pieces, but are in other respects identical.

British Museum (Natural History): Recent Acquisitions

A COLLECTION of 2,300 otoliths or 'ear-bones' has been purchased for the Fish Section of the Zoological Department. These specimens represent 570 different species, and were collected by Mr. G. A. Frost over a period of thirty years. This is the largest and most important collection of otoliths in existence, and it is especially valuable because it formed the basis of a series of papers published by Mr. Frost between 1925 and 1930. The most important gift to the Department of Entomology is the collection of Lepidoptera formed by the late Mr. Edward Meyrick. The collection is estimated to contain more than 100,000 specimens. Among the more important accessions to the Department of Geology is a collection of bones from the Lower Miocene of Kenya, including remains of mastodons, antelopes, rhinoceroses and dinotheres, collected by Archdeacon W. E. Owen; also a very fine series of the remarkable creature *Palæospondylus* from the Middle Old Red Sandstone of Achanarras, Caithness, collected and presented by Mr. C. Forster-Cooper, now the director of the museum.

PURCHASES in the Department of Mineralogy of the Museum include good crystals of cassiterite (tinstone) from Bolivia and three remarkably fine nodules of Variscite from Fairfield, Utah. The nodules, two of which are about a foot across, have been cut through and polished to show the beautiful colour of the mineral, which is nearly related to turquoise. From the same source have been obtained five splendid crystals of wulfenite (lead molybdate) from Red Cloud mine, Yuma county, Arizona. In this connexion it is of interest that Mr. A. W. G. Kinsbury, of Chewton Mendip, has recently rediscovered the mineral wulfenite at Higher Pits, Priddy, in the Mendips, and has recently presented specimens to the Museum. Four meteorites new to the collections have been acquired. The Department of Botany has received 582 specimens of flowering plants collected by Dr. Hugh Scott and Mr. E. B. Britton on the recent expedition to south-west Arabia, a district little known botanically, but historically famous by the collections made in 1775 by Linnæus's student Forskal. Also a collection of 382 specimens collected in Greenland and Ellesmere Land has been presented by Mr. R. W. Feachem. The purchases include 2,000 paintings of fungi by the late Dr. Knauth which will be of very great value in making identifications.

Research at Millport

THE annual report of the Scottish Marine Biological Association for 1936–37 shows that much good work is in progress. A scheme has been prepared for extension of accommodation which it is hoped will soon be carried out. Among other things, the library space will be considerably enlarged. Work on the growth and food of the herring has been continued by Drs. Orr, Marshall and Nicholls, mainly on the young herring. In 1935 the life-history of the herring was followed from hatching in March to metamorphosis at the beginning of June. Since July 1936 catches have been made every fortnight up to the present time in the immediate neighbourhood of the laboratory. The largest numbers were caught at dusk. Work on algal ecology has been continued by Dr. D. C. Gibb, and on animal ecology by Mr. A. J. Haddow on the growth of *Sertularia*, and by Dr. E. E. Watkin on the Amphipod genus *Bathyporeia*. In view of the failure of the herring supplies during the winter, a number of fishermen have turned their attention to "clams" as *Pecten maximus* is called locally. Preliminary work on this mollusc indicates that at five years it measures 4 inches wide, growth being indicated by winter rings, and it takes four years to reach a marketable size. It therefore grows too slowly to maintain for long the call now being made on the reserves of the species. Interesting results from examining the stomach contents of shags and coromorants are shown. The shags visiting sandy areas feed on shrimps and polychætes and on rocky shores eat prawns (*Leander*).

Vitamin B_1

WE have received from Messrs. Merck and Co. an illustrated brochure of upwards of fifty pages entitled "The Story of Vitamin B_1", which gives an up-to-date account of the chemistry, physiology and nutritional value of the vitamin. To each section is appended a useful bibliography, from which those interested can obtain more detailed information than it is possible to give in a summary review. The information supplied, nevertheless, covers the field remarkably well and brings together work which is scattered in numerous journals, so that the reader obtains a picture of our present knowledge of the vitamin in all its aspects and is readily able to see how far the work of different authors is in agreement or otherwise. After an account of the chemistry and synthesis of the vitamin, a useful section is devoted to the question of its standardization and the relationship of the different "biological units" to the international unit, information which is not readily available in summary form. Our knowledge of its physiology is then reviewed, and the following sections are devoted to its value in human and animal nutrition, the normal human requirements and the effects of a subnormal intake. The brochure is not intended for general distribution, but will be sent to investigators in the field of vitamin therapy, to medical specialists, food chemists, research workers in human and animal nutrition, colleges and universities, Government agricultural and experiment stations, and manufacturers of pharmaceutical and proprietary products.

National Physical Laboratory Abstracts

AFTER the publication of the volume of "Collected Researches" of the National Physical Laboratory at present in the press, that quarto publication will cease and will be replaced by an annual octavo pamphlet entitled "Abstracts of Papers", the first issue of which, for the year 1936, has already appeared. It extends to 65 pages, 61 of which are devoted to 140 abstracts and the rest to author and subject indexes. The title of each abstract is in Clarendon type and that of the publication in which the complete paper is to be found in italics with specification of year, volume and page. The abstracts themselves generally give the object and method of the investigation concerned in outline and the net results in detail, so that a large amount of valuable information is condensed into a small space. They are grouped under subjects. The present issue is published at 1*s.* by H.M. Stationery Office.

Esperanto for Scientific Papers and Abstracts

THE "Universala Esperanto-Kongreso" is to take place this year at University College, London, on July 30–August 6. A recent article by Dr. D. R. Duncan, published in the *Scientific Worker*, directs attention to the great potential value of Esperanto as a means of intercommunication between men of science. Being "intelligible to any educated European" without previous study, it is eminently suitable for scientific abstracts in cases where the original paper was published in a language little known outside its own country. Reports consisting largely of tables such as the "International Critical Tables" might well, it is suggested, use Esperanto instead of numerous parallel columns in different languages. Esperanto is, it appears, much used in Japan for scientific papers. A few journals outside Japan give Esperanto summaries at the end of papers published in the journal's own language, for example, the *Bull. Soc. Française des Electriciens*, the *Phare Médical* and the *Revista da Sociedade de Geografia do Rio de Janeiro*.

Society for Extending the Rothamsted Experiments

HIS GRACE THE DUKE OF DEVONSHIRE has consented to accept the chairmanship of the Incorporated Society for Extending the Rothamsted Experiments which had been held by his late father since the inception of the Society in 1904. The vice-chairmen are the Earl of Radnor and Lord Clinton. The purpose of the Society is to foster the development of the work carried out by the Rothamsted Experimental Station: the last important effort was to raise the funds for the purchase of the agricultural part of the Rothamsted Estate, which was successfully achieved in 1934, and its next effort will be in connexion with the centenary of the foundation of the Rothamsted Experimental Station which falls due in 1943.

Growth of a Sunspot

BETWEEN May 22 and 24, a large group of sunspots suddenly appeared near the central meridian and became visible to the naked eye. Measures of area taken from the Greenwich photographs show the following rapid increase in size of the spot group, which began as two or three tiny spots. The areas are corrected for foreshortening and are expressed in millionths of the sun's hemisphere.

May	22·4	U.T.	10	millionths
,,	23·3	,,	210	,,
,,	24·3	,,	1060	,,
,,	25·4	,,	1200	,,
,,	26·3	,,	1390	,,
,,	27·3	,,	1570	,,

Since the average group of this size takes about 8–10 days to develop fully, the very great increase in area during the first 48 hours suggested that the group would be unusually large, exceeding perhaps 2500 millionths. The maximum size appears, however, to have been reached about May 27 or 28, the group passing out of view at the western limb on May 30. These sunspots, in about latitude 8° north and longitude 12°, offered several points for study with an ordinary telescope. There was, for example, a marked drift equatorwards of the leader spot amounting to 3° or about 37,000 km. between May 24 and 27. The changes in structure between May 23 and 24 were also considerable. During the initial development of the group, the accompanying hydrogen flocculi seen spectroscopically in $H\alpha$ (and at times in $H\beta$) were persistently of enhanced intensity, although no outstanding short-lived eruptions were observed at Greenwich. The time of central meridian passage of the group was May 23·8, and it will return to the central meridian on June 20, unless by then the spots have dispersed.

Announcements

WE regret to announce the death of Dr. J. W. Mellor, C.B.E., F.R.S., author of "A Comprehensive Treatise on Inorganic and Theoretical Chemistry", on May 24, aged sixty-eight years; and of Prof. W. Stroud, Cavendish professor of physics in the University of Leeds in 1885–1909, director of Barr and Stroud, Ltd., Glasgow, on May 27, aged seventy-eight years.

SIR FRANK SMITH, secretary of the Department of Scientific and Industrial Research, has been elected an honorary fellow of the Institute of Physics. This, the highest distinction the Institute can confer, is reserved for those whom it especially desires to honour for exceptionally important services in connexion with physics or a science allied thereto; there are only seven other honorary fellows. Sir Frank Smith was a founder fellow of the Institute, and did much to help establish it on the sound basis which has assisted so much in its rapid development.

MR. A. H. R. FEDDEN has been elected president of the Royal Aeronautical Society for the year 1938–39.

THE annual inspection of the field plots and laboratories of the Rothamsted Experimental Station will be held on June 29, beginning at 11.15 a.m. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

We are informed that J. Wadsworth has resigned the directorship of Apia Observatory, Western Samoa, and expects to leave Samoa shortly.

Major-General C. H. Foulkes writes: "It has been suggested that my review in Nature of May 21 of Prof. Kendall's book 'Breathe Freely' might give the impression that the author is 'anti-A.R.P.'. This was very far from my intention, and in view of recent events in Spain and China, it need scarcely be said that no reasonable person could adopt such an attitude."

To encourage the reading of papers by students of fuel technology, the Council of the Institute of Fuel has decided to make an annual reward of a medal, together with a prize consisting of books and/or instruments to the value of £5 for a paper submitted by a student member of the Institute or by any student less than twenty-five years old of a university or technical college in the United Kingdom. Further particulars can be obtained from the Secretary, Institute of Fuel, 53 Victoria Street, London, S.W.1.

The twenty-seventh annual meeting of the Oxford Ophthalmological Congress will be held at Keble College on July 6–9. Further information can be obtained from the honorary secretary, Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury.

The twenty-fourth annual conference of the National Association for the Prevention of Tuberculosis will be held in the Great Hall of the British Medical Association House, Tavistock Square, W.C.1, on June 30–July 2.

At the International Congress Against Rheumatism recently held at Oxford, Prof. Ralph Pemberton of Philadelphia was elected president of the International League Against Rheumatism in succession to Dr. R. Fortescue Fox. The next Congress is to be held in New York in 1940.

The Jessie Macgregor Prize in Medical Science will be awarded next July for the best record of original work on the science of medicine. The work may be published or unpublished, but must not have been published more than three years earlier than July 1938. The value of the prize is about £50, and it is open to medical women graduates of the University of Edinburgh. Applications should be made to the Convener of Trustees, Royal College of Physicians, Edinburgh, not later than June 30.

Dr. Rudolf Kreutz, of Cologne, has been awarded the Sudhoff Medal by the German Society of the History of Medicine.

Dr. Herbert Hoover, the former president of the United States, has been given an honorary doctorate of the Technical University of Vienna.

Dr. Carl Landsteiner, of the Rockefeller Institute, New York, has been awarded the Cameron Prize of the University of Edinburgh, for his work on blood grouping and blood transfusion.

The John Phillips Memorial Medal of the American College of Physicians was recently awarded to Dr. Harry Goldblatt, professor of experimental pathology, Western Reserve University School of Medicine, Cleveland, for his work on the production of experimental hypertension in animals.

A monument to the late Mme. Curie was unveiled in Roosevelt Park, Raritan Township, New Jersey, on April 24, the seventieth anniversary of her birth.

An Argentine Institute of Nutrition attached to the Ministry of Foreign Relations has recently been founded at Buenos Aires.

The third International Congress for the Study of Goitre will be held on September 13–14 at Washington, when the following subjects will be discussed: (1) endemic goitre, cretinism and myxœdema; (2) thyroid gland and metabolism, nutrition and endocrine glands; (3) hyperthyroidism. Further information can be obtained from Dr. Allen Graham, 2020 East 92nd Street, Cleveland, Ohio, U.S.A.

The sixteenth International Congress of Physiology will be held at Zurich on August 14–18 under the presidency of Prof. W. R. Hess. It will consist of six sections devoted respectively to general and comparative physiology, biophysics, biochemistry, applied physiology (work, sport and aviation), psychophysiology and pharmacology. Further information can be obtained from Prof. E. Rottlin, Sonnenweg 6, Basel, Switzerland.

A Note upon the "Scialyscope", which provides a means by which surgical operations may be viewed by a number of students in a room adjacent to the operation theatre, was published in Nature of April 30, p. 780. Mr. G. Davidson, director of Technical Lights and Equipment, Ltd., 9–10 Bentinck Mews, Marylebone Lane, London, W.1, sends us a copy of a booklet compiled when the instrument was originally invented, as well as copies of illustrated French leaflets and a booklet showing installations of it at different hospitals. Further information can be obtained from that firm.

Erratum. In Nature of May 28, p. 980, paragraph entitled "Condensation on Board Ship", line 2, for "J. S. Duly" read "S. J. Duly".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1018.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A Method of Investigating Electron-Inertia Effects in Thermionic Tubes

IT is well known that the phenomena exhibited by thermionic vacuum tubes begin to alter when the frequency of the potential applied to their electrodes is increased so as to approach the inter-electrode transit-time of the electrons. It is convenient to group all these phenomena under the name of electron-inertia effects. They include the production of high-frequency oscillations by the magnetron and the Barkhausen-Kurz method, and the occurrence at very high frequencies of a phase shift of the conductance of a diode and of the mutual conductance of a triode, and increased damping in the grid circuit of a triode.

Many theoretical investigations of these effects have been made, but it is not easy to subject them to experimental test because of the difficulties encountered in working at the very high frequencies involved. It is, for example, very difficult to measure the amplitudes or phase relations of the potentials and currents, and if it is desired to apply high-frequency potentials to the electrodes in a search for resonance effects, it is generally necessary to do so by means of a Barkhausen-Kurz oscillator, the amplitude and frequency of which are not conveniently varied. If the frequencies of the oscillations involved in these investigations could be made very much smaller, the experiments would be much easier, and could be carried out in considerably greater detail.

This desirable effect can be achieved if, instead of electrons, more massive ions are used. It can be demonstrated that, in a tube with given potentials on the electrodes, the equations of motion for an ion of mass M are the same as those for an electron of mass m, provided the emission current is decreased in the ratio $\sqrt{m/M}$ and the time in all the equations is increased in the ratio $\sqrt{M/m}$. As a source of positive ions, it is convenient to use either a tungsten filament situated in a vapour of cæsium, according to the method first explained by Langmuir[1], or a platinum strip coated with an emitting substance, as described by Jones and Blewett[2].

In an investigation of some electron-inertia effects, we have used tubes of both kinds. A cæsium tube was made from the electrode system of an A.T. 40 triode, and a tube with plane electrodes having a variable spacing was used with a lithium emitter of the Jones and Blewett type. The more detailed experiments were made with the cæsium tube. An accelerating potential was applied to the grid and a small retarding potential to the plate, so that in the absence of any oscillating potentials no current was received by the plate. An ordinary retroactive oscillator was used to apply to the plate a high-frequency potential of amplitude less than the steady retarding potential. For most values of grid potential, no steady plate current was observed, but certain values of potential gave rise to a flow of plate current. The value of grid potential which gave rise to this plate current was dependent upon the frequency of the oscillating potential applied to the plate, and the phenomenon was presumably due to a resonance between the frequency of the applied E.M.F. and the frequency of oscillation of the ions about the grid wires. Similar results have been given by Gill and Donaldson[3] for an electron triode. If this is the correct explanation, the theoretical relation[4]

$$\lambda \sqrt{E_g} = 2{,}000\, d_g \sqrt{M/m} \qquad (1)$$

should hold between the grid potential (E_g) in volts, the wave-length (λ) in cm. corresponding to the applied frequency, and the grid diameter (d_g) in cm. This relation was, in fact, found to hold approximately. The wave-lengths lay between 300 m. and 800 m. for values of E_g between 450 and 75 volts, whereas if electrons had been used the wave-lengths would have been of the order of 1 m. It was found that the closeness with which expression (1) was obeyed depended on the amplitude of the applied potential, and on the emission current. We hope to give a detailed account of these effects elsewhere: the purpose of the present note is simply to direct attention to the method of investigation.

Similar effects were observed when the plane electrode tube was used with lithium ions. Equation (1) was again found to hold approximately, and was also found to represent correctly the effect of altered electrode spacing. With the lighter lithium ions the wave-lengths involved were of the order of 100 m. for potentials of the order of 200 volts and electrode spacing of the order of 1 cm.

It should be pointed out that since the emission currents in the case of positive ions are small, the effective impedance of a tube is large, and it has not been possible to use the above-mentioned tubes to produce oscillations of the Barkhausen-Kurz type. By making a cæsium vapour tube with a large emitting surface and by keeping the bulb at a high temperature so as to increase the emission current, we hope to be able to produce Barkhausen-Kurz type oscillations and investigate the mechanism of their production.

S. KOWNACKI.
J. A. RATCLIFFE.

Cavendish Laboratory,
Cambridge.
May 2.

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[1] Langmuir and Kingdon, *Proc. Roy. Soc.*, **107**, 61 (1925).

[2] Jones and Blewett, *Phys. Rev.*, **50**, 464 (1936).

[3] Gill and Donaldson, *Phil. Mag.*, **15**, 1177 (1933).

[4] Megaw, *J. Inst. Elec. Eng.*, **72**, 313 (1933).

The Florisbad Skull

SINCE its discovery by Prof. T. F. Dreyer[1] in 1932, the Florisbad skull has been discussed by the leading anthropologists[2] of South Africa. No one in Europe, so far as I know, has had an opportunity of examining a cast of the specimen. Thanks to Prof. Raymond Dart, of Johannesburg, I have been given this opportunity, and as a result I wish to confirm the importance of the discovery to all students of human evolution.

The primitive Rhodesian skull found in the mine at Broken Hill in 1921 is no longer an isolated antique. The Florisbad skull reproduces the massive and peculiar features of the Rhodesian forehead. But behind the forehead, the Florisbad skull assumes the characters of the Boskop skull. Indeed it may be regarded, as Dr. Alex. Galloway has maintained, as a transition from the Rhodesian to the Boskop type, the latter heralding the modern races of South Africa—Bushman and Hottentot. In its cheek bones and its upper face, the Florisbad fossil reproduces features seen in modern Bushmen and Hottentots. This new skull is a mosaic of Rhodesian, Boskop and Bush characters.

The geological ages of the Rhodesian and Boskop fossils are not known, but from the very primitive features of the Rhodesian skull and brain, one is tempted to ascribe it to a mid-pleistocene date. The large-brained Boskop skull one supposes to be much later in date—perhaps upper pleistocene. The Florisbad skull was found in a stratified deposit at a depth of 20 ft. The stone implements and fossil fauna found with the skull has led Prof. Dreyer to assign it to an early phase of the Middle Stone industry of South Africa. We may presume, therefore, that Florisbad man may have been contemporary with the Neanderthal race of Europe.

The brain of Rhodesian man measured about 1,300 c.c.; that of the Boskop man about 1,600 c.c.; that of the Florisbad man about 1,450 c.c.

The discovery of the Florisbad skull supplies evidence I have been in need of. The discoveries of fossil types already made leaves little doubt that South Africa, like Java, has been a centre where evolutionary change pursued its own independent course, ending in the Bushman and Hottentot types of to-day. It seemed hazardous to presume that the Rhodesian type, with its great supraorbital ridges and small brain, could be transformed into the Boskop type, with voluminous brain and smooth forehead, but that such a transmutation has really occurred seems to be assured by Prof. Dreyer's discovery.

ARTHUR KEITH.

Buckston Browne Farm,
Downe, Kent.
May 25.

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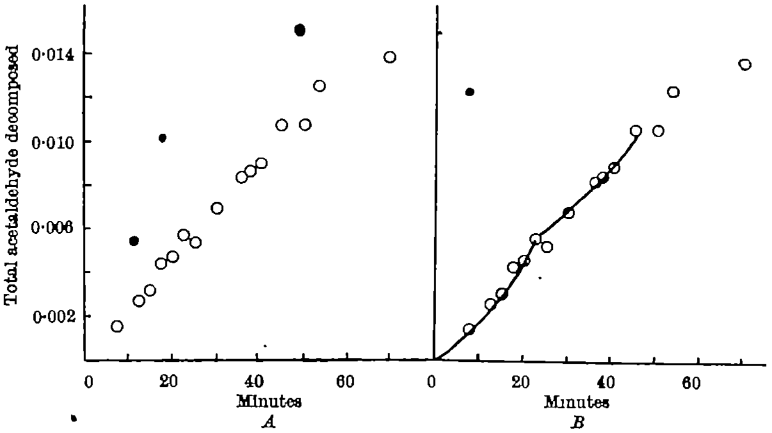
[1] Dreyer, T. F, *Proc. Kon. Akad. v. Wetensch. te Amsterdam*, **38**, 119 (1935). A description of the skull with an account of the endocranial cast by Dr C. U. Ariens Kappers. The endocranial cast has has also been described by A. J. Meiring (*S. Afr. J. Sci.*, **33**, 960, 1937). An account of the cultural and faunistic evidence is given by Prof. Dreyer in *Argeologiese Navorsing van die Nasionale Museum* (Bloemfontein), **1**, 65 (1938)

[2] Drennan, M. R., *S. Afr. J. Sci.*, **33**, 64 (1937); Dart, R., *Report of XVI International Geological Congress* (1936); Galloway, Alexander, *Amer. J. Physical Anthrop*, **23**, 1 (1937); *S. Afr. J. Sci.*, **34**, 89 (1937).

Decomposition Reactions of Organic Compounds in the Gaseous State

IN NATURE and elsewhere, Prof. M. W. Travers and his collaborators have published the results of experiments on gaseous decomposition reactions, and have claimed that in a number of respects their results invalidate work published from this laboratory in the course of the past twelve years. So long as these views have appeared as the expression of the personal point of view of Prof. Travers, I have not wished to intervene, but since I have seen statements from which I differ strongly repeated at second-hand, I ask leave to make two comments.



(1) Some of the statements made in the papers of Prof. Travers convey the impression that we have relied uncritically on pressure changes as indications of reaction rates. This is not correct. In some cases the reaction has been followed by analytical methods over its whole course[1], and in others a mathematical method has been used to show that the pressure changes employed were in fact proportional to the initial transformation rate over the whole range used[2].

(2) I am not competent to summarize the views of Prof. Travers, since I am far from understanding them, but the major difference of opinion relates to the degree of complexity of certain processes. According to Prof. Travers, in the thermal decomposition of, for example, acetaldehyde "the initial stages of thermal decomposition show strong self-acceleration, followed by a sudden slowing down. This slowing down is always accompanied by the speeding up of another process, but it generally happens that the secondary process begins to speed up before the break point, and slows down again after the break point is passed".

In the accompanying graphs, I have plotted in *A* the results given by Seddon and Travers[3] for the decomposition of acetaldehyde at 400°. It seems to me quite obvious that these points are grouped within the experimental error about a single curve somewhat concave to the time axis, an interpretation which would have tallied with our results and with those of Letort. (Seddon and Travers admit the possibility of a slight error in the initial timing.) In *B* is reproduced the curve which Seddon and Travers draw through the *same points*.

This summarizes and typifies the main matter at issue between the two schools of thought. Prof. Travers has given his evidence and stated his beliefs as he has every right to do, but since the conclusions are now being reported without an examination of the evidence itself, I feel compelled to direct attention to the nature of the observations, and to say that in my opinion they are of a kind inadequate to justify the kind of deductions which have been made from them about the kinetics of these reactions.

C. N. HINSHELWOOD.

Physical Chemistry Laboratory,
Balliol College and Trinity College,
Oxford.
May 2.

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[1] For example, *Proc. Roy Soc.*, A, **149**, 340, 355 (1935); A, **146**, 345 (1934); A, **115**, 215 (1927)

[2] For example, *Proc. Roy. Soc.*, A, **146**, 334 (1934).

[3] *Proc. Roy Soc.*, A, **156**, 234 (1936) Table VI

Electron Multiplier as an Electron Counting Device

In an earlier communication[1], I have described the possibility of using an electron multiplier, based on the secondary emission principle, for the detection of individual electrons by cooling the multiplier for the purpose of suppressing the thermal emission in liquid air. I stated there that this method of counting individual electrons does not necessarily require the use of liquid air, provided multiplying electrodes, with fairly great secondary emission factor and sufficiently high work function are used. There is a large discrepancy in the data of various papers published on the subject of work function and secondary emission of a surface. Experiments had to be carried out to determine whether a surface satisfying our requirements could be found, and we found the following surface satisfactory from the above point of view:

Very thin layers of barium oxide on a nickel base activated by the method normally used for oxide-coated cathodes will easily give a multiplication factor of $T = 2{\cdot}5$, with a primary electron velocity of 200 volts. A multiplication of about 10,000 times was achieved in a ten-stage multiplier. The thermionic emission (at room temperature) and field emission of the active surfaces in this multiplier are negligible.

On this basis an apparatus was built consisting of the above multiplier and an amplifier with a cathode ray tube. The zero effect of the counting device was about 5 per minute. It was possible to detect individual electrons emitted by the cathode when illuminated by a very weak beam of light or by heating the cathode by a built-in heater. The small zero effect is probably due to cosmic rays. The device can also be used for the counting of gamma rays.

The maximum resolving ability of the above multiplier with an amplifier of suitable construction is 10^{-8} sec.; this greatly surpasses that of the gas-filled counters.

Further details will appear in a paper to be published elsewhere.

Z. BAY.

Tungsram Research Laboratories,
United Incandescent Lamps and
Electrical Company,
Ujpest, nr. Budapest.
April 25.

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[1] Bay, Z, NATURE, 141, 287 (1938).

Rectifying Properties of Crystals

B. K. Sen[1] has recently reported in NATURE, that the rectifying properties observed by Khastgir[2] were found also in some crystals having a centre of symmetry. As in this case a volume rectification must be excluded, Sen concludes that generally the observed rectifying properties should be ascribed to a superficial phenomenon.

So long ago as 1935, I reported the results of experiments on unipolar conduction in carborundum monocrystals, in the direction of the principal polar axis. The experimental procedure I used enabled me to distinguish between a superficial rectification of the 'blocking layer' type, and a true volume rectification. This volume rectification is very less marked and in opposite direction to the surface rectification.

The facts observed by Khastgir must be ascribed substantially to a very strong superficial effect. On the other hand, my experiments demonstrate the existence of a true volume rectification, the existence of which is a natural consequence of the lack of symmetry in a crystal with polar axis[4].

There are thus three different cases:

(1) Deaglio's experiments (true volume rectification).

(2) Khastgir's experiments on carborundum (energical surface rectification concealing the volume rectification).

(3) Sen's experiments on crystals with centre of symmetry (surface rectification only).

ROMOLO DEAGLIO.

Istituto Elettrotecnico Nazionale,
Turin.
May 7.

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[1] Sen, B K., NATURE, **140**, 1102 (1937).

[2] Khastgir, S. R., NATURE, **135**, 148 (1935); Khastgir, S. R., and Das Gupta, A. K., *Indian J. Phys*, **9**, 235 (1935).

[3] Deaglio, R., *C R*, **200**, 1303 (1935); *R. Acc. Scienze Torino*, **70**, 626 (1935).

[4] Osterberg, H., *Phys Rev.* (2), **50**, 1187 (1936).

Formation of Negative Ions at Surfaces

In a recent series of papers[1], one of us (F.L.A.) has discussed experiments, carried out with the assistance of Dr. J. C. Milligan, which led to the discovery of a new process of negative ion formation. This process was the formation of negative ions at metal surfaces by bombardment of the surface with positive ions, the negative ion being presumably formed by the positive ion capturing two electrons from the surface. After acceleration away from the surface, the negative ion has an excess energy which is acquired from the acceleration of the positive ion towards the surface. Dr. R. A. Smith[2] has recently carried out a quantum theoretical investigation of the above process which satisfactorily accounts for the experimental results.

Further work carried out during the past year has shown that the negative ion emitted from the surface need not necessarily be of the same element as the positive ion which leads to its formation. Sloane and Press[3] report in to-day's NATURE that they have repeated these experiments and have come to the same conclusion.

Our new results show that five peaks of light negative ions are obtained by the mass-spectrograph when the electrodes are bombarded by positive ions of argon or nitrogen or mercury, and that practically identical negative ion curves are produced by each type of positive ion. The probable mass numbers of these peaks are about 16, 24, 32, 37, and 44. In each set of curves, using positive ions of argon, nitrogen or mercury, the peak of mass number about 24 (possibly C_2H) is about a hundred times as strong as any of the other peaks. All the negative ions have excess energy and increase in intensity with increase of the positive ion current. With the filament properly degassed and liquid air on all traps, no peaks are detectable, thus showing that good vacuum conditions can be obtained in our apparatus. These new results show that no negative ions of nitrogen are formed, the N^- peak formerly reported being probably O^- produced from occluded oxygen in the surface ejected by the impact of nitrogen positive ions, as is shown to occur below.

The apparatus was then flushed out with oxygen and several runs taken in this gas. The negative ion analysis curves were now entirely different from those obtained in argon, nitrogen and mercury vapour. The main peaks in oxygen were those of mass number 16 and 32, representing O^- and O_2^-. The O^- peak was very intense, being 140 times as high as it was in the other gases. The O_2^- peak had increased by a factor of about 65. The peak at about 24, which was so intense in argon, nitrogen and mercury vapour, was barely perceptible, as were also the other peaks.

The oxygen was then all pumped out and the electrodes bombarded with positive ions of mercury by removing the liquid air traps. The main peak in the analysis curves of negative ions produced on the filament was still O^-, being 24 times stronger than any other peak. For the ions produced on the gauze electrode E_2 of our apparatus[1], the main peaks were those of mass numbers 24 and 32. Re-flashing the filament considerably reduced the O^- peak from the filament, but had no marked effect on the ions from E_2.

The results in oxygen, which are in agreement with those already published[1], appear to show that both O^- and O_2^- are produced by positive ions of oxygen capturing two electrons from the surface, as was previously suggested. However, these ions can also apparently be produced by bombardment by positive ions of mercury of a surface which has absorbed oxygen. Flashing of the filament reduces its content of absorbed oxygen, and so reduces the O^- peak from the filament. The other peaks probably arise in the same way from other gases and vapours either occluded in the metal or adsorbed as a monomolecular layer on its surface.

The latter mode of formation of negative ions of one element by bombardment of the surface with positive ions of another element may be due to a collision of the second kind. Thus a positive ion of mercury, nitrogen or argon may capture an electron into an excited state, the excitation energy being transferred to a gas atom on the surface by a collision of the second kind. This excited atom then captures a second electron from the metal by a resonance process. This mode of formation is the same as the one formerly suggested (by F.L.A.) to account for those negative ions which are formed from their own positive ions, except that in the new process transfer of excitation and kinetic energy occurs between the two species of atoms.

When a high yield[2] of light negative ions is produced by Hg^+ ions, the number of Hg^- ions formed would be considerably decreased. This may account for their not having been observed by Sloane and Press[3].

F. L. ARNOT.
CLARK BECKETT.
University,
St. Andrews.

May 14.

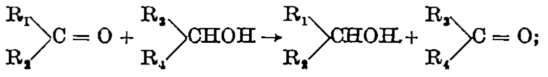
[1] Arnot and Milligan, *Proc. Roy. Soc.*, A, 156, 538 (1936) Arnot, *Proc. Roy. Soc*, A, 158, 137 (1937). Arnot, *Proc. Roy. Soc.*, A, 158, 157 (1937).

[2] Smith, *Proc. Roy. Soc*, A, in the press.

[3] Sloane and Press, NATURE, 141, 872 (1938).

Photochemical Interaction between Ketones and Secondary Alcohols

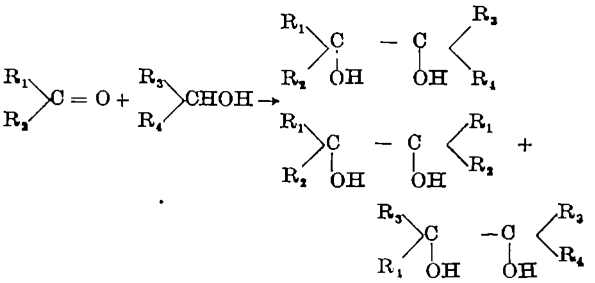
IT has been observed by various authors[1] and recently confirmed by an extensive investigation in our laboratory, that under the influence of ultraviolet light, secondary alcohols and ketones undergo a process of mutual oxidation and reduction. This can consist of a complete hydrogen exchange,



$$\begin{matrix}R_1\\R_2\end{matrix}\!\!>C=O+\begin{matrix}R_3\\R_4\end{matrix}\!\!>CHOH\rightarrow\begin{matrix}R_1\\R_2\end{matrix}\!\!>CHOH+\begin{matrix}R_3\\R_4\end{matrix}\!\!>C=O;$$

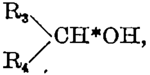
(i)

or of the formation of pinacols,



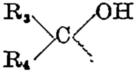
(ii)

In both cases the characteristic reaction is the migration of the hydrogen atom H* of the alcoholic group



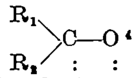
$$\begin{matrix}R_3\\R_4\end{matrix}\!\!>CH^*OH,$$

which may occur in an addition compound formed primarily from the alcohol and the ketone[2]. (That the hydroxylic hydrogen atom is not primarily required for the reaction follows from the fact that similar condensation reactions occur between ketones and the methyl ethers of secondary alcohols.) The radical



$$\begin{matrix}R_3\\R_4\end{matrix}\!\!>C\!\!<\begin{matrix}OH\\ \cdot\end{matrix}$$

can be stabilized by giving up the hydrogen atom of the hydroxyl group or by combining with a second, similar radical, the actual course of the reaction probably depending on the nature of the reactants.

It is probable that dissociation of the C—H* group is not the primary photochemical reaction. As a matter of fact, phenylmethylcarbinol, $C_6H_5.CHOH.CH_3$, is not racemized by ultra-violet irradiation, although dissociation of the C—H*-bond would have such an effect due to the configurational instability of radicals[3]. On the other hand, irradiation of an equi-molecular mixture of optically active phenylmethylcarbinol and acetophenone gives an optically inactive mixture of the diastereomeric acetophenone-pinacols, although one of them could have been formed in the active state. So we are led to the assumption that the primary photochemical step is the activation of the carbonyl compound, which is in accord with the known absorptive capacity of carbonyl compounds, and the relative transparency of alcohols. This activated form, for example, the diradical  $\begin{matrix}R_1\\ \\ R_2\end{matrix}\!\!>\!\underset{:}{C}\text{—}\underset{:}{O}$ [4], reacts with the alcohol, $(R_3)(R_4)\dot{C}HOH$, splitting the C—H* bond and giving two free radicals — configurationally unstable — which can dimerize symmetrically or asymmetrically (II) or stabilize by a second oxidation-reduction process (I).

The above facts and considerations are able to throw some light on the photochemistry of ergosterol and similar compounds. Irradiation of ergosterol in a neutral solvent gives lumisterol without configurational change in the secondary alcoholic group CH*OH [5], but in presence of an acceptor compound (eosine) which suffers activation first, the H* is removed and a bimolecular product (ergopinacol)[6] is formed[7].

A detailed report on our experiments will be published elsewhere.

CH. WEIZMANN.
Y. HIRSHBERG.
E. BERGMANN.

Daniel Sieff Research Institute,
Rehovoth, Palestine.
April 3.

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[1] See e g. Ciamician and Silber, *Ber. dtsch. Chem. Ges.*, **38**, 1575 (1903) and later.

[2] Wolf, K L., and Herold, *Z. physikal. Chem.*, B, **5**, 124 (1929); **13**, 165, 194 (1931).

[3] Pauling and Wheland, *J Chem Physics*, **1**, 362 (1933). Compare also Bergmann and Schuchardt, *Liebig's Ann.*, **487**, 225 (1931).

[4] Bodenstein, *Z. physikal. Chem*, B, **12**, 151 (1931). Farkas and Hirshberg, *J. Amer. Chem. Soc.*, **59**, 2450, 2453 (1937).

[5] Windaus and Dimroth, *Ber. dtsch. Chem. Ges.*, **70**, 376 (1937).

[6] For the formula of this compound see Lettré and Inhoffen, "Sterine, Gallensaeuren, etc.", p. 135 (Stuttgart, 1935); Inhoffen, *Naturwiss.*, **25**, 125 (1937). This ergopinacol seems to be formed from ergosterol through a series of hydrogen migrations; otherwise it would be inconceivable that a hydrogen atom at C_7 should leave the molecule

[7] The analogous reaction is given by dehydro-ergosterol dehydrolumisterol and dehydro-cholesterol. Windaus and Linsert, *Annalen*, **465**, 148 (1928), Dimroth, *Ber dtsch Chem Ges.*, **69**, 1123 (1936); Urushibara, *Chem Centralblatt*, 1, 2982 (1937).

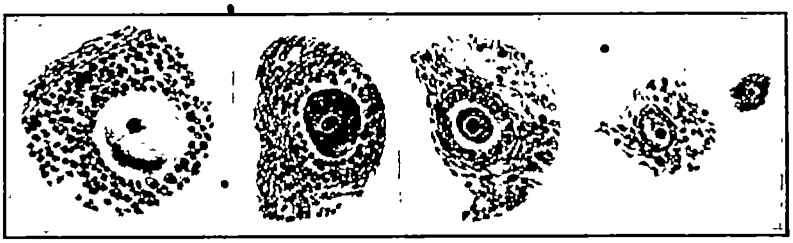
Ovotrophic and Folliculoplasic Hormones

RECENT findings have forced me to distinguish the nucleotrophic or *mitoplasic* from the *plasmotrophic* effect of hormones; plasmotrophy being tissue growth by cellular hypertrophy alone, mitoplasia, growth by mitogenesis as well.

Those hormones of the steroid series which have at least *one* oxygen-bound valency in the — 17 position are usually mitoplasic; for example, œstrone. Colchicine, by arresting mitosis in the metaphase, helps to reveal mitoplasia (Dustin and co-workers), a dosage of 4 γ per gram body weight being optimal for mitotic immobilization at least fifteen hours after injection in the rat.

Pituitary hormones are generally plasmotrophic, as seen by their effect on such tissues as cartilage, mammary gland, adrenal cortex, corpus luteum, thyroid, and the interstitial cells of Leydig. The cells of the ductless glands secrete hormones when enlarged, this secretory capacity being latent when they become atrophic owing to the absence of the anterior pituitary. In general, plasmotrophy increases the specific productivity of all cells and the functional capacity of organs such as liver and muscle.

Although with the aid of colchicine Dustin's collaborators were able to observe a slight degree of mitoplasia in the thyreotrophically stimulated thyroid, the general appearance of the gland suggests a predominantly plasmotrophic effect; the mitoplasia might in this instance be due to contamination of the thyreotrophic fraction with another pituitary factor having the capacity to engender, perhaps in non-thyroid tissue, a factor mitoplasic for thyroid cells. Such a mechanism would be analogous to the plasmotrophic stimulation of the Leydig cells of the testis to produce steroids, mitoplasic for male genital accessories and perhaps also for germinal cells.



CAMERA LUCIDA DRAWINGS OF FOLLICLES OBSERVED SIMULTANEOUSLY IN A SINGLE OVARY AFTER INJECTION OF COLCHICINE INTO A PREGNANT RAT. × 450.

Although follicle stimulation is an apparent exception to the rule that pituitary substances are mitoplasic only indirectly or not at all, it has been easy to show with colchicine that egg development entails follicular mitoplasia. The mechanism of follicle-ripening is elucidated by the following observations:

(1) After hypophysectomy in the rat, small ova remain small, medium-sized ova persist for weeks, as also do corpora lutea, and large ova become atrophic. No additional primary follicles develop, the medium-sized ones continue to show mitosis for about three weeks, and Graafian follicles showing an antrum degenerate. *The occurrence of follicle mitoplasia between two and three weeks after hypophysectomy is convincing evidence that follicular mitoplasia is not immediately dependent on the pituitary: I assume that it depends on the ovum.*

Ova that are medium-sized at the date of hypophysectomy persist in the production of their mitoplasic factor until such time as they degenerate; in which respect they resemble the cells of the corpus luteum, which persist and maintain pregnancy if hypophysectomy is done on or after the twelfth day of pregnancy in the rat, although their removal before term almost invariably leads to fœtal death.

(2) Five camera lucida drawings (above) of follicles observed simultaneously in a single ovary following colchicine injection of a pregnant rat, illustrate the frequency of mitosis with reference to egg size. In normal and hypophysectomized rats, mitosis begins only when the ovum has more than doubled its initial diameter (more than twenty-five times its initial volume); and the maximum frequency of mitosis occurs at a point when the diameter is five or seven

times (volume about 125–350 times) that of a primordial ovum. After death or expulsion of the ovum, a few mitoses sometimes occur, but mitoplasia soon ceases; the granulosa cells become pyknotic, and wandering eosinophil cells invade the follicle, which degenerates and disappears, or in suitable conditions forms a corpus luteum.

(3) These observations were found to hold good also for the ovary of the mouse, guinea pig, rabbit and dog. Rat ovaries with and without gonadotrophic stimulation were compared in pregnant, normal adult, infantile and hypophysectomized animals. It was consistently clear that pregnancy does not interrupt the follicular mitoplasic activity of medium-sized egg-cells. A large egg-cell failing to produce follicular mitoplasia was occasionally found, but never a mitoplasic follicle without a larger egg-cell.

Conclusion. A follicle-ripening anterior pituitary or anterior pituitary-like factor does not exist.

The pituitary generates an ovotrophic hormone, for which a separate existence from the luteinizing and interstitia-stimulating factors of the gonadotrophic complex is yet undetermined.

The ovum itself produces the folliculoplasic hormone, to isolate which investigation of a suitable technique is in progress. J. Freud.

Pharmaco-Therapeutic Laboratory,
University of Amsterdam.
April 25.

Histamine and the Action of the Thyroid Gland

In previous investigations[1] we have pointed out that irradiation of white mice with ultra-violet light is accompanied by a loss of body weight. Furthermore, we have noted[2] that there is a relation between the loss of body weight and the function of the thyroid gland. It was possible to demonstrate that the acetonitrile test of Reid Hunt[3] becomes positive during the time in which a lowering of body weight of the irradiated mice was found. Because there is a connexion between erythema-producing power of ultra-violet light and the weight loss, the conclusion was drawn that the formation of histamine-like substances seems to be responsible for the activation of the thyroid gland and the loss of body weight.

In order to test this belief, the following experiments were carried out: histamine hydrochloride (0·01–0·04 mgm.) was injected subcutaneously into white mice five times weekly for fourteen days. The diet of the mice was bread (32 gm. weekly) and water *ad libitum.* The body weight was controlled every week.

We found that it is possible by this means to effect a lowering of the body weight in the injected mice, but not in every case. Apparently, the initial level of the activity of the thyroid gland is important. In those cases, however, where it was possible to obtain a lowering of the body weight, there was also a positive acetonitrile test.

The accompanying table will serve as a preliminary report:

No.	Average body-weight difference between treated and untreated mice	Acetonitrile test for thyroid according to Reid Hunt (Doses 1 5 mgm./gm. body-weight)		
		Surviving 24 hours		
		Histamine treated	Untreated	Result
55	– 6 per cent	7 from 10	2 from 9	positive
58	0	4 from 7	7 from 7	inverse
60	– 3 per cent	5 from 9	4* from 8	positive

* One of these was moribund.

These findings seem to be supported by the findings of Dietrich and Schwiegk[4]. These authors pointed out that injection of histamine produces a higher blood flow in the thyroid gland, as well as in other parts of the circulation, and on the basis of this result a more intense functioning of the gland is understandable.

The observation of a higher degree of activity of the thyroid gland after repeated injections of histamine seems to support further the histamine theory of general ray reactions[5].

Additional data will be published later.

F. Ellinger.

Biological Institute,
Carlsberg Foundation,
Copenhagen.
May 7.

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[1] *Radiology*, in the press

[2] *Skand Arch physiol*, in the press

[3] *Amer. J. Physiol.*, 63, 257 (1923).

[4] *Arch. Exp Pathol u. Pharmakol.*, 165, 53 (1932).

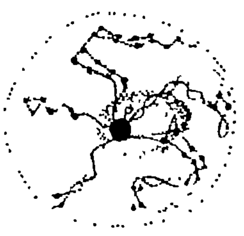
[5] comp. Ellinger, F., "Die biologischen Grundlagen der Strahlenbehandlung" (Berlin, 1935).

Development of the Giant Salivary Gland Nuclei of *Drosophila*

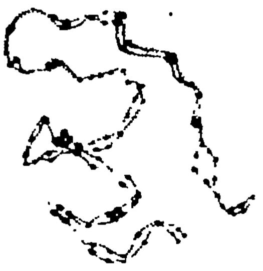
The development of the giant spireme-like salivary gland nuclei of various species of *Drosophila* larvæ (*repleta*, *melanogaster*, *funebris*, *robusta* and *virilis*) has been studied in preparations of whole organs and sections stained after Feulgen.

The nuclei of the salivary glands and other organs of very small larvæ have the structure shown in Fig. 1. The chromocentre is formed at the telophase through the fusion of the heterochromatic proximal ends of the chromosomes. It is situated at the periphery of the nucleus and is always connected with the nucleolus lying in the centre of the nucleus. On the surface of the nucleus are located thread-like paired chromosomes twisted together. Each of these chromosomes consists of two closely connected genonemata. The proximal ends of the chromosomes are united with the chromocentre; owing to this it is possible to determine their haploid number. When the focus is changed a reticulum of the resting nucleus is seen.

The genonemata do not stain after Feulgen and they are well visible owing to the lengthwise arranged



1.



2.

Fig. 1.

A salivary gland nucleus from a small larva (1·5—2 mm. long) of *D. repleta.* ×3200.

Fig. 2.

Two paired chromosomes twisted together. From the cæcum of the midgut of a larva of *D. repleta.* ×3200.

chromomeres. The dimensions and the number of the chromomeres augment with the growth of the larva; the genonemata lengthen and form numerous curves.

The genonemata are uncoiled and straightened with the growth of the nucleus. For this reason, sections of the genonemata including lengthwise arranged chromomeres correspond to single chromomeres of the nuclei of young larvæ. A close contact between homologous chromomeres of two chromosomes twisted together becomes possible and this results in the appearance of bands (Fig. 2).

In a larva 3 mm. long, bands may be noted in all the organs where spireme-like nuclei are found, the chromosomes being at the same time very fine (Fig. 3). Their diameter gradually increases, that is, growth of the chromosomes sets in. After this the number of chromonemata (genonemata with chromomeres and chromoplasma) is doubled and therefore the diameter of the chromosomes also becomes doubled.

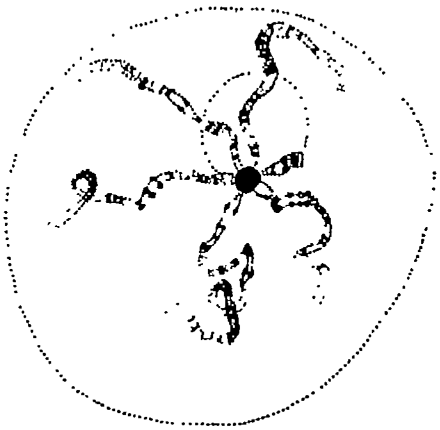


Fig. 3.

A SALIVARY GLAND NUCLEUS FROM A LARVA (3 MM. LONG) OF *D. repleta*. THE PROXIMAL ENDS OF THE CHROMOSOMES ARE CONNECTED WITH THE CHROMOCENTRE. ×3200.

A second duplication of the chromonemata occurs in larvæ of the last age. In the nuclei of the cæcum of the midgut the number of chromonemata is doubled once. In some organs no such duplication is to be noted. In some organs (œsophagus, ring-gland) the spireme-like nuclei are never formed. Here the nuclei as well as the nuclei in different organs of the imago may be compared with definite stages of development of spireme-like salivary gland nuclei. Small nuclei are comparable with the nuclei of very young larvæ, larger ones with those of larger larvæ where the chromosome bands have not yet been formed.

In the present work the identity has been established of the structure of all resting nuclei in the larvæ and imago of *Drosophila* and the absence of any essential difference between them and the spireme-like salivary gland nuclei. This structure of the resting nuclei, that is, pairing of homologues and their connexion with the chromocentre, is retained from the last telophase. This proves the continuity of the chromosomes.

S. L. FROLOVA.

Institute of Experimental Biology,
Moscow. April 25.

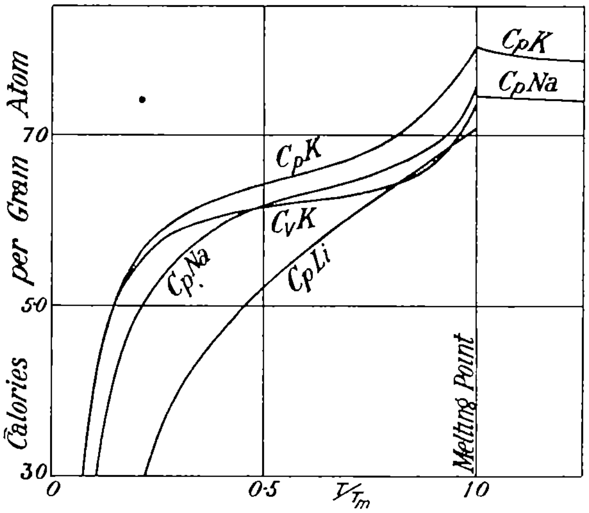
Specific Heat of the Alkalis

IN the alkali metals, the electrons may be considered as degenerate in the Fermi-Dirac sense and incapable of contributing more than a few per cent to the specific heat. The explanation of any effect which exists is therefore probably to be sought in the lattice itself.

We have recently completed measurements of the true (as opposed to mean) specific heat of potassium over the temperature range − 70° C. to + 336° C. and the results show the normal tendency to attain a constant value of the order of $3R$, followed by an abnormal rise of specific heat, setting in at about room temperature and extending up to the melting point (63·4° C.). The potassium was of a high degree of purity and was distilled *in vacuo* into the calorimeter in which the measurements were made. Further, the rate of increase of abnormal specific heat with temperature is of a much lower order than that which impurity should produce, since spurious specific heat due to premelting caused by impurity may be expected to increase as the inverse square of the difference of the temperature from the melting point.

We are therefore of the opinion that the abnormal rise of specific heat is a property of pure potassium.

We have also made some preliminary measurements of the specific heat of lithium over a range of 180° immediately below the melting point. These, combined with the experimental data of others given in Landolt-Bornstein's "Tables" and some values obtained by Bidwell[1], have been used to draw the experimental curve shown in the accompanying graph, on which have also been plotted our experimental values of C_p for potassium, and the C_v values derived from them. The values for C_p for sodium have also been plotted from Landolt-Bornstein; unfortunately, there are insufficient data for rubidium and cæsium.



For the purpose of comparison a common temperature scale, obtained by expressing the temperatures as fractions of the absolute melting temperature, has been used. It will be observed that the abnormal rise of specific heat, extending over a considerable range below the melting point, appears to be a common property of all three elements.

The abnormal behaviour of the specific heat of lithium and sodium has been already noted by

Bidwell[1], who suggests that the abnormality may be caused by a gradual breakdown of the lattice as the melting point is approached. In support of this hypothesis he quotes observations[2] which tend to show that the X-ray diffraction patterns disappear also well below the melting point.

Whatever the cause of the phenomenon, we wish to emphasize that, so far as present knowledge goes, it is an effect which is characteristic of the alkali metals, since it is almost absent in other elements, for example, mercury[3], bismuth[4], iodine[5] and lead[6], on which measurements of true specific heat have been made right up to the melting point.

L. G. Carpenter.
T. F. Harle.
C. J. Steward.

Physical Laboratory,
University College,
Southampton.
April 13.

[1] Bidwell, *Phys Rev*, 28, 584 (1926)
[2] Bidwell, *Phys Rev*, 27, 381 (1926)
[3] Carpenter and Stoodley, *Phil. Mag*, 10, 249 (1930)
[4] Carpenter and Harle, *Proc. Roy Soc*, A, 136, 243 (1932).
[5] Carpenter and Harle, *Phil. Mag.*, 22, 193 (1937).
[6] Klinkhardt, *Ann Phys*, 84, 167 (1927).

Free Field Calibration of Microphones

The determination of the 'field calibration' of a microphone, that is, the sensitivity under free space conditions, has been rendered difficult in the past by the presence of air currents comparable with the velocities to be measured, or field irregularities and uncertainties in direction due to reflection from the walls in a small enclosure. If, in the case of a pressure operated microphone, one tries to avoid this trouble by determining the pressure calibration by the resonant tube[1] or thermophone methods and by calculating the increase in sensitivity due to reflection from the microphone, the difficulty, if not impossibility, of making this calculation rigidly for practical forms of microphone is encountered.

We have developed a new technique of calibration by substitution in the free field, using a search tube of small diameter connected to a condenser microphone. The free space calibration of this search tube is obtained by inserting its open end through a rubber bush in one end of a closed resonant tube and adjusting its position until it is one or more half wavelengths from the bush, that is, until it is at a pressure maximum other than those occurring at the two ends of the resonant tube. The search tube is then in a standing wave, which is conveniently measured by a Rayleigh disk suspended at the centre of the resonant tube. We have shown experimentally that the response of the search tube microphone is dependent only on the acoustic pressure at its mouth and is independent of the diameter of the resonant tube so long as this is large compared with the diameter of the search tube. We have been unable to detect any distortion of a sound field from a loud speaker in an absorbent test room due to the presence of the search tube, so it may be used to explore the field before and after the insertion of the microphone to be calibrated. If this microphone has had a pressure calibration in the resonant tube, the increased sensitivity due to reflection can be deduced. A check on this increase is obtained by a comparison of the explorations of the field with and without the microphone present. This has been done and the variation of the '2 : 1 effect' with frequency investigated.

The matter will be dealt with in a paper in the near future.

A. J. King.
C. R. Maguire.

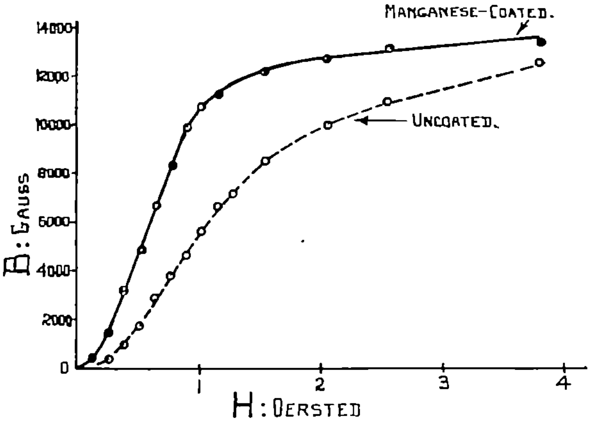
Research Department,
Metropolitan-Vickers Electrical Co., Ltd.,
Trafford Park, Manchester, 17.
May 9.

[1] Churcher, B G and King, A J, *J Inst. Elec. Eng*, 68, 97 (1930).

Effect of Manganese Coating on the Magnetic Quality of Iron Wire

A length of Armco iron wire was heated in hydrogen at about 1320° C. until a condition of maximum permeability was reached. The magnetization curve was then obtained (broken line curve in the accompanying graph).

Through the courtesy of Mr. Kenneth Gray, of Messrs. Mellowes and Co., a sample of the same consignment of Armco iron wire was sprayed with a coating of pure manganese powder to a thickness of about 0·002 in. This sample was then heated in hydrogen at about 1320° C. until a condition of maximum permeability was reached. The magnetization curve was then obtained (full line curve in the graph).



This notable improvement of the magnetic quality of iron wire due to a coating of manganese is all the more surprising when it is recalled that the non-magnetic quality of Hadfield's manganese steel is due to a 10–15 per cent manganese content, the maximum permeability of this steel being about 1·2.

T. F. Wall.

Department of Electrical Engineering,
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April 25.

Viscosity of Air and the Electronic Charge

From measurements of wave-lengths of X-ray lines with ruled grating and from the Bragg angles of reflections from crystals, it is possible to compute the magnitude of the electronic charge. The value thus obtained by Bearden[1] and Bäcklin[2] is $4\cdot807 \times 10^{-10}$ E.S.U., which is considerably higher than Birge's[3] best estimate of Millikan's oil drop value of electronic charge $(4\cdot770 \pm 0\cdot005) \times 10^{-10}$ E.S.U.

Millikan has in his own experiment[4] assumed a value for the viscosity of air at 23° C. of (1822·6 ± 0·04 × 10^{-7} C.G.S. units, which is based only on the observations of Harrington[5].

Various experimenters have measured the viscosity of air, obtaining results varying from 1820 × 10^{-7} to 1850 × 10^{-7}. In view of the importance of an accurate knowledge of the coefficient of viscosity, we have carried out an investigation on viscosity from flow through capillary tubes. For the purpose of measuring instantaneous values of pressures, a method based on the counting of interference fringes originally adopted by Wagstaff[6] was employed with improvements. Five different capillary tubes were used and various necessary corrections were applied. The final value of viscosity of dry air at 23° C. obtained by us is (1833·3 ± 2·1) × 10^{-7} C.G.S. units, while the increase per degree centigrade is 4·95 × 10^{-7} C.G.S. units. Our value is essentially close to Kellstrom's[7] value (1834·9 ± 2·7) × 10^{-7} and also to Bond's[8] value (1834·7 ± 0·8) × 10^{-7}. Rigden[9] has reported a slightly lower value.

If our value of viscosity of air be substituted in Millikan's oil drop experiment, $e = (4{\cdot}811 \pm 0{\cdot}009) \times 10^{-10}$ E.S.U., which agrees with the X-ray value of $e = 4{\cdot}807 \times 10^{-10}$ within the source of experimental error.

A detailed account of the work will be published elsewhere.

G. B. BANERJEA.
B. PATTANAIK.

Department of Physics,
Ravenshaw College,
Cuttack.

[1] Bearden, *Phys. Rev.*, **37**, 1210 (1931)
[2] Bäcklin, *Z. Phys.*, **93**, 450 (1934).
[3] Birge, *Phys. Rev.*, Supp., **1**, 1 (1929).
[4] Millikan, *Phil. Mag.*, **34** (1917).
[5] Harrington, *Phys. Rev.*, **8**, 738 (1916).
[6] Wagstaff, *Phil. Mag.*, **45**, 84 (1923).
[7] Kellstrom, *Phil. Mag.*, **23**, 250 (1937)
[8] Bond, *Proc. Phys. Soc.*, **49**, 206 (1937)
[9] Rigden, NATURE, **141**, 82 (Jan. 8, 1938)

Life-History of the Salmon (*Salmo salar* L.)

IN a recent communication, published in *The Times* of March 26, we appealed to British and Irish boards of salmon fisheries for help in obtaining material for the study of the sexual phases in salmon parr; we now wish to appeal to all European bodies who could send us samples of either salmon parr or salmon smolts five inches in length or more.

We have found that a ripe and almost certainly functional male phase is attained normally in most—and possibly all—male *Salmo salar* from the Welsh and Cheshire Dee before they migrate to the sea as smolts[1]. To obtain evidence of the functionality of this phase it is necessary to examine parr or smolts in the post-breeding season. Material from the Welsh Dee has confirmed the inference that the young males spawn in this river; a full account of this work will be published elsewhere later. It is, however, desirable to investigate the problem throughout the geographical range of the salmon to ascertain whether the phase is constant under widely different environmental conditions.

It is conceivable that breeding habits may vary in this fish with extremes of habitat. The results from the Dee indicate that spent males may behave differently from the mature females of the same age, whence it is advisable to sample different groups or shoals of parr or smolts. Such samples from European countries would be gratefully received and gladly acknowledged by us at the address given below, and reasonable expenses paid.

J. H. ORTON.
J. W. JONES.

Department of Zoology,
University of Liverpool.

[1] Orton, J. H., Jones, J. W., and King, G. M., *Proc. Roy. Soc.*, B, **125**, No. 898 (March 1938).

Revision of Al I Terms

IN the course of a study of the proper co-ordination of the AlH spectral terms to the Al + H atomic combinations[1], some doubts arose as to the correctness of Lansing's analysis[2] of the Al I lines in the region 3050–3070 A. Spectrograms of an interrupted aluminium arc were taken with the large concave grating of this Institute. The measurement of the seven lines (three of which were attributed by Lansing, on the basis of wrong measurements, to an $sp^2\ {}^2D \rightarrow s^2p\ {}^2P$ transition) revealed, first, that no one wave-number difference is equal to the separation of the $s^2p\ {}^2P$ ground state of Al, and secondly, that all the seven observable lines can be explained at once by a $3s3p4s\ {}^4P \rightarrow 3s3p^2\ {}^4P$ transition. This explanation is supported by the analogous term-combinations in the isoelectronic sequence Al I, Si II, etc.[3]; the separations of the multiplet components and relative positions of the two ${}^4P$ terms of Al can be calculated to a rather good approximation from the positions and separations of the related terms. Preliminary results of Zeeman effect experiments on the strongest of the seven lines involved also confirm the ${}^4P \rightarrow {}^4P$ explanation.

The classification, wave-numbers and estimated intensities of the analysed group of seven Al I lines are given in the following table:

		$3s3p4s\ {}^4P$		
		$j = 5/2$	$j = 3/2$	$j = 1/2$
$3s3p^2\ {}^4P$	$j = 5/2$	32700·6 (10)	32604·6 (8)	—
	$j = 3/2$	32776·5 (6)	32680·4 (2)	32624·1 (3)
	$j = 1/2$	—	32727·1 (4)	32671·0 (0)

Since the incorrect previous assignment has been quoted in books of reference (such as "Atomic Energy States" by Bacher and Goudsmit), a revision, that is, the dropping of the term-value of $3s3p^2\ {}^2D$, seems to be necessary. One gains, however, a more uniform co-ordination (in the sense already outlined[1]) of the hydride and deuteride molecular terms of the elements in the third column of the Periodic Table with the proper atomic term-combinations.

R. SCHMID.
L. GERO.
KATALIN LORINCZI.
G. NEU.

Physical Institute, Royal Hungarian
University for Technical and Economic
Sciences, Budapest.
April 21.

[1] Schmid and Gero, *Naturwiss.*, **26**, 108 (1938).
[2] Lansing, *Phys. Rev.*, **34**, 597 (1929).
[3] Beckman, Anna, Diss., Uppsala (1937).

An Optical Illusion

In the course of some cinematographic tests, I observed a visual effect which may be of some interest to readers of NATURE and is probably open to a ready explanation.

A cage consisting of two bright wire rings crossing at right angles and about 8 in. in diameter was rotated about its polar axis, at varying speeds. The object was to produce a bubble-like appearance on a film. During rotation three optically black lines appeared, one apparently reaching from pole to pole in a straight line and the other two stretching from pole to pole in right and left hand curves. It is obvious that these dark lines are caused by the passage of the parallels of longitude across each other; thus the vertical line appears when one circle is edge on to the line of sight, and the curved lines when rotation through 45° from that position has occurred.

I should value an explanation of the cause of the lines. It is probably needless to add that they do not show on the cinematograph film. The lines are seen quite distinctly at low speeds—even oscillating the cage with the fingers—and in any light. A spot light and dark background gives the best effect.

LOUGH PENDRED.

28 Essex Street, Strand,
London, W.C.2.
May 16.

Points from Foregoing Letters

S. Kownacki and J. A. Ratcliffe outline a method for investigating 'electron-inertia' effects in thermionic tubes. They point out that if positive ions of atomic mass are used instead of electrons, the frequencies involved are very much smaller and more manageable. They have investigated some 'electron-resonance' effects with tubes in which positive ion emitters were used, and the frequencies involved were about 5×10^5 and 10^6 c./sec. when cæsium and lithium ions respectively were used.

Sir Arthur Keith, after examining a cast of the South African 'Florisbad' skull, concludes that it is an important evolutionary link indicating that South Africa, like Java, has been an independent centre of development from a sub-human form to the modern Bushman and Hottentot.

Prof. C. N. Hinshelwood differs strongly from Prof. Travers in the interpretation of the kinetics of certain gaseous organic reactions, and gives as an example data obtained by Seddon and Travers for the decomposition of acetaldehyde at 400°, from which he would draw quite different conclusions.

An electron-counting device based upon the secondary emission principle has been constructed by Prof. Z. Bay. It does not involve cooling in liquid air to suppress thermal ionization, but utilizes a very thin layer of barium oxide on a nickel base with a high 'work function', and a ten-stage multiplier which gives a ten thousand fold increase. The instrument has a resolving ability which greatly surpasses that of the gas-filled counters.

When negative ions are formed at metal surfaces by bombardment with positive ions, the resulting negative ions need not be of the same element as the bombarding positive ions, according to Dr. F. L. Arnot and C. Beckett. As an example, they describe experiments showing that positive mercury ions may produce negative oxygen ions.

The exchange of hydrogen atoms between secondary alcohols and ketones, or similar compounds, under the influence of ultra-violet light (a reaction important also in the photochemistry of ergosterol) has been investigated by Ch. Weizmann, Y. Hirshberg and Dr. E. Bergmann. They consider that it comes about through the activation of the carbonyl group, CO, which afterwards reacts with the secondary alcohol group, splitting the C—H bond, and giving two free radicals which may either join together or be stabilized by a second oxidation-reduction process.

The fact that mitoses occur in follicles of rats some time after hypophysectomy leads Dr. J. Freud to the view that follicular growth is perhaps only indirectly dependent on the pituitary. It is assumed that the pituitary produces a hormone causing growth of eggs. When the egg volume reaches twenty-five times the original, the production of a hormone by the egg itself becomes apparent by the mitogenic response of the follicle. The folliculogenic hormone is therefore not of pituitary origin but is produced in the egg-cell.

Histamine hydrochloride injected into white mice is found by Dr. F. Ellinger to decrease the body weight in the same way as irradiation with ultra-violet light. He considers that histamine exerts its action by stimulating the thyroid gland.

Several stages in the development of the giant salivary gland nuclei in the fruit fly, *D. repleta*, are described and illustrated by S. L. Frolova. She finds that all resting nuclei in the larvæ and imago of *Drosophila* are alike and do not differ from the spireme-like salivary nuclei.

From new determinations of the true specific heat of potassium and lithium, together with previously known values for lithium and sodium, L. G. Carpenter, T. F. Harle and C. J. Steward have drawn curves showing that the abnormal rise of specific heat, extending over a considerable range below the melting point, is common to these three alkali elements.

A new technique for the calibration of microphones, by substituting in the 'free field' a search tube of small diameter connected to a condenser microphone, is described by A. J. King and C. R. Maguire.

Dr. T. F. Wall finds that the magnetic permeability of an iron wire is notably increased when covered with a thin coating (about 0·002 in.) of manganese.

A redetermination of the viscosity of air by Dr. G. B. Banerjea and B. Pattanaik gives a value of $1{\cdot}833{\cdot}3 \times 10^7$ C.G.S. units, which when introduced in Millikan's data from his oil-drop experiment, gives a value of 4·811 for the electronic charge, in close agreement with the value obtained from X-ray experiments.

Dr. R. Schmid and collaborators have identified in the Al I spectrum a $^4P \rightarrow {}^4P$ transition, which necessitates the dropping of a previously accepted ^2D term.

Research Items

Race and Language in India

WITH a view to possible light on the problem of race and language, Dr. D. N. Majumdar has investigated the physical relationship of certain Austric-speaking tribes of India with special reference to measurements of Hos and Saoras made by himself and others (*Proc. Ind. Acad. Sciences*, 7, 1 ; 1938). The relevant questions to be answered are: (1) Whether the Austric-speaking tribes in India and more particularly the Munda-speaking groups represent the same racial type ; (2) Is there any racial difference between the Mundas and the Dravidian-speaking group ? (3) Are the Hos and Mundas more variable than the Sonthal and Bhumij ? Taking first the comparison of the Ho series from the Kolhan with the Mundas and Bhumij, two neighbouring groups, believed to be of the same racial stock, a comparison of the mean measurements shows that while there are quite marked differences between the three groups, the only significant difference between Hos and Mundas is in stature, while between Hos and Bhumij there is no evidence of difference except for the nasal measurements, which in the Mundas and Bhumij are of doubtful accuracy. Otherwise it is to be concluded that the three groups are of the same or similar origins. Comparison of the Saoras with the Hos and with the Mundas and Bhumij confirms the general belief that the Saoras are of an entirely different stock. Twelve comparable characters show in their means a significant difference in seven, especially marked in nasal length and bizygomatic breadth ; but it is of interest to note that all four types are almost identical as to cephalic index. In regard to differences from the high caste Brahmins and Kayasthas, and the tribal Khasis of Assam, of ten characters, both absolute and indical, significant differences exist between the Hos and Saoras and the caste groups—from the Brahmins in seven and from the Kayasthas in eight, these being interpreted as a racial difference. Between Hos and Khasis there are significant differences in six characters, the difference of the Saoras and Khasis being approximately the same.

Genetics of Schoolboys

IN a study of the stature of 2,500 schoolboys in Sheffield between the ages of 5 and 17 years, Dr. M. A. MacConaill (*Ann. Eugenics*, 8, 117) divides them into three classes: blond, brunet and heterochrome ; the blonds having blue eyes and fair hair, brunets brown eyes and dark hair, heterochromes all other combinations of eye and hair colour. The heterochromes were found to be significantly shorter than the blond and brunet groups at all ages except during puberty. They were also more variable than the blonds and brunets. In explanation of these significant results, it is suggested that the heterochromes are more heterozygous than the other two types. In an earlier paper by MacConaill and Ralphs in the same journal (7 ; 218) a study of the post-natal development of eye and hair colour was made in the same group of schoolboys. The type called leucochrome, with blue eyes and blond hair, showed a steady fall in frequency throughout the age period from 5 to 21 years. All other types were called allochrome, and were divided into brunet, heterochrome and xanthochrome (pure blonds, other than leucochrome). The leucochrome is the type of infancy, from which all other types gradually arise through development of pigment. They fall to a steady ratio of 17 per 1,000 at the age of puberty. It is suggested that the leucochrome type is essentially a Mendelian recessive, the delayed development of pigment in the other types being a manifestation of delayed dominance, as in some animals.

Removal of Poison Glands of Rattlesnakes

PROF. JOHN TAIT of McGill University describes an operation for the surgical removal of the poison glands of rattlesnakes, devised to make the animals more amenable to physiological experimentation (*Copeia*, March 1938, p. 10). The snake is anæsthetized in a glass box containing dilute chloroform vapour and the operation, which is described in detail, occupies at top-speed twenty-one minutes, the depth of anæsthesia being gauged carefully throughout the process. The removal of the glands alters the shape of the head, which becomes narrow like that of poisonous colubrine or innocuous snakes. It has no effect upon the temper or health of the snake nor does it affect the maintenance or successional replacement of the fangs; fang-growth and replacement being apparently controlled independently of the associated poison glands. Another point of interest was that in one or two of the early trials the poison sac was perforated and venom flowed freely into the open wound; the poison was swabbed away so far as possible, but in no case did the snake show any harm from being deluged with its own poison. The procedure devised for deglanding should prove a useful advance, for it produces a wound that heals readily, no case of lethal sepsis having been recorded in operations on some hundred and twenty snakes. On the other hand, the old method of removing the fixed and reserve fangs usually resulted in an infection of the mouth, which was intractable to disinfection and resulted in death.

Development of Compound Eyes

AN important work upon the morphogenesis of the compound eyes of arthropods, by Francis Bernard, has been issued as Supplement 22 to *Bull. Biol. France et Belgique* (1937). In spite of differences in the minute structure of the elements of compound eyes, there is a common plan in their development and growth. Thus the development of parts follows a regular succession—optic ganglia, retina and peripheral pigmentary cells, cornea and crystalline lens. So in the growth of compound eyes—a subject little studied hitherto—Bernard finds that increase in size is due to additions of new elements or ommatidia formed in a lateral hypodermic zone. The elements do not reach the surface and become functional until two or three stages after the cell-divisions which originate them. The additional facets grow in regularly rhythmic series parallel with the stages of moulting, except in the crab, *Macropodia rostrata*, where phases of arrested development have been observed. Finally, the author devotes a chapter to the study of the structure of reduced compound eyes, adding twenty new examples from his own observation. Reduction in the adult eyes is due to three distinct processes: simple atrophy or arrest of normal development as in the retina of all arthropods studied and in the crystalline cones of insects; hypertrophy of certain secretions, as in the rhabdome of all arthropods, and the cones of Crustacea; and degeneration in the course of larval life, as in the optic ganglia of certain parasitic Crustacea. This comprehensive study should facilitate new researches on the subject of morphogenesis in compound eyes.

Dextrality in *Limnæa peregra*

The inheritance of dextrality and sinistrality in snail shells has been shown to be a phenomenon of considerable complexity with several peculiar features. The problem has been carried further in a long paper by Capt. C. Diver and I. Andersson-Kotto (*J. Genetics*, 35, No. 3). It has already been shown in *Limnæa peregra* that four types of broods exist: *A* broods, all dextral; *K* broods, all sinistral; *E* broods, sinistral with a few dextrals; and *F* broods, dextral with a few sinistrals. Sinistrality is also a simple recessive to dextrality, but owing to the nature of the character, it is determined in the egg before fertilization by the joint action of the genes in the zygotic constitution of the parent. The constitution of an individual is therefore determined by the brood it produces, and segregation is only visible in F_3. *E* broods are genetically sinistral, but contain up to 20 per cent of phenotypic dextrals, the percentage varying in different strains. On the other hand, the sinistrals produced in *F* broods are usually genotypic as well as phenotypic. These and many other results of breeding experiments are explained on the hypothesis that *E* broods are the product of a series of modifying genes, some stronger in effect than others, which convert a homogeneous sinistral brood into a mixture. They follow the system of delayed inheritance, like the principal gene. The *F* broods are probably of different types, some of them due to a direct mutation from dextrality to sinistrality.

Action of One Plant Upon Another

A short paper by Prof. F. E. Weiss (*J. Roy. Hort. Soc.*, 63, Pt. 4, 166–169, April 1938) directs attention to an interesting trend of modern botanical research, namely, the influence of one plant upon another. Relations between stock and scion, and between two symbionts are obvious instances, but there are also less patent influences. Prof. Weiss considered the work of Gurwitsch on mitogenetic rays, where the proximity of one plant has been held to induce cell division in another organism. Toxic substances released from one plant may inhibit the growth of another, and it is probable that the grass under the trees in some orchards has a deleterious effect upon the fruit crop. Ripening apples liberate a substance, probably ethylene, which can assist the maturation of later varieties, and also, according to Gane and Smith, can affect the germination of peas deleteriously. The late Prof. Molisch had experimented further in this direction, and found that very light doses of apple vapour assisted the germination of many kinds of seeds, where heavier applications were harmful. Leaf-fall in privet, elder and other plants was induced by the emanations from apples, which also stimulated the rooting of poplar and willow cuttings. Vapours from pot-bound roots of *Melaleuca squamea* and *Acacia verticillata* accelerated the growth of vetch seedlings. It is obvious that more research is desirable, but the results collected by Prof. Weiss offer a most attractive field for future investigation.

A Virus and its Insect Vector

Some ingenious experiments upon the relations between Hyoscyamus virus 3 and the aphid *Myzus persicæ* are described in a recent paper by Mrs. M. A. Watson (*Proc. Roy. Soc. B.*, 125, 144–170, March 1938). Relations between a virus and its insect vector are often very close. The paper under review shows that the aphid can transmit the virus much more easily if made to fast before feeding upon infectious material. Previously fasted aphids, when fed for one hour on healthy plants before their diet was changed to infectious material, however, transmitted the disease no better than unfasted ones. Unfasted aphids quickly lost their power of infecting, whilst fasted insects retained this ability for a longer time. A consideration of these points leads to the supposition that the virus is inactivated by some substance acting during the digestion of food. Trypsin is known to inactivate the virus *in vitro*, and since this enzyme is not produced when an aphid fasts, the assumption that it acts as a substance toxic to the virus fits all the above facts. It is not yet clear, however, how such inactivation by a stomach enzyme could exert an effect through the salivary glands and proboscis, which are regarded as the organs of re-infection.

New Map of Graham Land

The map of Graham Land, Antarctica, was considerably changed as the result of Sir H. Wilkin's flight ten years ago. Now as the result of the air and sledge journeys of the British Graham Land Expedition under Mr. J. Rymill, some of the older features of the map have been reinstated but with modification. The new map appears in the *Geographical Journal* of April and May accompanying an article by Mr. Rymill on the work of the expedition. The peninsularity of this part of Antarctica is again established. Casey Channel and Stefansson Strait disappear. Scripps Island, in about lat. 70° S., is a mountainous area of the mainland. But a remarkable new channel appears on the map. King George VI Sound, twelve to thirty miles in width, stretches for more than two hundred miles between the mainland of Antarctica and Alexander I Island. The latter is much increased in size and appears to be linked by shelf ice, probably of glacier origin, with Charcot Island farther west. The sound is filled with ice and was explored by sledge and aeroplane. At the most southerly point reached in about lat. 72° S. there was no sign of a channel to the east. The sound turned in a south-south-west direction and widened considerably, suggesting that it opened into a wide bay south of Alexander I. Island. The lack of a good route eastward towards the Weddell Sea prevented the exploration of the inaccessible western coast of that sea, which had been one of the main objectives of the expedition.

Cyclone Season 1934-35 at Mauritius

No. 17 of Miscellaneous Publications of the Royal Alfred Observatory by M. Herchenroder, entitled "The Cyclone Season 1934–35 at Mauritius", contains charts and descriptions relating to the eight cyclones of that season with some reference also to five minor disturbances. The season was not a remarkable one, the number of cyclones and minor disturbances being the same as in 1933–34, except for the absence of cyclones around Mauritius and Madagascar in March and for the lack of evidence of any such storm throughout the entire season around the Cocos Keeling Islands. The author, in reference to a common notion that tropical cyclones are not accompanied by high pressure systems as is the case with intense temperate depressions, notes that five out of the eight here described disproved this notion in a striking manner. Four of these formed near Madagascar, and the accompanying anticyclone was easily identified with the aid of the South African weather reports. The incursion of this anticyclone north-eastwards into lower latitudes with the invasion of cooler air from higher latitudes appeared to be a preliminary event incidental to the formation of the tropical cyclone centre. It is suggested that perhaps only lack of information prevents a similar state of affairs from being demonstrable in the case of the formation of tropical cyclones in other parts of the South Indian Ocean. This lack of information, it is suggested, is unlikely ever to be got over by reports from ships alone. Attention is directed also, in this discussion, to another matter in connexion with the development of these cyclones, and that is the growing belief among observers that a necessary condition for such development is the extension of the cold easterly or south-easterly current of the accompanying anticyclone above the equatorial current, a belief referred to, for example, in the meteorological report of the Madagascar Weather Service for March 1935.

Effect of the Surrounding Medium on Fracture in Solids

P. Rehbinder and E. Wenstrom (*Bull. Acad. Sci. U.R.S.S.*, 548 ; 1937) have shown in previous publications that 'brittle fracture' of solid bodies becomes easier on immersion in a suitable liquid, and that the surface hardness is reduced by this immersion. This phenomenon is connected with the reduction in surface energy produced by immersion. In the present work they show that the *plastic* fracture of wires stretched under a non-polar liquid (pure hydrocarbon oil) is greatly influenced by the addition of polar substances. For example, the time during which plastic flow takes place before fracture in lead may be reduced by a factor of 30–60 by the addition of 0·001–0·005 per cent of $C_{25}H_{51}COOH$. This effect is described as an 'internal lubrication' of the metal, and it is suggested that it plays an important part in the action of lubricated cutting tools.

Absorption of Fast Electrons

A. J. Ruhlig and H. R. Crane (*Phys. Rev.*, 53, 618 ; 1938) have extended the work of Crane on the energy losses of high-energy electrons in thin lead sheets. The particles studied included a group 0·35–1·35 M.e.v. from radioactive phosphorus and a group up to 17 M.e.v. produced by the Li + ^{1}H gamma-radiation. In the lower energy region, the losses due to radiation are negligible according to the Bethe–Heitler theory, and the loss is due almost entirely to ionization processes. The experimental value for the energy loss is about three times that given by the theory of Bloch, and shows an increase on going from 0·5 to 1 M.e.v. which is difficult to understand. In the high-energy group the energy loss is primarily radiative, and follows theory in a general way. The experimental values are appreciably higher than the theoretical.

Accuracy of Parallaxes

In a recent paper, Prof. W. J. Luyten shows that parallaxes determined from spectral class and proper motion possess a high *individual* accuracy, contrary to the generally accepted view that they are useful only for statistical investigation (*Mon. Not. Roy. Astro. Soc.*, 98, 5, March 1938). In 1923, the author published the spectra and hypothetical parallaxes for 100 stars of large proper motion, and in 1924 he published a list of hypothetical parallaxes for bright stars in the southern hemisphere. When these lists appeared, only a small proportion of the stars had known trigonometric parallaxes, but these have been determined for practically all of them since. Two tables show the comparison between parallaxes predicted and those determined trigonometrically, and the agreement is as good as we find between two different series of trigonometric parallaxes. There are a few cases where considerable discrepancies appear, but it is suggested that the spectral class used is wrong for three stars in the first list, and in the second list, taken from *H.C.*, 252, 1924, *p* Eridani, which shows a fairly large discrepancy, is an exceptional star, having a tangential velocity of only 8 km./sec., and a much larger mass than the mean for its spectral class. The author is of opinion that if accurate spectral classes, magnitudes and proper motions were available, it would be possible to predict the parallax of a star with a mean error of 23 per cent, corresponding to mag. 0·7 in the resulting absolute magnitudes.

Czech Astronomical Observations

Memoirs Nos. 3, 4 and 5 recently published by the Czech Astronomical Association at Prague give, respectively, results of solar observations, observations of variable stars, and the results of the expedition to Sara, U.S.S.R., to observe the total solar eclipse of June 19, 1936. The solar observations, which were carried out by nine of the Society's members, express the sun's activity during 1935 as given by sunspots, faculæ and prominences. Using a direct-vision spectroscope and the *H*α line of the solar spectrum, the height of the chromosphere was also systematically determined around the disk. The variable stars discussed are RY Bootis, ST Camelopardalis and R Scuti, which have been regularly observed by members of the Society since 1930. R Scuti is shown to have a variability which places it in the RV Tauri type, that is, an irregular variable resembling to some extent a Cepheid, with a range of about two magnitudes and a variability in spectrum. The solar eclipse expedition included in its work (*a*) a study of the height and intensity of the chromospheric lines of the flash spectrum using the moving plate method ; (*b*) the distribution of radiation at 0·56 μ over the solar disk ; (*c*) the sky spectrum during totality ; and (*d*) a photometric study of the corona in the infra-red. The results are a useful quota to knowledge of the sun obtained under the rare conditions of a total eclipse, whilst the intensity determination of radiation across the disk affords an interesting comparison with the extensive observations made by Abbot some years ago without an eclipse.

The National Physical Laboratory

Report for 1937

THE report of the work carried out at the National Physical Laboratory during the year 1937 shows marked activity in each of the seven departments into which its field of operations has been divided and also in connexion with the special work of the William Froude Laboratory on the propulsion of ships[*]. One aspect of the report which should not be lost sight of in its perusal is the indication, which is implicit on practically every page, of the value of the assistance it can give to industry both in the results of its own wide programme of research and also in its readiness to undertake special investigations on behalf of manufacturers. This should be more widely known and appreciated as the scope of their work and the amount of scientific data accumulated place the staff in a quite unique position to offer advice and help.

In the Physics Department, investigations on the thermal conductivity of several gases, liquids, and solids have been proceeding. These have included a survey of published data regarding the thermal and electrical conductivities of iron and steel with results which have indicated the direction of the further investigations which are being undertaken. Research has been carried on in connexion with the thermal insulation of buildings, refrigeration, and properties of metals at high temperatures. The investigation which has been proceeding on the International Temperature Scale is now completed and the report summarizes its results in relation to the standard platinum, 10 per cent rhodium-platinum thermocouple used in the region between 660° and 1063° C. and the conditions which limit its accuracy. The Radiology Section, among many other investigations, continued the study referred to in the previous report on the fatigue failure of metals. The examination of annealed mild steel has been completed and has shown that when the applied stress is such as ultimately to produce fracture, severe fragmentation of the crystallites occurs and increases up to the point of fracture. Where fragmentation has already been carried to an advanced stage by severe cold work, it has been found that, provided the stress applied is below that necessary to produce eventual fracture, no further structural change occurs.

The value of the work of the Electrical Department has received recognition by the acceptance of the results of the investigations on units and standards. Also a new clock has been devised and constructed at the Laboratory which is of such a high degree of accuracy that its error is but a fraction of a second in a year. This has been attained by mounting the quartz ring oscillator on three fixed points as supports located at the nodes of the vibrating ring. This provides a more robust form of construction which makes it practically independent of mechanical vibrations and changes of level and so constitutes it a practical instrument for use in astronomical observatories, in radio-telegraphy, etc. In addition to the clock made for the National Physical Laboratory, one has also been made for the Royal Observatory, Greenwich, and two are being made for the Australian Government for use in connexion with radio communication. The work on visual characteristics has led to a number of interesting results, some of which are of direct importance in photometry and in practical problems of lighting. A paper published by the Department gives a full account of the work done on non-foveal vision, the visual conditions which supervene when the sensitivity of the eye is reduced by the presence of a source of high intensity in the field of view. In relation to the detection of objects in an artificially lighted street, the relative merits of lights of different spectral distributions have been studied. This work, in progress, is on the lines of ascertaining the average time taken by different observers to detect models of a person or a dog introduced into a film projection under conditions simulating those existing in typical carriageways.

Among the new researches commenced during the year in the Engineering Department is an investigation on the welded construction of pressure vessels. Developments in chemical engineering have led to a big increase in the use of liquefied gases, and for transport it is of considerable importance that, without sacrificing the necessary margin of safety, any improvements which result in reduction of weight should be investigated. Other new researches deal with the surface finish of steel strip—a matter of special importance to the aircraft industry—experimental work on the properties, in particular the variation of liquid density and of vapour pressure with change of temperature, of the gases propane and butane, and also an investigation into the silencing of motor cycles.

The use of cast materials for engine crankshafts is a recent unexpected development. In co-operation with the Institution of Automobile Engineers, the British Cast Iron Research Association and five interested firms, one steel material and four irons were fully investigated and the conclusion of the inquiry is recorded. These materials were subjected to static, hardness, and impact tests and also to a comprehensive series of fatigue tests involving bending, torsion, and combined bending and torsion. Metallurgical examination included chemical analysis and microstructure. Under the combined fatigue stresses these cast metals exhibited characteristics sharply dividing them from the ductile wrought steels. The results have been published separately and give a lead as to the wide possibilities of application of these cast metals in the field of engineering.

The Aerodynamics Department has been working at high pressure particularly in connexion with development work on new types of aircraft. The analysis of turbulent flow by determination of the turbulent energy in various frequency bands has been continued. So far as this work has gone, it has proved of exceptional interest, and the agreement found with the modern theory of turbulence indicates that there is every hope of understanding turbulent phenomena much more fully in the near future. Airscrew research has been carried out in co-operation with the Royal Aircraft Establishment on full-scale airscrew performance in the 24-ft. wind tunnel there. On the subject of 'flutter derivatives' it is hoped that some light will be thrown by the results of measurements of the instantaneous air forces acting on oscillating aerofoils by an apparatus which is under development.

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[*] The National Physical Laboratory: Report for the year 1937. Pp. iv+150. (London: H.M. Stationery Office, 1938.) 2s. 6d. net.

Among the researches carried out at the William Froude Laboratory was one for the Herring Industry Board and the Coal Utilisation Council concerning the herring drifter, and it was shown that the form of hull in use at present can be so improved as to give a 40 per cent reduction in power for a speed of 9 knots, with a definite improvement in seaworthiness as shown by tests in rough water. In the Alfred Yarrow Tank it is proposed to replace the wave making apparatus which after twenty-one years service is badly deteriorated. The new equipment will be of 12 b.h.p. instead of 7 b.h.p. and will, by being run from a separate electric supply, be able to give a longer test. Numerous researches have been carried out on screw propellers and in several cases the results have been published. Other researches have been in connexion with the shape of ship bows, natural frequency relative to ship vibration, and the effects of helm action on propulsive efficiency. For a special tug, a programme of research on a pair of paddle wheels will shortly be put into operation.

These are but a selection of the activities which are treated in the report, in which particulars of the several papers published by each of the departments are given.

Nutritional Surveys of Inland Australia

Problems of Child Nutrition

FEW of the various national nutrition committees appointed following the recommendations of the League of Nations have brought more enthusiasm and resource to their task than the Commonwealth of Australia's Advisory Council on Nutrition. Its recently published fourth report provides ample evidence not only of painstaking endeavour to arrive at a true assessment of the nutritional state of white children living in urban and rural districts of Australia, but also of the need for devising means whereby the revealed deficiencies may be corrected.

Dr. F. W. Clements, who is engaged on a three-year programme of surveys designed to cover a large section of the interior mainly beyond the railway system, presents his preliminary findings for certain inland areas of Queensland, New South Wales and Victoria. Of the children examined in New South Wales, 23·7 per cent showed signs of unsatisfactory nutrition; in Queensland the figure was 18·8 per cent, and in Victoria, 13·3 per cent. Amongst pre-school children of Melbourne examined during the same period, the corresponding percentage was as high as 21·7. Although the numbers examined were necessarily small, there is no reason to suppose that they were in any way selected or unrepresentative of the prevailing conditions. The Council, therefore, finds itself faced with two distinct problems, the undernourished child of the city, and the undernourished child of the remoter outback districts.

Chief consideration has been given to the occurrence of rickets and nutritional anæmia, the incidence of both of which was found to be considerable. In Victoria, for example, a high incidence of anæmia among pre-school children was discovered, boys apparently being more prone to develop the symptoms than girls; and the conclusion is reached that the average hæmoglobin level in children of the Queensland outback is distinctly lower than that of children living in the cities of Scotland. A careful watch for scurvy was unrewarded save for one doubtful case of hypertrophic gingivitis. That fruit is rare may be gathered from one of those touches of significant observation which make this whole report of unusual interest. At a backwood's race meeting the author purchased from a wandering salesman a dozen small shrivelled apples at a cost of 2½*d.* each. Fresh tomatoes are also a luxury, but potatoes and pumpkin are largely eaten. Further inquiry into the circumstances of those children found to be suffering from rickets, elicited the fact that they were accustomed to a low intake of protective foods, little milk and no cod liver oil. It is reported, too, that in several towns no milk is available for the feeding of children in infancy.

The section on the Mount Isa communities is perhaps the most interesting in the report. Here, two almost distinct towns have grown up around the Mount Isa lead-silver mines. At the mine site the enterprising company has built for its employees comfortable houses adequately planned and situated amid sylvan surroundings. Rent is reasonable, electricity is free, and many other advantages play an important part in maintaining a sense of citizenship. On the town side, on the other hand, are to be seen shacks improvised from carbide drums, kerosene tins and hessian, where a shiftless and improvident population has no incentive to maintain a decent standard of living. The following reflects the difference in condition, and it is to be noted that the parents of children suffering from rickets in the Mines School were all new arrivals to the district and had been long unemployed.

Deficiency Diseases	*Town School*	*Mines School*
Nutritional anæmia	12·0 per cent	3·4 per cent
Active Rickets	17·0 ,,	10·3 ,,
Chronic infections	4·0 ,,	1·7 ,,

In view of their importance and bearing on similar problems being investigated in other parts of the Empire, it is to be hoped that these Australian results will be placed on permanent record and be made easily available to all who are engaged on nutrition survey work.

International Conference for the Protection of the Fauna and Flora of Africa

THE Second International Conference for the Protection of the Fauna and Flora of Africa was opened by the Marquis of Dufferin and Ava, Parliamentary Under-Secretary of State for the Colonies, in the Moses Room of the House of Lords on May 24 and was attended by Government delegates of the Union of South Africa, Belgium, Great Britain and Northern Ireland, Egypt, France, Italy, Portugal and the Netherlands. The interests of the Anglo-Egyptian Sudan were represented by the United Kingdom and Egyptian delegations jointly. The main object of the Conference was the exchange of information and exploratory discussion preparatory to a further conference, which it is hoped to hold in 1939. The Earl of Onslow presided, and subsequent meetings were held on May 25 and 27. A committee of experts was appointed to draw up a list of suggestions for addition of further species to the Annex of the Convention.

It was announced that the Convention, signed in 1933, had been ratified by the United Kingdom and Belgium in respect of their African territories, and by the Union of South Africa, Egypt and the Sudan, and that it was hoped that France, Italy and Portugal would shortly be able to complete their ratifications. During the course of the meeting, the French delegate announced that he had just received information that the President of the French Republic was at that moment on the point of signing the ratification of France.

The proceedings opened by the submission of statements by delegates of action taken by their respective Governments since the signing of the Convention of 1933. The High Commissioner, Mr. C. T. te Water, on behalf of South Africa, stressed the necessity of arousing public interest and stimulating effort for the protection of wild life, and pointed out that international conferences such as the present one help greatly in bringing to the attention of the Governments concerned a subject of great national importance. He stated that his Government is continuing its policy of setting aside areas as game reserves and national parks, and since the Convention had come into force, further legislation has been promulgated for the preservation of fauna and flora. He alluded to the serious condition of the status of the mountain zebra (*Hippotogris zebra*), which is slowly dying out, and said that the matter is being given close consideration by the Government in order to secure measures for the adequate protection of the remaining herds, and that land is being acquired in various districts to this end. He also mentioned that the laws with regard to shooting game from motor-vehicles are very strictly carried out.

The Belgian delegation reported the creation of further national parks and stated that an important feature of the administration of these parks is the undertaking of systematic exploration of their fauna and flora, with special reference to the presence of disease, particularly parasitic disease, among the animals contained therein. The Government has taken measures for the protection of flora by setting up forest reserves in which special attention is given to the need for maintaining an adequate water supply.

Sir William Gowers, Senior Crown Agent for the Colonies, in presenting the report of the United Kingdom, directed attention to the great diversity of conditions in the fourteen territories concerned, and their difference in range of flora, fauna and density of population. The establishment of reserves is the policy of many Governments, but, while it is not regarded as incompatible with the principles of the Convention that a national park should be inhabited by natives, it is nevertheless regarded as important that the extent of native population should not be such as to interfere on one hand with the rights of the natives and on the other with the interests of game preservation. It has therefore been necessary to proceed with caution before definitely demarcating areas to be set aside as national parks. In pointing out the salient features of the report, Sir William Gowers mentioned the action being taken by the Tanganyika Government in establishing a national park on the Serengeti Plains, the steps taken by the Government of Nyasaland to set up a strict natural reserve in its territory, and the proposals under consideration for similar measures in Kenya, Nigeria and Sierra Leone.

Mr. F. B. Wright, Acting High Commissioner for Southern Rhodesia, reported the establishment of four game reserves and emphasized the interest felt by his Government for the objects of the Convention.

The Italian delegate stated that a special scientific mission has been sent to Italian East Africa to undertake a full survey of the position with regard to fauna and flora, and that the results of this investigation will be communicated for circulation.

The Portuguese delegate in presenting his report put forward two suggestions ; first, that the question of surrounding animals by fire for hunting purposes should be examined again on account of the harm which this causes to fauna and flora ; and secondly, that the possibility of taking measures for the partial and progressive modification of nomad native agriculture in African forests, in order to avoid the frequent and irregular clearing of important tracts of forest land, should be considered.

Statements were also given by the Egyptian, French and Anglo-Egyptian Sudan representatives, and the Netherlands delegate stated that his Government is greatly in favour of the Convention and has already applied Article 9 (concerning the traffic in 'trophies') to the Dutch East Indies.

A discussion on the subject of vermin took place and it was agreed that a positive definition of this is impracticable. Mr. te Water suggested that all Governments concerned be asked to furnish memoranda showing action taken in their respective territories to deal with this problem.

The question of (*a*) the exchange of information relating to infectious or contagious diseases of importance for the preservation of fauna or flora, or capable of affecting man as well as animals and, (*b*) the exchange between Governments of lists of persons known to have been guilty of persistent infringements of game regulations, were both examined at length, and the conclusion reached that with regard to both these questions a centralized system of exchange of information is desirable, and that recommendations to this end should be put forward.

The report submitted by the Committee of Experts as to species recommended for inclusion in the Annex of the Convention on the occasion of its next revision was accepted. This contained proposals for the transference of certain species mentioned in the Annex from Class *B* to Class *A*, thereby affording them greater protection, and included among others the giant eland (*Taurotragus derbianus* (Gray)), black rhinoceros (*Rhinoceros bicornis* Linnæus) and secretary bird (*Sagittarius serpentarius serpentarius* Miller). The report also suggested the inclusion in both classes of certain species not heretofore included in the Annex. For inclusion in Class *A* were recommended among others the red wolf (*Canis simensis* (Ruppell)) and bongo (*Boocercus eurycerus* Ogilby) and the African peacock (*Afropava congensis* Chapin), so recently discovered to science, northern secretary bird (*Sagittarius serpentarius gambiensus* Ogilby), African broadbill (*Pseudocalyptomena graueri* Rothschild), Abysinnian ground chough (*Zavattariornis stresemanni* Holtoni), the flightless rail of Inaccessible Island (*Atlantisia rogersi* Lowe) and the so-called fishes of the grottoes of Thysville, African species of the genus *Cæcobarbus*. The last-named was the only case for the protection of fish brought to the attention of the Committee. The species being blind and of great zoological interest, it is the opinion of the Committee that it should receive as complete protection as possible.

The Conference agreed to recommend that a further meeting be held in London in 1939, concurrently with the meeting of the proposed International Conference for the Protection of Fauna and Flora of Tropical Asia and the Western Pacific. On the proposal of Mr. te Water, it was agreed to express the hope that it would be possible for the Governments concerned to arrange for the attachment to their respective delegations of officers in charge of the principal national parks, such as the Kruger National Park, and the Parc National Albert, whose expert advice would greatly assist the work of the Conference.

Impact of Chemistry on Biology

THE forty-second Bedson Lecture was delivered in the Chemistry Lecture Theatre, King's College, Newcastle-on-Tyne, on May 19 by Sir Henry Dale, who spoke on "The Impact of Chemistry on Biological Science". Sir Henry pointed out that the two sciences of biology and chemistry were developed during the nineteenth century independently of each other; tremendous advances have been made in more recent times as the two subjects have become closely interwoven into the science of biochemistry.

Since the end of the last century, organic chemistry has developed along two main lines: (1) the synthesis of new substances of little direct relation to biological science, and (2) the isolation and identification of substances from 'vital' chemistry. Progress has been slow in the chemistry of the animal body, and the lag between chemical recognition and the assignment of a definite biological function to compounds isolated is well exemplified by the fact that although creatine was isolated from muscle in 1832, it was not until 1927 that a definite role in muscle metabolism was assigned to this substance.

The comparatively new science of bacteriology had its origin in the work of Louis Pasteur, an organic chemist whose interests developed along 'biochemical' lines until he eventually became a complete biologist.

The investigation of protein chemistry by Sir Frederick Gowland Hopkins which led to his attempt to make a 'perfect' diet by mixing the correct amounts of fats, carbohydrates and proteins gave rise to one of the most sensational discoveries in recent years, the vitamins. In a very short time, many of these compounds have been not only isolated, but also in some cases have been assigned a definite chemical formula which has been proved by synthesis.

Several enzyme actions have recently been investigated from a chemical point of view, and it seems extremely probable that enzyme and coenzyme phenomena will shortly be explained as chemical actions, closely connected in some cases with the vitamins.

The discovery of the natural stimulants formed by the animal body, the hormones, has opened up an important new field of biochemical research, in which great advances have already been made. Several of these compounds have been isolated and synthesized, such as, for example, thyroxin and adrenaline, and the sex hormones have been shown by synthesis to be closely connected with inert sterols present in animal tissues.

Finally, even the transmission of nerve 'messages' has been shown to involve reversible physicochemical changes in which simple organic compounds play a part.

Pre-Roman Provence

EARLY in April of this year, it was announced that archæological discoveries, which are of no little importance, had been made near Saint-Rémy, a small town a few miles from Arles in Provence. Provence, the original 'Provincia' of Rome's extra-Italian expansion, is rich in monuments, which, if Roman in origin, are none the less Greek in spirit and conception. This is a legacy from the Greek colonists from Phocaea, who founded Marseilles about 600 B.C. and extended their influence over the whole region, which was later to be known as "The Province". Intermarriage with the natives left an indelible mark on the physique of the population, more especially to be seen in the beauty of the Provençal women.

Although the district around Arles was termed "Grecia" until the fourteenth century, little is known that is of purely Greek culture, nor has it been determined with precision how far and to what degree Greek influence pervaded the country. The importance of the results of recent excavations lies in the fact that they have brought to light remains belonging to the pre-Roman period, as well as evidence pointing to the measure of fusion with native culture.

At Saint-Rémy, which possesses two theatres of the Roman period, both Greek and Roman constructions beside a tile-covered canal have been found near a Roman road, triumphal arch and tomb dating from the first century, and beneath a Roman wall. Fifty-two altars of local stone and marble were dedicated to either the god Sylvanus or the goddess Cybele. The foundations of an entirely Greek house were uncovered, in which twelve rooms are seen to have opened into an *atrium*, in which the bases of four columns are still visible. Baths of the time of Augustus, measuring forty-seven yards by thirty-five yards, were found. Into these, water flowed through a huge sculptured head. A large amount of Greek red-on-black pottery was found with forty-four small votive lamps and a magnificent rock crystal ring, ornamented with a woman's head.

Further discoveries in these excavations are now announced. According to a dispatch from the Paris correspondent of *The Times* in the issue of May 23, while most of the walls which have been found belong to a large Roman construction, the architectural remains of pre-Roman date are also important. A pillar with egg and astragalus pattern is of second-century Greek style, while column heads, probably pointing to Italian models, are evidently the work of competent masons of Greek training. The gargoyles, however, are the rustic Celtic versions of classical gargoyle lions. It is thought that they belong to a building, possibly a temple, of Greco-Celtic style.

Further evidence of cultural fusion comes from Glanom, a small Celtic *oppidum* near Saint-Rémy, where in a large necropolis graves containing Celtic and local Hellenistic pottery have been excavated by M. de Brun, keeper of the local museum. The tombs, it is stated, are marked by tall pillars, on which Celtic names are inscribed in Greek character. The cemetery is dated in the period of the Roman occupation at the end of the second century B.C. Still earlier evidence comes from Roquepertuse, where the Count de Gerin-Ricard, keeper of the Musée Borely at Marseilles, has excavated a sanctuary of the fourth century B.C. Here he has found what is described as a curious mixture of native and Greek taste. The pillars supporting the entablature are decorated with the heads of slain enemies, the horses on the frieze are of the barbarian type, while the double heads affixed to the architrave are a successful and attractive blend of Celtic and Greek elements.

Antarctic Plankton*

EXACT systematic work is essential for oceanographical plankton studies, since we must know the species with which we are dealing before we can use them in any practical way. Mr. Hendey's extensive monograph on the diatoms of the Southern Ocean is most useful and is a careful study entailing a large amount of labour. With so much material it has been possible to review the inside variation present in most groups and in the individual species. The interesting fact is clearly brought out, agreeing with Wimpenny (1936) that the diatom frustules in cold water are smaller, thicker-walled and more vigorous than those from warmer waters, the reverse of what is known to exist in many marine animals. The holoplanktonic flora of the cold water from the oceanic habitats forms the major part of the collection and consists of a small number of discoid and a large number of filamentous pennate forms. The author, however, in his classification discards the usual division into Centricæ and Pennatæ, and his method of regarding many so-called species and varieties as "phases" of one species reduces considerably the number of species recognized. Thus, to take one example, *Corethron* according to Hendley is a monotypic genus, *Corethron criophilum*, much discussed by many workers, being the only species with many phases. This at least tends to simplify matters, and a reduction of the ever-increasing number of species is all to the good.

Most of the diatoms of the Southern Ocean have a wide distribution and can tolerate a great variation in the conditions of their environment, but it is found that *Rhizosolenia curvata* Zacharias has a very limited range, being a typical sub-antarctic species occasionally spreading into Antarctic waters. Dr. Hart in his paper on this diatom shows that it forms a valuable indicator of the southern limit of sub-antarctic surface water. It has always been recognized that this surface water is frequently forced some small distance south of its normal limit, the Antarctic Convergence, and it has been possible to prove that *R. curvata*, an easily recognizable and characteristic form, is always in the plankton whenever it has been possible to show such southward movement hydrographically.

The seasonal circulation of the Antarctic macroplankton is dealt with by Dr. Mackintosh. Amongst other interesting facts it is shown that certain species which are usually regarded as inhabitants of the surface layers make an annual vertical migration into deep water in winter, and this migration by which they move from one current system to another is probably the means by which they keep within their normal geographical boundaries. The three species which in places make up the bulk of the Antarctic macroplankton, *Rhincalanus gigas, Eukrohnia hamata* and *Calanus acutus*, are mainly concentrated in the surface water in summer but descend into very deep water in winter. Since part of the Antarctic surface water moves in a northerly direction and there is a compensating southerly movement of the warm deep water, this vertical migration almost certainly results in the return of the species to the regions from which it originally came. The circulation is on a very large scale, the vertical range being from four to six hundred metres and the horizontal range being presumably some hundreds of miles.

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* Discovery Reports. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Vol. 16. Pp. 151–364+plates 6–13. The Plankton Diatoms of the Southern Seas. By N. Ingram Hendey. 33s. net. Vol. 16. Pp. 365–412. The Seasonal Circulation of the Antarctic Macroplankton. By N. A. Mackintosh. 6s. net. Vol. 16. Pp. 413–446+plate 14. *Rhizosolenia curvata* Zacharias. By Dr. T. John Hart. 5s. net. (Cambridge: University Press, 1937.)

Science News a Century Ago

South African Exhibits

In 1837, Smith Elder and Co. published "A Catalogue of the South African Museum now exhibiting in the Egyptian Hall, Piccadilly", the property of a society entitled "The Cape of Good Hope Association for Exploring Central Africa". The Association had been formed in Cape Town on June 5, 1833, and its object was the acquisition of knowledge relative to the geography, natural history and commercial resources of the interior, and of the social condition of its inhabitants. £537 were subscribed within a few days, and an expedition left Graff-Reynet in June 1834. The zoological and ethnographical exhibits were one of the sights of London, and were afterwards sold by auction by Messrs. J. C. and S. Stevens on June 6–8, 1838, in pursuance of a resolution passed by the Association, over which Sir John Herschel occasionally presided. The sale included a number of models of Kaffirs and specimens of the arts and manufactures of the Bechuanas, zoological specimens and a geological collection.

Geographical Society of Berlin

Under its foreign correspondence, the *Athenæum* of June 9, 1838, said: "The Geographical Society of Berlin held an extra meeting last month to welcome the former President, Prof. Charles Ritter, on his return from the scientific tour which he had made in Greece and the Levant. Prof. Lichtenstein, the actual President, expressed on the part of the Society great satisfaction in their renewed connexion with one who had done so much to advance the science of Geography. Prof. Ritter then gave a hasty sketch of the interesting observations which he had made in Greece and the Ionian Islands, in European and Asiatic Turkey and in Maldavia and Wallachia."

Karl Ritter, who was once described as "the greatest geographer of modern times", was born at Quedlinburg on August 7, 1778, and at nineteen years of age became a tutor in the family of Bethmann-Hollweg at Frankfort-on-Main. With his pupils he travelled through Switzerland, Savoy, France and Italy, and studied at Göttingen. In 1819 he was called to the gymnasium at Frankfort as professor of history, but the next year was made an extraordinary professor of geography in the University of Berlin. The great work, "Die Erdkunde im Verhältniss zur Natur und zur Geschichte des Menschen", which had established his reputation, had appeared in two volumes in 1817–18. He died on September 28, 1859, at the age of eighty years.

Zusseh Silkworms of India

At a meeting of the Asiatic Society on June 9, 1838, Dr. Geddes read a paper "On the Zusseh Silkworms of India". The moth of the Zusseh silkworm, he said, was the *Saturnia paphia*. The moth had been twice caught while depositing her eggs by Dr. Geddes —once in December 1826 and again in November 1830. The eggs deposited after that were, in each case, above 200; they were in small heaps, adhering together, and generally hatched in a little more than ten days. The interval between hatching and spinning was different in different larvæ from the same moth, being in some cases as long as 36 days and in others as much as 50. When fully grown, the larva is about 4 inches long, its head is light brown, its body green with rows of spots, orange, red and blue. Dr. Geddes fed them upon the leaves of the Ber tree (*Zizyphus jujubus*) but he had also seen them on the Ahseen (*Terminalia alata glabra*) on which the insect is fed in the Nagpore territories. The natives place them on the tree when hatched; and as soon as the leaves are devoured, they chop off the branches, and place them, insects and all, upon another tree. When ready to spin, the insect first forms a thick ligature of an inch in length which it fastens to a twig, and at the extremity it spins its cocoon, which sometimes reaches the size of a pigeon's egg.

The Actonian Prize

Early in 1838 the Royal Institution received a donation of one thousand pounds from Mrs. Hannah Acton. The gift, which was made out of respect and regard for the memory of her late husband, Mr. Samuel Acton, architect, was to form an endowment fund, and the trust established, which the Managers of the Royal Institution undertook, was to award a prize of one hundred guineas, once every seven years, to the person who should be "the Author of the best Essay illustrative of the Wisdom and Beneficence of the Almighty in such department of Science as the said Committee of Managers for the time being of the said Institution shall in their discretion select". In June 1838 the conditions governing the award of the Actonian Prize were made known. The first award was to be made in 1844, and the subject was to be chemistry. In due course the prize of 1844 was given to George Fownes for his essay on chemistry. Every seven years since, in accordance with Mrs. Acton's pious intention, the prize has been awarded. The list of the recipients contains many distinguished names, including those of Sir George Stokes, Sir William Huggins, Madame Curie, Sir Charles Sherrington, Dr. George Ellery Hale and Prof. A. V. Hill. The prize was last given in 1935 to W. T. Astbury, for his paper on "X-Ray Studies of the Structures of Hair, Wool and Related Fibres".

Ornithological Society

The *Gentleman's Magazine* for June 1838 contains the following account of the anniversary meeting of this Society held on May 18 with Mr. M. W. Colbourne in the chair. The Council in its report congratulated the members on the position which the Society had already obtained. The number of its members was stated to be 205, a number probably unprecedented in the first year of any other scientific society. Reference was then made to the great injury which the collection in St. James's Park at first sustained from the children and other frequenters of the Park; but the Council now had the pleasure of reporting that a marked improvement in this respect might be observed. Little more than a nucleus of the Museum and Library has as yet been formed, but the Council expressed a confident hope that with the valuable services of the curator, Mr. Blyth, a sufficiency of illustrations for the monthly lectures will be very shortly obtained. The accounts of the Society for the last year had been audited, and the balance in hand was £11 16s. The sums then owing by the Society were £36 17s. 9d. and the sums owing to the Society were £42.

University Events

Cambridge.—M. Black, of Trinity College, has been appointed University lecturer in geology, and W. W. Williams, of Fitzwilliam House, University lecturer in geography.

C. Culpin, of St. John's College, has been appointed University demonstrator in agricultural engineering.

Candidates for the Michael Foster studentship in physiology are requested to send their applications, with a statement of the course of research they propose to undertake, to Prof. E. D. Adrian, Physiological Laboratory, by July 7. The student receives the annual value of the fund (about £100), and may be re-elected for a second year.

Approval is sought for the plans prepared by Mr. C. Holden for the Austin Wing of the Cavendish Laboratory, and for the plans prepared by Mr. J. Murray Easton for an extension to the Psychological Laboratory.

The General Board recommends that a readership in medicine be established for one tenure only, and that the General Board be authorized to appoint Dr. McCance, at present assistant physician in charge of the Biochemical Department at King's College Hospital, London, to this post from August 1, 1938, with a pensionable stipend of £850.

The following have been approved for the degree of Sc.D.: Prof. J. F. Baker of Clare College, professor of civil engineering in the University of Bristol; C. Forster-Cooper of Trinity Hall, director of the British Museum (Natural History); and Dr. E. C. Stoner of Emmanuel College, reader in physics in the University of Leeds.

Glasgow.—The University has decided to confer the honorary degree of LL.D. on the following, among others, at the Commemoration Meeting on June 22: Prof. W. J. Jongmans, professor of palæobotany in the University of Groningen; Prof. Max Planck, professor of theoretical physics in the University of Berlin; Prof. M. J. Stewart, professor of pathology in the University of Leeds; Prof. C. T. R. Wilson, emeritus professor of natural philosophy in the University of Cambridge; and Prof. G. G. Henderson, emeritus professor of chemistry in the University of Glasgow.

Oxford.—Prof. J. H. Muirhead, emeritus professor of philosophy, University of Birmingham, has been appointed Herbert Spencer lecturer for 1939. His subject will be "The Man versus the State as a Present Issue".

R. H. S. Thompson, Trinity College, has been elected to a fellowship and praelectorship in medical science at University College.

In Congregation on May 24 it was announced that the Minister of Agriculture and Fisheries has appointed Lord Fleming, Sir Henry Bunbury, and Mr. Lawrence Holt to advise him on the representations of the University that part of the sum of £75,000, the cost of settling the action between the University and Sugar Beet and Crop Driers Ltd., should be borne by public funds.

Reading.—Mr. E. Capstick has been appointed to the newly instituted professorship of dairying as from September 30.

Societies and Academies

Paris

Academy of Sciences, April 4 (*C.R.*, 206, 1065–1151).

Pierre Lejay: Variations in the amount of moisture contained in the air in the neighbourhood of Shanghai.

Claude Chabauty and Charles Pisot: An algorithm for the simultaneous approximation of two real numbers.

Mendel Haimovici: The geometry of an integral.

Arnaud Denjoy: The singularities of analytical functions of functions defined by an element.

Armand Rauch: Integral functions of the class of divergence of positive order ρ.

Charles Blanc: A decomposition of the problem of the type of Riemann surfaces.

Henri Milloux: Holomorph functions and their derivatives in the circle unity.

Adrien Foch, André Fortier and Jean Fivet: The correction at the entrance of a cylindrical tube traversed by a gaseous current.

Victor Volkovisky: The transport of ions in a fluid moving with a supersonic velocity.

Damodar D. Kosambi: Homogeneous metrics in cosmogonic spaces.

Henri Grouiller: The determination of the curves of blackening in astronomical photographic photometry.

Pierre Lacroute: Variations in the spectrum of *P* Cygni.

Georges Durand: Orbit of the visual double star $O\Sigma$ 77 and the mass-luminosity relation.

Jean Louis Destouches: Remarks on the heavy electron.

Georges Fournier: Geometrical structure of space and electronic atmospheres.

Max Geloso and Pierre Deschamps: Researches on the mechanism of the electrolytic deposit of copper in the presence of iron salts.

Mme. H. Emmanuel-Zavizziano and H. Haïssinsky: Electrolysis of solutions of protactinium. Starting with titanium solutions containing actinium, a concentration of the latter can be obtained under suitable conditions of electrolysis.

Mlle. Lucienne Chaumeton: Magnetic study of the dehydration of crystallized copper hydroxide.

Pierre Rouard: Some optical properties of very thin sheets of platinum.

Mlle. Marie Louise Delwaulle, Félix François and Joseph Wiemann: Application of the Raman effect to the study of the complex compounds existing in solutions containing mercuric bromide and an alkaline bromide.

Bertrand Goldschmidt: The mixed precipitation of the sulphates of barium and strontium.

Jean Amiel: Paramagnetism of the organic cupritetrachlorides and cupritrichlorides.

Guy Emschwiller and Gaston Charlot: Solubility of calcium carbonate in solutions of ammonium salts. The increase in the solubility of calcium carbonate in the presence of ammonium salts is mainly due to phenomena of hydrolysis and only to a minor extent to the action of the salt.

André Borocco: Dissociation pressure of rubidium and cæsium hydrides and deuterides. The dissociation pressures of rubidium and cæsium deuterides are greater than those of the corresponding hydrides.

Guy Cogné : Zinc peroxide. The peroxide $ZnO_2.0{\cdot}5\ H_2O$, not hitherto isolated, has been prepared. From its reactions, it would appear to be a true peroxide, and not a compound of zinc oxide and hydrogen peroxide.

Raymond Delaby and Jean Hubert : Bromine index of the ethylenic nitriles.

Urbanski : Nitration of phenylnitromethane. Dinitrophenylnitromethane can be prepared by the intensive nitration of phenylnitromethane : it was shown to have the 1.3.5 constitution.

Marcel Tuot : Secondary reactions observed in the course of organo-magnesium condensation of the esters in the fatty series.

André Guillemonat : Oxidation of some substituted cyclohexenes by selenious anhydride.

Gilbert Mathieu : Recent deformations of the soil in the north-west of La Vendée and the reason for the existence of the Island of Yeu.

Gérard Waterlot : Structure and origin of the Poitevin marshland.

Jacques Flandrin : Main structural lines of the Djurdjura (Algeria).

František Link : Twilight phenomena visible during total eclipses of the sun.

René Bernard : Variations of intensity of the sodium *D* line present in the spectrum of the light of the sky at twilight. Discussion of the results obtained by Currie and Edwards in Canada, in the course of the International Polar Year 1932–33, with special reference to the observation of the *D* line of sodium in the atmosphere.

Gérard Gazet du Chatelier : Structure of the andrœceum of the Sterculiaceæ.

William Henri Schopfer and Samuel Blumer : Growth factors of species of the genus *Ustilago*.

Constantin Dawydoff : Two remarkable cœloplanids of Indo-Chinese waters.

Antoine Jullien and Daniel Vincent : The esters of choline in some organs of molluscs.

Paul Meunier and Yves Raoul : A vitamins and carotenoids. The kinetic study of the Carr-Price reaction. The rapid fading of colour in the Carr and Price reaction in the presence of acetic anhydride is characteristic of vitamin A_1 provided that the medium is free from unsaturated fatty acids.

Maurice Doladilhe : Anaphylactic properties of hæmolysin.

Erratum.—Maurice Henry Pirenne : The diffraction of X-rays by silicochloroform. The summary of this paper in Nature of April 16, p. 702, should read : "The valency angle is within two or three degrees of the angle of a regular tetrahedron. A plane structure of the $SiCl_3$ group, such as has been proposed by G. Urbain, is inadmissible."

Cracow

Polish Academy of Science and Letters, March 7.

T. Banachiewicz : A new aspect of quaternions.

W. Nowatke : Molecular dimensions of organic compounds and the constant of dialysis of their solutions. The author has shown that there is a direct relation ($\delta\sqrt{n}$ = constant) between the dialysis constant (δ) and the number of atoms in the molecule (n) and also between the dialysis constant and the radius (r) of the molecule ($\delta.r$ = constant).

J. Walas : The migrations of alpine plants along the water-courses of the massif of the Tatras.

Mme. M. Skalinska : Cytogenetic researches on the aneuploid *Aquilegia*.

J. Hans and Mlle. Z. Tabencka : The blood vessels in the skin of *Myxine glutinosa*.

H. Szarski : The subdermal corpus lymphaticum in the frogs *Rana esculenta*, *R. temporaria* and *R. terrestris*.

Z. Grodzinski and J. Marchlewski : The action of serum on the mobility of the spermatozoids of the cock.

L. Monné : The vital polychrome colorations of the different cells of gasteropods with the aid of pyronines.

Zb. Glowczynski : The proportion of vitamin A in the seed of canary grass, *Phalaris canariensis*.

Mlle. R. Skrochowska : Acquired habits in their relations with the repeated action of stimuli in *Vorticella*.

Rome

National Academy of the Lincei (*Atti*, 26, 193–251 ; 1937).

F. Enriques : Curves infinitely close together on an algebraic surface.

B. Levi : A property of the system of the *n*th partial derivatives of a function of more variables.

U. Cisotti : Mechanics of disperse continuous media.

G. Armellini : Fundamental problems of cosmogony and Newton's law (1).

C. Agostinelli : Integration of the differential equation

$$\frac{\delta^2 u}{dx^2}+\frac{\delta^2 u}{\delta y^2}+\frac{\delta^2 u}{\delta z^2}-\frac{1}{x}\,\frac{\delta u}{\delta x}=f,$$

and a problem analogous to that of Dirichlet for a hemispherical field (2).

M. Schönberg : A class of functional equations.

A. Colacevich : Spectroscopic and spectrophotometric observations of the comet Finsler (1937*f*).

A. Iandelli and E. Botti : Crystal structure of the compounds of the rare earths with metalloids of the fifth group (5). 1 : 1 compounds with bismuth.

E. Mariotti : Modification of van Slyke's method for the analysis of proteins.

L. Mascarelli and M. Pirona : Contribution to the knowledge of diphenyl and of its derivatives (19). Preparation of some new derivatives.

C. Perrier and A. Bellanca : The use of the potentiometer for the determination of time temperature curves in thermal analyses.

Atti, 26, 253–303 ; 1937.

G. Fubini : Asymptotic studies for some differential equations.

C. Mineo : Impossibility of a stratification of homotectic equilibrium for rotating fluid stars.

R. Woinarosky : Kinematics of a solid body in ordinary space of three dimensions.

G. L. Andrissi : Observations of the comet 1936 *a* (Peltier).

L. Gialanella : Meridian observations of Jupiter, Saturn, Uranus and of the moon in 1936.

G. Wataghin : Theory of elementary particles (1). A system of gravitational equations of the first order (2).

A. Cavinato : Observations concerning the note of S. Vardabasso "Contribution to the knowledge of the recent volcanism in Sardinia".

L. Mascarelli and B. Longo : Contribution to the knowledge of diphenyl and of its derivatives (20). A new example of the change from the diphenyl to the fluorene system : synthesis of 3-methylfluorene.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, June 7

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. B. P. Babkin: "The Physiology of the Digestive Glands" (succeeding lecture on June 9).*

ST. MARY'S HOSPITAL (INSTITUTE OF PATHOLOGY), LONDON, at 5.—Sir Henry Dale, F.R.S.: "Chemical Agents transmitting Nervous Excitation".

Thursday, June 9

RESEARCH DEFENCE SOCIETY (at the London School of Hygiene, Keppel Street, W.C.1), at 3.—Annual General Meeting.

Prof. C. H. Best: "Insulin and Diabetes: The Present Position" (Stephen Paget Memorial Lecture).

CHELSEA PHYSIC GARDEN, at 5.—Prof. E. J. Salisbury, F.R.S.: "Plants in Relation to the Human Environment" (Chadwick Public Lecture)*.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, June 6–11. Conference on "Oil Shale and Cannel Coal" to be held at Glasgow.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned

LECTURER IN CHEMISTRY in the Battersea Polytechnic, London, S.W.11—The Principal (June 9)

LECTURER IN PHARMACEUTICS in the Leicester College of Technology and Commerce—The Registrar (June 13).

LECTURER IN PHYSICS AND MATHEMATICS in the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E C 3 (June 15).

ASSISTANT LECTURER IN MATHEMATICS AND ASSISTANT LECTURER IN ECONOMICS in University College, Swansea—The Registrar (June 17).

ASSISTANT LECTURER IN CHEMISTRY in the University of Sheffield—The Registrar (June 18)

EXAMINER in the Standards Department of the Board of Trade—The Assistant Secretary, Establishment Department, Board of Trade, Great George Street, S W.1 (June 18).

PROFESSOR OF PATHOLOGY and LECTURER IN PATHOLOGY in the University of Bristol—The Registrar (June 20).

ASSISTANT LECTURERS IN ORGANIC CHEMISTRY AND IN GEOLOGY in the University of Bristol—The Secretary (June 21)

PROFESSOR OF VETERINARY PHYSIOLOGY in the Royal Veterinary College, Camden Town, London, N.W 1—The Bursar (June 30).

ASSISTANT IN RESEARCH IN RADIOLOGY, ASSISTANT IN RESEARCH IN PSYCHIATRY and ASSISTANT IN RESEARCH IN PATHOLOGY in the University of Cambridge—Mr R. Williamson, Department of Pathology, Tennis Court Road, Cambridge (July 1)

TECHNICAL OFFICER in the Meteorological Office—The Secretary (S.2.a), Air Ministry, Adastral House, Kingsway, London, W C.2 (July 2).

WOMEN EXAMINERS and AN EXAMINER in the A.I D Test House, Kidbrooke, S E 3—(The Secretary, Air Ministry (I G.), Kingsway, London, W.C.2

TECHNICAL OFFICER at the East Malling Research Station, near Maidstone, Kent—The Secretary.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

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Progress Report on the Scheme of Research on Quality in Crops with special reference to Rice, during the Period December 1934 to November 1937. By Dr. A. Sreenivasan. Pp 22. (Bangalore. Indian Institute of Science) [165

Comité International des Poids et Mesures. Procès-verbaux des Séances. Deuxième Serie, Tome 18, Session de 1937. Pp. viii+310 (Paris. Gauthier-Villars.) [165

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 115 A Soil Survey of Part of the Denmark Estate, Western Australia. By J. S. Hosking and G. H. Burvill. Pp. 80+3 maps Section of Food Preservation and Transport, Circular No 2-P.: Hygienic Methods for the Preparation of Beef in the Meat-works. Pp 20. (Melbourne: Government Printer.) [165

Field Museum of Natural History. Technique Series, No. 5: Unique Construction of an Exhibit of Pliocene Edentates. By Phil C. Orr. Pp. 6. 15 cents. Botanical Series, Vol 19, Part 1. The American Species of *Passifloraceæ*. By Ellsworth P. Killip. (Publication 407). Pp 331 2 50 dollars. *Zoological Series, Vol 23: The Birds of El Salvador.* By Donald R. Dickey and A. J. van Rossem. (Publication 406). Pp. 609+24 plates. 4.50 dollars. (Chicago Field Museum of Natural History.) [751

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Archæological Studies in Ireland

IRELAND, for long not so much a neglected corner in the archæological field as the victim of a provincial outlook, is to come into her own as an element in the mosaic of European prehistory. She is at last to take her proper place in the pattern which a band of workers closely in touch with one another is rapidly piecing together, more especially in the north-western sector of Europe, of the early movements of cultures and peoples, from which has emerged the complex of modern Western civilization. To say this is not to ignore the achievement of Ireland's archæologists and historians in the past, many of them, like Sir William Wilde and George Coffey, of international repute. Granting these exceptions, in little more than a decade there has been a change in the spirit and orientation of Irish archæology which has diverted interest from exclusive preoccupation with Ireland as a unitary region, or as an appendage of Britain only, in such studies, and their bearing on the identification and history of the mythical races and peoples of early Ireland, to the wider horizon of the correlation of her development in civilization with that of Great Britain and the Continental mainland. The story of this change has been told recently by Dr. Adolf Mahr, keeper of antiquities and director of the National Museum of Ireland, in his presidential address for 1937 to the Prehistoric Society, of which a digest appears on another page of this issue of NATURE (see p. 1041).

To those familiar with the material, it may appear that even less than justice has been done to a remarkable achievement. In no more than one hundred and seventy-five pages—though assuredly the longest presidential address ever presented to a learned society—Dr. Mahr has summarized, discussed and placed in its true archæological perspective the great store of new information accruing in the last five years from the intensive archæological investigations which have been carried on in the Irish field. This information has been analysed and brought into relation not only with the cultural succession of Ireland's own prehistory, but also with the general archæological complex in northern Europe of the prehistoric period as a whole. In range it surveys from the alleged, but now disputed, Upper Palæolithic man of the Kilgreany cave in Co. Waterford, down to the Early Iron Age, and even beyond in an occasional glance over Dr. Mahr's self-imposed barrier into the Early Christian period, commonly known as Late Celtic. In passing from one period to another the survey pauses to discuss problems intrinsically fascinating, but even more compelling as vital for the understanding of Ireland's part in the general development of prehistoric culture as a whole.

Among these topics of discussion, the lithic civilization of the 'Riverford' people, newly recognized by Dr. Mahr himself in a culture which in Ireland appears to centre on the Bann River, is one of the first importance. Ultimately derivative from the Baltic Maglemose, and a manifestation of Prof. Gordon Childe's 'forest culture', it takes us back to the very springs of civilization in northern Europe, and it may be, as Dr. Mahr suggests, the clue to the identification of that ethnically obscure stratum in the peoples of Britain, the Picts—a suggestion which in its ramifications opens up interesting vistas of further research.

Scarcely less significant is the story of the Irish megalith, now told in the light of the recent crucial excavations of the 'horned' cairns of northern Ireland, and in relation to its bearing on the origin of the 'Iberic' element in the Irish population, the development of the Irish Bronze Age, and the survival of non-Aryan traits in Irish culture.

With the Late Bronze Age early in the last millennium before Christ there comes the break in culture and the incursion of a new people from Central Europe, the Celts. If they herald what is to most the very dawn of Ireland's greatness as the centre of culture she became in later centuries, they have also left a legacy of problems to puzzle modern generations—their origin, their distribution, and the relation of the two branches of the Celtic-speaking peoples, the *q* Celts and the *p* Celts, both to one another and in the composition of the British and Irish peoples—matters of perennial argument to which the latest research in Ireland contributes its quota. These problems are further complicated by the novel line of evidence of pollen analysis of the peat, which while it has afforded a new and assured datum line in late glacial and early post-glacial times in Ireland, threatens, as at present understood, to throw into confusion the chronology of the Late Bronze Age.

It is a temptation to follow further the fascinating array of problems, which have already engaged the attention of the archæologist, or lie before him in the prospect of further research, more especially in the field of recreating the religious and social concepts of the ancient civilization of Ireland, so far as this is possible by the interpretation of the evidence of archæology and of surviving custom and belief. On such matters, however, reference must be made to the text of Dr. Mahr's address. Enough has been said to indicate that archæological studies in Ireland are well advanced along a path which will lead not only to fuller knowledge and understanding of Irish civilization from the earliest phases through the cycle of its full development to eclipse, but by bringing it into touch with the European background will enable it to add its contribution to studies in a wider field.

For this great expansion in Irish archæological studies in the last decade no single circumstance, or set of circumstances, is entirely responsible. That the zeal of Harvard University for scientific research for its own sake inspired a like enthusiasm and emulation in Ireland is unquestionable ; but credit is mainly due to the public spirit and the vision of the Governments of Eiré and of Northern Ireland in directing measures for the relief of unemployment out of public funds into the channel of archæological excavation. But zeal without understanding is blind, and it was fortunate for Irish studies that there were among the men of science of Ireland those who were able to take advantage of their opportunities and devise a campaign of systematic research, from which the greatest and most generally valuable increase in the sum of knowledge might accrue. Even so, the gain might have been less, had it not been possible for Northern Ireland and Eiré to work in complete harmony and with the fullest measure of co-operation. Archæology in Ireland knows no political or geographical boundaries.

Newton

Isaac Newton, 1642-1727
By J. W. N. Sullivan. With a Memoir of the Author by Charles Singer. Pp. xx+275. (London : Macmillan and Co., Ltd., 1938.) 8*s.* 6*d.* net.

As the arts aspire to the nature of music, according to Pater, so the sciences aspire to the nature of mathematics. This at least would seem to have been the view of the late Mr. J. W. N. Sullivan when he devoted two of the principal efforts of his life, one to a work on Beethoven, the other to a work on Newton. From Prof. Charles Singer's memoir of the author, it appears that the latter was ten years in preparation. Even then the absence of chapter headings and occasional repetitions suggest that some final revision may have been intended. But a perfectly satisfactory manuscript existed at the time of the author's early death, and the book is in all essential respects a finished work.

This study deserves a respectful welcome, because it is a serious contribution in a field of literature which has been for the most part conspicuously neglected. While the lives of great artists, and of musicians in particular, have been studied over and over again with the most minute care, the lives of the great masters of science have generally been allowed to pass quickly into oblivion. The literature which has gathered round Wagner, for example, must already be immense. Even second-rate masters receive their tribute on a slightly lower scale. But in general the work of the great mathematician or man of science is quickly absorbed into the common stream of progress, while his life of individual effort is disregarded and forgotten. The biographical side of scientific history has been little cultivated, and a scientific parallel to literary criticism can scarcely be said to exist.

For all this there are obvious reasons. The man of science leads a regular and uneventful life. He is rarely temperamental and he is free from picturesque vices. The great artist is probably less emotional than is popularly supposed, but the emotional appeal of his work gives him a sensitive audience who are eager for details of his personal characteristics, either from mere curiosity or, more seriously, to gain some clue to the secret of his power. The appeal of pure science is to the intellect alone, and therefore the intimate contact of its greatest exponents with their contemporaries is commonly restricted in their lifetime and their personal relations afford little material for study afterwards. Thus their work must stand in popular estimation with none of that light which shines on the work of the artist.

The distinction is further remarkable because the "Principia" is a great work of art. So is the "Theoria Motus". So are many of the memoirs of the great mathematicians and physicists. They have an architectural quality which makes the whole far greater than the sum of its parts. The work of art in the accepted sense of the term is not susceptible of definite and certain analysis, and for that very reason it lures the critic to express his individual reaction to it. When it appears in the form of a scientific masterpiece, the work is ruthlessly disintegrated from the beginning. What are taken to be its most original and valuable elements—often erroneously—are seized upon and isolated, and the personality of the author comes to be seriously misrepresented or ignored altogether. The tendency is perhaps natural and inevitable, but it is none the less true that in this respect science is at a disadvantage when compared with the arts. Any attempt to redress the balance is welcome.

Materials for a life of Newton are scanty, and, such as they are, they are very apt to give a false and one-sided impression. Controversies take the form of correspondence, and as letters of this kind bulk largely among the documents which survive, it is hard not to give them an exaggerated importance. Mr. Sullivan has tried to hold the balance fairly between Newton on one side and Hooke, Flamsteed and Leibniz on the other. Whether he has altogether succeeded is doubtful. It might have been better to have reduced the treatment of these matters in scale and to have dealt more fully with less controversial aspects of Newton's life. The judicious reader will make some adjustment in this sense for himself.

It is not that these incidents, rather unpleasant as they may be and of a sort likely to occur in any career such as Newton's, are without interest. The greatest space is given to an account of the relations with Flamsteed. In these it is clear that Halley played an unfortunate part. The world owes too much to the association of Halley with Newton to be severely critical of Halley. But the peculiar circumstances of Flamsteed's appointment entitle him also to sympathy and understanding. No director of an observatory can be expected to welcome anything in the nature of dictation as to what his observing programme is to be, or as to when and in what form his observations shall be published. From interference of this kind Flamsteed was specifically exempted by the terms of his appointment. Halley's desire to see the Greenwich star observations published may have been natural enough, but any pressure in this direction was unjustified and as naturally resented.

Until the intervention of Halley, the relations between Newton and Flamsteed had been perfectly correct. Thereafter they steadily degenerated. Newton wanted selected places of the moon for a research on the lunar theory which he wished to keep secret, and which in fact came to no successful issue. He even resented a suggestion that the communication of Flamsteed's observations to him should be made known. Mr. Sullivan sees that Newton wished to treat Flamsteed as a mere tool, but he failed to see that this attitude was preposterous. He quotes from a letter of 1695: "By frequent trials and alterations of his contrivances, Kepler found out the true theory of the planetary motions. You must not be ashamed to own that you follow his example." This looks like genuine and acute criticism on the part of Flamsteed, who saw whither he was being led. Kepler's success with the problem of two bodies was largely due to a most skilful use of observations suitably selected from Tycho Brahe's material. Was a similar method applied to the moon likely to be equally effective in a case of the problem of three bodies? Flamsteed's scepticism seems to have been justified by the event. But Mr. Sullivan is consistently unfair to him. When it comes to the difference over the first election to the Plumian professorship, no charitable explanation is found. The choice of Roger Cotes may have been right, yet even now that seems far from certain. It provided Newton with an able editor for the second edition of the "Principia". But Cambridge may have lost the opportunity of establishing a school of observational astronomy at an early date. To attribute to Flamsteed unworthy motives in the matter is quite gratuitous.

In the dispute with Hooke, following the communication of the "Principia" to the Royal Society, Halley also played an unfortunate part. Hooke's remarks were made not publicly before the Society but on what must be considered a privileged occasion. On this point Halley misled Newton, and it may well be that his account of what was said was none too accurate. The dispute was composed and its personal aspect is not very important. What emerged from it is that the law of the inverse square had been common property within a certain scientific circle in England for some years. This is not remarkable, since it only needed a combination of Huygens's theory of uniform motion in a circle with Kepler's third law. It was thus left for Newton to prove that the same law of gravitation accounted also for Kepler's first and second law. The other discovery of fundamental importance related to the attraction of a sphere at an external and at an internal point.

Whatever may be said against Hooke—and Mr. Sullivan does not fail to say it—he came near enough to the discovery of the law of gravitation to prompt the question, why was no abler mathematician more successful in anticipating Newton ? The clue, it may be suggested, lies partly in the utter blindness to the nature of Kepler's work which prevailed on the Continent. In England it was different, thanks mainly to Horrocks. It is surely significant that the posthumous works of Horrocks were edited by Wallis and published in 1672 under the title "Astronomia Kepleriana defensa et promota". The tradition thus preserved in England enabled Newton to start with the inestimable advantage of having a definite problem to solve.

The third controversy in Newton's life was with Leibniz, though this was carried on not so much by the principals as by fervent partisans on the two sides. The rival claims to originality must seem trivial to-day. The progress of science had made the need for some appropriate form of calculus so obvious that the wonder is that there were no more than two claimants to the parentage. The difference between the two amounts to much more than a mere matter of notation. Newton was a geometer, Leibniz was an analyst ; though, as Poincaré has remarked, all early mathematicians are apt to look as if they belonged to the first category. This does not mean that Newton was a geometrician, though it is true his methods were largely geometrical. The distinction depends on the intuitive element in the mental processes. Now intuition was the secret of Newton's power and of his success. It gave him what he wanted, and for mathematics as such he cared little or not at all. But intuition has its weak side in being incommunicable. The main stream of mathematics flowing through Euler, Lagrange, Cauchy can be traced back to Leibniz ; it owes comparatively little to Newton. The challenge problems from the Continent are mentioned. It would have been much more impressive if the solutions had been given by some Newtonian, and not by Newton himself. In the little regard he attached to the source of his own greatness Newton is by no means unique, as Mr. Sullivan supposed. Pascal is a conspicuous example. Others who have abandoned a mathematical career for which they were eminently fitted can no doubt be quoted down to the present day. Sir Christopher Wren was reputed among his contemporaries at an early stage, and not without reason, as a mathematician scarcely inferior to Newton himself.

Like the "Principia", the "Opticks", first published in 1704, should be regarded as a work of art, to be treated as a whole. No better example of the danger of one-sided analysis and selection can be found than in this case. Had the book been published fifteen years earlier, it would have deserved all the praise it has received. As it is, it is hard to find excuses for Newton's blindness to the merits of the "Traité de la Lumière" of Huygens. But after reaching fifty years of age, Newton was a changed man, both in mental power and in temperament. It really seems as if the nervous breakdown which occurred about that time left lasting effects until the end of his life. The intense effort which produced the "Principia" had exacted a heavy toll. In this may be found an explanation of much that would otherwise appear mysterious in the life of Newton as a whole.

The experimental philosophy of Newton seems to have been native to him, but it can be traced back to Francis Bacon. Its principles were observed in practice even by a born Cartesian like Huygens, and they have only broadened with time. The laws of dynamics had become known well enough for terrestrial applications. Their formulation by Newton, coupled with the law of gravitation, then opened the field of celestial mechanics, in which the comparison of theory and observation afforded a means of verification to a far higher degree of approximation than experiment makes possible. Thus the true foundation of Newtonian mechanics is astronomical. It is still valid for calculations in its original field, from a range table to a planetary ephemeris. Mr. Sullivan follows the mode in disparaging the nineteenth century. But if it is impossible to indict a nation, it is even more difficult to indict a century. The chief criminal seems to be Clerk Maxwell, whose derivation of the field equations from the work of Faraday is an achievement of the same order as Newton's derivation of celestial mechanics from the work of

Kepler. But he was also chiefly responsible for the extension of Newtonian mechanics to a field not originally contemplated. Yet in doing so he was only following the first rule of experimental philosophy, which was realized in the seventeenth century and is still valid. In this philosophy, observations and experiments are the bricks, mathematical theory is the mortar; and the first rule, variously stated by Newton and by Huygens, is that the mortar must be reduced to a minimum.

In the seventeenth century the state of mathematics offered little temptation to depart from this salutary rule. To-day the position is different, and it seems altogether too early to anticipate what the final outcome will be. In the meantime, the issue commonly presented to the popular mind, whether Newtonian mechanics is right or wrong, seems altogether too crude. Newtonian mechanics, like Euclidian geometry with which it is inseparably bound, represents a necessary phase through which the human mind had inevitably to pass. If evolution is allowed in theology, it may fairly be admitted without reproach in science. From the scientific point of view reality is a chimæra of the philosophers. The word should have no place in the bright lexicon of science. Though Newton rated his scientific activities low and his other pursuits more highly, he never confused the issue between them. In the same way experimental philosophy, whatever difficulties may confront it, will work out its own salvation from within, not from without.

H. C. P.

Theory of Integral Equations

Théorie générale des fonctionnelles: (Collection de monographies sur la théorie des fonctions.) Tome 1: Généralités sur les fonctionnelles; Théorie des équations intégrales. Par Prof. Vito Volterra and Prof. Joseph Pérès. Pp. xii + 359. (Paris: Gauthier-Villars, 1936.) 100 francs.

IN the modern mathematical development of operational methods, the theory of integral equations has yielded a calculus of so broad a generality that it has very considerably extended the field of analysis. The foundations of the theory were laid almost simultaneously by E. I. Fredholm of Stockholm and Vito Volterra of Rome, whose brilliant papers opened to the mathematical world one of its most fertile regions. The first treatises on the subject were two monographs written by Prof. Volterra and published in Paris in 1913. They were entitled, "Leçons sur les fonctions de lignes" and "Leçons sur les équations intégrales et les équations intégro-différentielles", and were based upon courses of lectures given by the author at the Sorbonne and at Rome respectively. In 1936, a new edition of the latter book became necessary and, in view of the rapid progress made in the theory since 1913, the author in collaboration with Prof. Pérès, of Paris, decided to rewrite the work under the new title, "Théorie générale des fonctionnelles", of which the book under review is the first of three volumes.

It may be remarked here that the modern calculus of functionals began in 1887 when Volterra published a series of papers in the *Rendiconti della R. Accademia dei Lincei* in which the term *functions of lines* was used. The designation 'functional' (*fonctionnelle*) was first employed by J. Hadamard in a paper "Sur les opérations fonctionnelles" (*Comptes rendus*, 136, 351–354; 1903); and in the "Theory of Functionals", an English translation of a course of lectures given at the University of Madrid in 1926 and afterwards published in Spanish, Prof. Volterra writes: "The name *function of a line* was initially taken to mean what, in general, is now called a *functional*".

The text of the present volume is based upon parts of the earlier work, already mentioned, which it replaces, and also upon the Madrid lectures. It is divided into two parts. The first, consisting of five clearly written chapters, introduces the notion of a functional and then explains the general properties of functionals, such as continuity, series of homogeneous functionals, differentiation, integration, etc. The subject-matter is drawn freely from that of the first chapter in the "Theory of Functionals", referred to above, with considerable extensions from the researches of Fréchet, Levy, Pérès and Riesz.

The second part, occupying the remaining six chapters, is devoted to the modern theory of integral equations, which is treated quite rigorously. The first section (Chapters vi and vii) is concerned with the author's well-known equations of the first and second kinds. The singular case of the former receives full treatment both by the author's original method and also by a new one due to Prof. Pérès. Then follows a lucid discussion of Fredholm's equation, the two cases depending upon the non-vanishing and the vanishing of the fundamental determinant D(λ) being considered. Here is included also a new method by M. Pérès of obtaining the functions of Schmidt.

Finally, a section has been devoted to a treatment of non-linear equations in which much of the recent work of Schmidt, Leray and the author has been incorporated. An extensive bibliography and index have been provided at the end.

Students of all ages will be grateful to the authors for producing such a volume in which the results of so much modern research are to be found. The work is, undoubtedly, a very valuable and important contribution to the theory of integral equations. F. G. W. B.

Agricultural Policy for Peace and War

Famine in England
By Viscount Lymington. Pp. 271. (London: H. F. and G. Witherby, Ltd., 1938.) 7*s*. 6*d*. net.

LIFE in Britain has carried a commercial and industrial bias for so long that any thought of an exodus to the land seems anachronic, much as a movement in that direction would benefit national health and security. Lord Lymington is among those who would deprive industry, trade and usury of their present domination; and, even at the cost of losing foreign investments and overseas trade, he would seek to establish a new Eden where, *inter alia*, humus would be enshrined as the goddess of fertility, and agricultural chemicals consigned to the bottomless pit! We must, he says, stop exploiting the land for temporary economic gain, and return to 'good farming' by restoring and maintaining soil fertility. Capital taken from the land as tithe and death duties must be returned to it, so that we may be able to renew dead stock, increase live stock, settle far more people on the land, and produce far more home-grown food than we now do. We must, too, regenerate the land in order to regenerate our people.

The first step should be to make Britain immune from starvation in time of war, and its sequelæ, or panic, disease and civil war. Our normal reserves of food are very small, and our means of increasing production and of importing supplies in wartime are much inferior to what they were in 1914; and the potential menace from air-attack on land and sea is many times greater. For these and other reasons the author advocates the policy of dispersed inland storage of essential foodstuffs (which the Government has now adopted, except that wheat will be stored in ports on the west coast). The demand for a whole year's reserve supply of wheat seems, however, to be excessive, for in time of emergency we could at once increase the milling percentage from 70 to 92–94, with much benefit to the health of the people, and admix the wheat with barley and potato; we could grow more wheat for grain instead of for straw, and cease to feed it to poultry; we could start now to plough up our deteriorated pastures and eventually sow down some of them to wheat; and by the judicious use of fertilizers we could increase crop yields by 1½–2 cwt. per acre.

The author's proposal to build up soil fertility on the basis of a large livestock population during peace, and gradually to kill off the animals, except the dairy cattle, during war, appears thoroughly sound; but his long-term policy of increasing cattle numbers by 60 per cent, and doubling present numbers of sheep, pigs and poultry, though physically possible would, as he realizes, get us into difficulties with the Dominions and certain foreign countries. He foresees declining food supplies from most of the food-exporting countries, and for this reason also he favours a policy of national sufficiency in foodstuffs.

Lord Lymington has a very doleful tale to tell of Britain's neglect of agriculture and its far-reaching consequences, but unfortunately he is apt to overstate, and here and there to misstate. The assertion that "without hesitation, one can say that from Land's End to John o' Groats the soil in general is deteriorating" should have been backed by evidence. It is no doubt true of our run-out pastures, but there is no supporting quantitative evidence for our arable soils, the official crop returns from which show no material change; and in the case of wheat, a recent study by the Food Research Institute of Stanford University reveals that the trend of yields in the British Isles from 1885 to 1935 has been one of slow increase.

Further examples of unwarranted generalization are the statements that the use of poison sprays to kill charlock causes "a dead, unhealthy soil, in which no crop can flourish naturally", and that "most of the apples we now eat are sprayed with arsenic". Chlorination of water-supplies also comes under the author's ban for some unspecified reason; and his oft-repeated denigration of inorganic fertilizers, based apparently on their occasional misuse, shows that he has listened uncritically to a vocal few who, in their justifiable enthusiasm for humus-producing manures, exceed the bounds of experience by postulating an antagonism between the two kinds, ignoring the fact that in general they are complementary.

The book is well written except for misuse of 'will' and 'shall', 'would' and 'should', recalling the time-honoured S O S : "I will be drowned, no one shall save me". It should appeal to all the regenerate scientific men who now take an interest in social relations, but being somewhat too 'extreme' and dogmatic, it is not an entirely safe book to place in the hands of the million, for whom it was obviously written.

E. H. T.

British Birds

The Handbook of British Birds
By H. F. Witherby, Rev. F. C. R. Jourdain, Norman F. Ticehurst and Bernard W. Tucker. Vol. 1 (Crows to Flycatchers). Pp. xl + 326 + 32 plates. (London: H. F. and G. Witherby, Ltd., 1938.) 25*s.* net; set of 5 vols., 21*s.* net each.

THE eagerly awaited first volume—there are to be five in all—of the "Handbook of British Birds" has now made its appearance. It may be said at once that the work is fully up to, and indeed exceeds, the high expectations formed. The editors, all of them distinguished ornithologists, have laboured long, unostentatiously and with sustained enthusiasm to make the book a success, and it is safe to say that neither in Britain nor indeed in Europe is there in existence so complete and accurate a work on birds.

A feature of this volume—as it will be of the four succeeding volumes—is the coloured plates which portray the bird, both male and female, in summer, winter, and immature plumage. These plates are finely reproduced, and the colouring of the birds is clear and faithful.

In their preface, the authors tell us something of the history of the work, which has been with them a labour of love. Their aim was to produce something that would be of practical value not only to the expert, but also to the beginner and to the student interested in birds yet knowing little of them, and they have admirably succeeded in their task. The many readers of the "Practical Handbook", which was the ornithologists' Bible and which went out of print in 1934, will be interested to learn that the present work is much more than a new and enlarged edition of that 'Handbook". New and valuable features have been introduced. One of these is a chart of song periods, prepared by Mr. H. G. Alexander—the fruits of thirty years close observation; another is the descriptions of display and posturing, written by Mr. Jourdain and Mr. Tucker; a third is a series of maps showing the breeding sites of certain local species in Britain, and the migrations of certain species, discovered by the *British Birds*' ringing scheme. The inquirer can indeed turn up any British bird at random, and read, placed before him clearly and concisely, all that is known about it.

No book of this kind could have been produced without extensive researches into the subject, and it is pleasant to see that the ornithologists—a considerable company—who have supplied information are individually thanked in the preface.

When this volume is compared with the older standard works on British birds, it is seen at once how greatly the number of species has increased. To take an example; in the old days an author described the jay, and thought that there was one, and only one, species of jay in the British Isles. The experts of the present day have discovered that no fewer than three species of jay may be found in the British Isles—the British jay, the Irish jay and the Continental jay, all with small, but quite distinct, differences of appearance. Let us take another bird, the crested tit; old authors were not aware that three species of this bird had been found in Britain—the Scottish crested tit, the Northern crested tit and the Central European crested tit. Other examples are the British blue tit and the Continental blue tit; the British long-tailed tit and the Northern long-tailed tit; the British tree creeper and the Northern tree creeper, and so on.

Whether this differentiation of species may be carried too far is a controversial subject—the late Abel Chapman was a strong opponent of it—but there is value in the descriptions of all the recognized species, and it should now be possible for the student to discover from a bird in the hand whether it is a native of Britain or an immigrant of an allied Continental race.

Another thought must occur to the reader of this work—the remarkable spread of certain species into areas where they were hitherto unknown.

I hope the education authorities of Britain will take notice of this work, for I can imagine nothing more likely to encourage nature study in the younger generation. In our great public schools also, the completed five volumes might be given as a most valuable prize.

Since we have now the finest bird book in Europe, let us see that we become up to date with our Wild Bird Protection Acts, and let us arouse public opinion to save those species of birds which seem—unless some special measure is taken for their preservation—doomed to extinction.

SETON GORDON.

Höhere Mathematik für den Praktiker

An Stelle einer funfte Auflage des "Lehrbuchs der Differential- und Integralrechnung" von H. A. Lorentz. Neu bearbeitet von Prof. Dr. G. Joos und Prof. Dr. Th. Kaluza. Pp. xii+364. (Leipzig: Johann Ambrosius Barth, 1938.) 23 gold marks.

"WHY do men write big books?" asked Bernard Shaw. "Because they haven't time to write small ones!" The authors of this small book must have expended a great deal of time and energy in selecting essentials and presenting the mathematical methods and results which are most needed by engineers and physicists. The range covered is amazingly wide.

Starting with permutations, combinations, and the binomial theorem, we go on to probability, determinants, complex numbers, progressions, exponentials and logarithms, trigonometry, vectors and analytical geometry of two and three dimensions. These subjects receive only a few pages apiece, but the talent of the authors for compression makes the treatment really valuable. Much more space is given to the differential and integral calculus, which go as far as maxima and minima of functions of several variables and the transformation of double and triple integrals. There is a short section on Fourier's series and integral, including the use of the harmonic analyser. Differential equations are solved numerically and graphically, as well as by the usual elementary methods, and there is a brief account of partial differential equations. This is followed by a section on the calculus of variations. There are seven pages on functions of a complex variable, and in this the authors succeed in giving an intelligible account of conformal representation and Cauchy's theorem, with an application to the evaluation of a definite integral by means of contour integration. The book concludes with answers to examples and an index.

Naturally there are many portions of this book which the specialist will condemn as inadequate, but the object of the authors is to give a wide general view, and their work will be welcomed as a gallant counter-attack against the forces of narrow specialization. H. T. H. PIAGGIO.

Histoire générale du tissu

Document No. 2: Tissus anciens. Partie 1: Le Kaunakès; étude critique d'après les textes, les monuments, figurés et les survivances supposées du tissu. Par Émile Cherblanc. Pp. 66+16 plates. (Paris: Les Éditions d'Art et d'Histoire, 1937.) 30 francs.

IN this second study in the series dealing with the history of weaving, M. Émile Cherblanc reviews the evidence from all sources, including that now made available by recent archæological discovery in Irak, bearing on the nature of the garment, reputedly of Chaldean origin and known to classical writers, notably Aristophanes, Menander and Pollux, as the kaunakes (καυνάκης). M. Heuzey in 1886 in a communication to the Académie des Inscriptions et Belles Lettres concluded, on the evidence of two monuments, as well as the literary sources, that the kaunakes was an oblong mantle of wool with a long pile, which was worn draped simply about the body.

In the light of the evidence now brought under review, M. Cherblanc concludes that the examples from the monuments upon which M. Heuzey relied represent two distinct classes of material, one a sheepskin of which the fleece was retained, and the second composed of skins joined and sewn together. In the third and second millennium B.C. and the pre-Hellenic period, the term did not refer to a fabric. In the time of Aristophanes it was used of a garment of Persian origin made of a thick and heavy material, in which a large quantity of wool was used. This was worn on the shoulders and probably was semicircular in form like the κατα φλοκατας of the modern Greek shepherd, and possibly with the same goat-skin texture. The author maintains that the allusions to the kaunakes in all classical authors, with the exception of Martial, can be shown to agree with the meaning of a garment of sheepskin which retains the fleece. An examination of the Coptic 'knot' pile fabric, which through the '*point sarrasinois*' had an important influence on the Eastern and European carpet fabrics, shows it to be entirely Egyptian in origin and unrelated to the kaunakes.

M. Cherblanc's ably reasoned study is very fully illustrated by material from the monuments and diagrammatic sketches of the technical points and processes involved in the argument.

Contributions to the Microscopic Anatomy of the Pancreas

By Paul Langerhans (Berlin, 1869). Reprint of the German original with an English translation and an introductory essay by Dr. H. Morrison. Pp. 39. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1937.) 4*s*. 6*d*. net.

THIS little work, now reprinted from the *Bulletin of the Institute of the History of Medicine* (March 1937), contains one of the classics of medicine, which was presented by the medical student Paul Langerhans in 1869 at the age of twenty-one years as his inaugural thesis for the degree of doctor of medicine at the Berlin Faculty. The thesis constitutes not only the first detailed account of the microscopical anatomy of the pancreas, a subject which had hitherto been neglected by anatomists and physiologists but also the first description of peculiar groups of cells in this organ, the nature of which Langerhans was unable to explain. In 1893, however, they received the name of "islands of Langerhans" from the French histologist Laguesse, who first suggested that they were the seat of the internal secretion of the pancreas; but it was not until 1921, or more than fifty years after the appearance of Langerhans' thesis, that insulin, the specific cure of diabetes, was isolated from these cells by Banting and Best of Toronto.

In addition to the German original and English translation of the thesis, the work contains a short account of the life and work of Langerhans, who died at Madeira at the early age of forty-one years; there is also a list of his publications and portraits at different ages.

River Pollution and Waste Waters from the Milk Industry

By Dr. A. Parker

DURING recent years, the problems of treatment and disposal of the waste waters from the milk industry have increased in importance with the development of the industry in England and the establishment of depots and factories each receiving milk from many farms. Serious pollution of rivers and streams and difficulties at sewage disposal works in many parts of the country have been caused by discharges of waste waters from milk collecting and distributing depots and from factories making cheese, butter, condensed milk and other milk products. About four years ago, an investigation of the various problems was begun by the Water Pollution Research Board of the Department of Scientific and Industrial Research. Though the investigation has not yet been completed, it has already provided results of considerable practical value. It is the purpose of this article to give a brief description of those results.

In attempting to solve any problem of treatment and disposal of trade waste waters, the first step should always be to consider the practicability, taking costs into account, of so modifying the manufacturing processes that the wastes need not be produced or that the polluting matter carried away in the wastes is greatly reduced in quantity. Methods of purification of waste waters should only be considered after all practicable modifications in the factory processes have been adopted to reduce the polluting character of the wastes or to re-use the waste waters in the factory. Frequently the polluting character of the waste waters can be reduced by reducing losses of valuable material in the factory, or by recovering products or by-products of value. This is the first line of attack which has been followed in the Water Pollution Research Board's investigation of the problem of pollution by the waste waters from the milk industry.

The investigation has shown that even at milk collecting and distributing depots, where the milk is received only for cooling, pasteurizing and distribution, the waste waters from washing delivery churns, coolers, pasteurizers, tank wagons, other equipment and the floors usually carry away 0·5–1·0 per cent of the milk received. This means that the waste washing waters from a collecting and distributing depot handling 10,000 gallons of milk a day usually contain 50–100 gallons of whole milk. The volume of waste washing water in relation to the volume of milk handled varies considerably at different depots. If the volume of washing water is about the same as the volume of milk handled, 10,000 gallons of milk a day received in a collecting and distributing depot give rise to 10,000 gallons of waste water containing 0·5–1·0 per cent of milk. As measured by the test for dissolved oxygen taken up from aerated water in five days, water containing 1 per cent of whole milk has a biochemical oxygen demand of about 120 parts per 100,000 parts. Average domestic sewage has a biochemical oxygen demand of 40–50 parts per 100,000, and the volume of domestic sewage is usually about 25 gallons a day per head of the population. A volume of 10,000 gallons a day of waste water containing 1 per cent of milk is thus equivalent in its de-oxygenating or polluting effect on a stream to the domestic sewage from a population of about 1,200.

From factories making cheese, butter, condensed milk and other products, in addition to washings from delivery churns, there are waste waters from washing cheese vats, butter churns, evaporators and other equipment. Even when care is exercised to reduce the losses of milk, of the main products and of the by-products whey, buttermilk and skim milk, the waste washing waters from cheese and butter factories contain organic matter equivalent to at least 2 per cent of the milk handled. At many factories the waste washing waters from the manufacture of cheese and butter contain organic matter equivalent to 3–4 per cent of the milk handled, and as much as 6–8 per cent has been found at some factories.

In the past, some factories have considered whey and buttermilk as waste materials and have discharged them into the nearest stream, with disastrous polluting effects. Whey has a biochemical oxygen demand of 4,000–5,000 parts per 100,000, so that it is approximately a hundred times as strong in polluting character as an equal volume of crude domestic sewage. In other words, if the whole of the whey from a cheese factory handling 10,000 gallons of milk a day were discharged into a stream, its polluting effect would be about the same as that of the crude domestic sewage from a town with a population of 40,000–50,000 people. Whey and buttermilk should be treated as valuable by-products, not as waste materials. They have high food values and can be utilized as food or in the preparation of foods. There is a market for dried whey and buttermilk, and there is no doubt that this market can be further developed.

From the Water Pollution Research Board's investigation, it has definitely been concluded that the quantities of polluting matter carried away in the waste waters from the various branches of the milk industry can be considerably reduced by simple and inexpensive modifications in the operations within the factories, and by more careful control of the processes of draining and washing. At most depots and factories, the delivery churns are rapidly emptied and insufficient time is allowed adequately to drain the churns before they are transferred to the washers. By installing a simple drainage rack with a milk collecting-channel beneath and allowing the churns to drain on the rack for one or two minutes, the quantity of milk carried away in the water used for washing the churns can be reduced from more than 0·5 per cent to less than 0·25 per cent of the milk handled. This saving has definitely been effected at a large factory. It represents a saving of about 10,000 gallons of milk or £750 per annum, with milk at 1*s*. 6*d*. per gallon, for a collecting and distributing depot receiving an average quantity of 10,000–12,000 gallons of milk a day. If adequate drainage trays were installed at all the depots and factories in Great Britain, the total saving of milk would be roughly 3 million gallons per annum, or £150,000 per annum with milk at an average wholesale price for all purposes of 1*s*. per gallon.

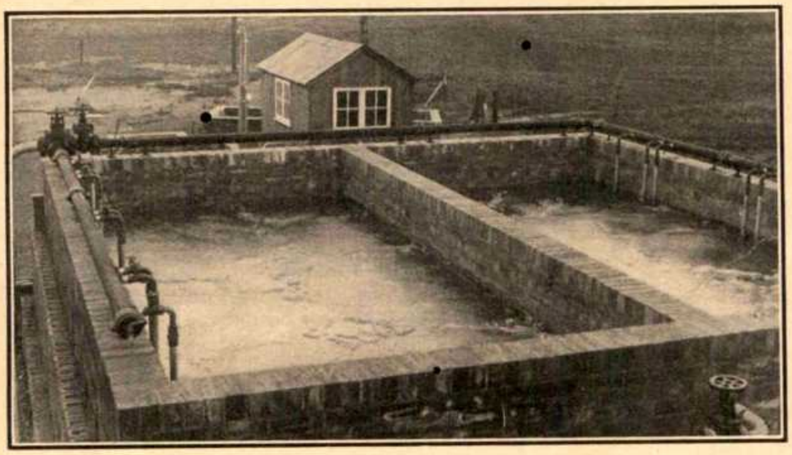

Fig. 1.

AERATION TANKS OF EXPERIMENTAL PLANT FOR THE TREATMENT OF MILK EFFLUENTS BY THE ACTIVATED SLUDGE PROCESS.

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Substantial improvements can usually be made also in the methods of draining and washing cheese vats, butter churns and other equipment to bring about considerable reductions in the quantities of whey, buttermilk and other products in the waste waters. Cheese vats and butter churns, after the removal of whey and buttermilk, should first be washed with small quantities of water which should be added to the whey and buttermilk for use as food or for the preparation of foods. Subsequent washings with larger quantities of water would then contain much less polluting matter. Modifications of this kind not only cause direct savings in the factory but also reduce the size and the cost of construction and operation of the plant required for the treatment of the waste waters.

The next step in the investigation was to study possible methods of purifying the waste waters unavoidably produced. Plants in France and Belgium which were satisfactorily treating waste waters from condensed milk factories were visited. These plants utilize the activated sludge process according to the method devised by H. Kessener of Holland. Experiments made in the laboratories of the Rothamsted Experimental Station for the Water Pollution Research Board indicated that it would be practicable to purify the waste waters either by the activated sludge process or by the process of biological oxidation in percolating filters operated under certain conditions. In the experiments with percolating filters it was found that in single filtration, by the method normally employed in the treatment of sewage at sewage disposal works, solid matter was deposited in the top layers of the filter, which in consequence became choked and inoperative. It was found, however, that this difficulty could be overcome by adopting a method of biological filtration suggested by H. C. Whitehead and the late F. R. O'Shaughnessy of the Birmingham, Tame and Rea District Drainage Board. By this method, the waste waters, after sedimentation to remove suspended solids, are passed through two biological filters in series, and the order of the two filters in series is changed at intervals of two or three weeks. Under suitable conditions, the partially treated effluent from one filter brings about the removal of the solid matter previously deposited in the top layers of the other filter, when this filter occupied the primary position.

With the financial co-operation of the industry, the investigation was extended to include experiments on a large scale at a cheese factory in Shropshire, where United Dairies Ltd. provided the necessary facilities. Through the Milk Marketing Board and the Scottish Milk Marketing Board, the industry has contributed nearly £11,000 towards the cost. Two large experimental plants were erected at the factory in Shropshire during the summer of 1935. In one plant, the waste waters, after sedimentation, are treated by the activated sludge process (Fig. 1) operated in a manner similar to that adopted for the treatment of sewage at sewage disposal works. In the other plant (Fig. 2), the settled waste waters are submitted to biological oxidation in two percolating filters in series, and the order of the filters is reversed at intervals of ten days to three weeks. Each filter contains hard metallurgical coke, graded 0·75–1·5 in. Both plants have been in continuous operation since their erection in July 1935, in the treatment of milk washings and mixtures of milk washings and whey washings. For the activated sludge process, the settled crude waste is diluted, if necessary, to give a mixture with a biochemical oxygen demand of not more than 50 parts per 100,000 parts. From this mixture, with a period of aeration of twenty-four hours, a final effluent with a biochemical oxygen demand of about 1 part per 100,000 is obtained. For the biological filtration plant, the settled wastes are diluted to give a mixture with a biochemical oxygen demand of not more than 30 parts per 100,000 parts. From this mixture a final effluent with a biochemical oxygen demand of less than 1 part per 100,000 parts is obtained, even with the high rate of treatment of 240 gallons a day per cubic yard of filtering medium in the two filters together, that is, 480 gallons a day per cubic yard in each filter. This is a rate of treatment much greater than that usually adopted in the treatment of domestic sewage at sewage disposal works in Great Britain. Tests over long periods have shown that trout are able to live in the undiluted final effluents from the experimental plants.

Of the two methods investigated for the treatment of milk effluents, the process of biological filtration with two filters in series and periodic change in the order of the filters appears to be the more suitable for operation under factory conditions. To allow a margin of safety, the diluted settled crude liquid should be supplied to the filters at a rate not greater than 160 gallons a day per cubic yard of filtering medium in the two filters together. During the past two years, several plants designed on the basis of the experimental filtration plant have been erected at depots and factories in different parts of the country, and other similar plants are in course of construction.

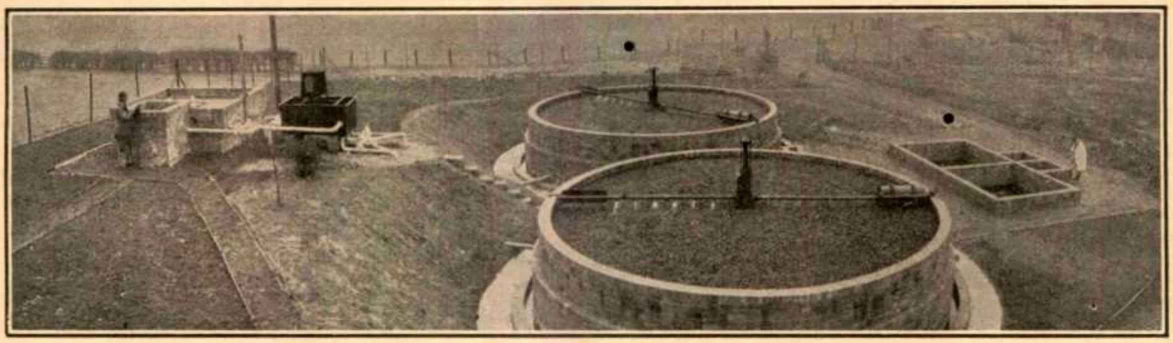

Fig. 2.

EXPERIMENTAL PLANT FOR THE TREATMENT OF MILK EFFLUENTS BY BIOLOGICAL FILTRATION WITH TWO FILTERS IN SERIES.

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New Aspects and Problems in Irish Archæology*

THE acquisitions of new archæological material by the National Museum of Ireland now represent a yearly increase forty times larger than that of ten years ago. The old-established collection of Irish antiquities contains an unusually high percentage of unlocalized or ill-localized specimens; but the National Museum is now building up a second collection, each object accurately located, which at least in numerical strength compares with the old one and will serve as a basis for distributional studies.

During the past five years, large-scale systematic excavations have been undertaken, which have contributed to the clarification of at least some of the most hotly contested problems in the archæology of Ireland. No comprehensive survey of Irish archæology, however, can as yet be made, though this may be possible in ten years time. Five years' excavation has merely touched the fringe of the problems before us.

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* Substance of the presidential address for 1937 by Dr. Adolf Mahr to the Prehistoric Society. *Proc. Prehist. Soc.*, 3, 2, pp. 262–436 + 7 plates (1937).

Recent progress in the conception of Irish archæology is in no small measure due to the fact that protective legislation of national monuments is now bearing fruit. The respective administrative and advisory organizations of the Free State and of Northern Ireland co-operate freely; and the archæological activities of the Royal Irish Academy and of the Royal Society of Antiquaries of Ireland are fully all-Irish in character.

No systematic excavation worthy of the name had been undertaken for many years. The opportunity to make a fresh start came with the proposal of Dr. B. H. O'Neill Hencken for the Harvard University Archæological Expedition to Ireland, which as part of a larger scheme of anthropological investigation in Ireland, excavated for five years in succession, from 1932 until 1936. Sites of a size never attempted before were then excavated, not with the object of collecting antiquities, but purely with the aim of obtaining scientific evidence. It taught Ireland scientific methods of excavation, and trained Irish workers in technique. In 1934 the Free State's scheme for the relief of unemployment opened the way to systematic excavation on an unprecedented scale, and a similar measure was adopted in Northern Ireland in 1935. In the Free State, no fewer than twenty-six excavations have been carried out, many extending over more than one season, and nearly all devoted to sites of outstanding importance. Irish, English, American and Danish archæologists have participated in the work. In addition, 'licensed' excavations have been carried out by the learned societies and private individuals.

In the most important department of the correlation of all evidence available, little work has been done. The Belfast Field Naturalists' Club in 1930 set about launching a cartographical survey of monuments, archæological sites and antiquities generally in Northern Ireland, of which the preparation was entrusted to Miss M. Gaffikin. In 1935 two distribution maps were published, one of megalithic monuments, the other of raths, cashels and crannogs. Some six hundred megalithic monuments have been listed, and some two thousand of the later monuments; but the authors disclaim completeness.

Physical anthropology has been neglected for so long in Ireland that Prof. C. P. Martin's book "Prehistoric Man in Ireland" is an almost unhoped-for achievement. His work is being continued by Prof. I. K. Jamieson, of Trinity College, Dublin.

Investigation of the problems of the peat, the most important source of Irish archæological material, was begun by Prof. G. Erdtmann in his studies of pollen analysis (1928), and is being continued by Prof. K. Jessen, of Copenhagen, and the Committee for Quaternary Research in Ireland. Important, if at present tentative, conclusions, based on evidence from sixty sites, as to late glacial and early post-glacial events and chronology have already emerged, while conclusions of a like tentative character as to climatic change at the beginning of the Late Bronze Age, when correlated with similar phenomena in north-western Europe, by placing this phase of the cultural succession in Ireland at a period some centuries later than that accepted by archæologists, opens up an important field for further investigation.

It was from work such as these bog investigations, from the large-scale excavations, and from the ancillary activity in the National Museum offices that the modern conception of Irish archæology arose and recent progress is due. Four major results stand out, of which three are due to excavation work. These are: first, as a result of excavations in Northern Ireland, the history of an almost forgotten but important megalithic monument, the horned cairn, with its derivatives, is now clear; secondly, it is known that the souterrain, as a type, can be as old as the Middle Bronze Age; thirdly, at least one crannog, that of Knocknlappa, Co. Clare, belongs to the Late Bronze Age, in other words, antedates the La Tène period: and fourthly, partly by excavation work, but principally by analysis and comparison of museum material, a hitherto unobserved cultural facies, the Riverford lithic civilization, has been recognized.

Dr. Mahr proceeded to discuss the evidence for the existence of the stone culture to which he has given the name of the 'Riverford civilization' and its relation to the stone cultures of Britain and northern Europe, and then turned to a critical and constructive examination of the fresh evidence bearing, more especially in relation to the European background, on the palæolithic and mesolithic periods, the neolithic period, megaliths, their derivation and distribution, megalithic art, the Bronze Age, and the early Iron Age. In summing up an analysis of the 'Keltic' problem, in which he follows a line of argument reverting more or less to the position on the *p* and *q* problem of Sir John Rhys, Dr. Mahr outlines the general conclusions of the archæological evidence as follows:

We have been able to trace the following immigrations or invasions into Ireland. (1) A mesolithic stratum. Probable source: the western continent. Route: south Britain. (2) Another lithic stratum, the Riverford people, or the Picts. Ultimate source: Maglemose culture somewhere around Denmark. Route: Doggerbank — Scotland — Hebrides. (3) The Megalithic invasion, heralding the Bronze Age. About 2100 B.C. Source: Iberia. Route: Brittany—Cornwall—Irish Sea. (4) The Late Bronze Age invasion. About 900 B.C. Source: Middle (and Lower ?) Rhine and eastern, plus northern France. Route: Lowland Britain—Cumberland—Wigtownshire. (5) The La Tène wave. About 200 or 150 B.C. British Kelts coming from Wigtownshire occupied only a limited district of north-eastern Ireland.

Of these, (3) was certainly a non-Aryan movement. Much of the non-Indo-Germanic traits of ancient Ireland must be due to it. (4), however, came from a region in which the Kelts were deeply rooted. It was probably the Keltic cradle; while (5) was an aristocratic conquest by bands, who came apparently without their womenfolk.

In reference to the aims of future research, one thing stands out clearly. The rigid canons of European prehistory are applicable to Ireland only with considerable qualification. They hold good so far as the general sequence goes, but some periods culturally so far outweigh others as almost to eclipse them. The only cultural strata in Ireland which really matter are (1) the basically 'lithic' Riverford complex; (2) the megaliths, and the earlier part of the bronze age they signify; (3) the Late Bronze Age (and the Kelticization of the country it brought about); and (4) the Early Christian period. There are periods in which Ireland has an importance for all Europe quite out of proportion to its size, and others in which she is simply an appanage of Britain.

The international importance of Irish archæology is too well known to be stressed here. Its importance for British archæology is, if anything, even greater. The only area of western Europe which was never Romanized, not only contains the clue to all problems of free Caledonia, but Roman Britain, too, is not intelligible without the Keltic background, which can be unfolded by research in Ireland. No problem in Irish archæology can be solved without the British evidence; but is there any problem in British archæology which can be solved without Irish evidence ?

Tenth International Congress of Chemistry

THE Tenth International Congress of Chemistry met in Rome on May 15–21. More than thirty nations sent representatives, two thousand eight hundred in all; they included about seven hundred from Germany, two hundred from France and seventy-five from Great Britain.

Proceedings were opened at the Capitol in the presence of His Majesty the King of Italy with an address on the "Conquests of Chemistry" delivered by the president of the Congress, His Excellency Prof. N. Parravano of the University of Rome, and this was followed later by a reception by the Minister of National Education in the stadium of the Palatine—two sites of impressive and historic dignity.

The business of the Congress was conducted in the fine modern rooms of the recently built Citta Universitaria, in which the large hall set apart for the meetings was filled to overflowing during the opening addresses of the various sections.

Among those who opened the sections were Prof. P. Walden, on "The Creed of Scientific Chemistry"; Prof. C. N. Hinshelwood, on "Physical Chemistry and Modern Scientific Thought", delivered in fluent Italian; Prof. Swietosławski, on "Developments of Industrial Chemistry"; Prof. Jolibois, on "Transformation of Matter and Motive Power"; Prof. Giordani, on "The Utilisation of Thermal Energy"; Prof. Votocek, on "Synthesis of Carbohydrates"; Dr. Hissink, on "The Chemistry of Soils"; Dr. L. M. Lampitt, on "The Trend of Food Science"; Prof. E. von Euler, on "Vitamins and Hormones in Food and in the Human Organism"; Prof. Ruggli, on "Housing, Furnishing and Clothing in their Chemical Aspects"; Prof. Viviani, on "Natural and Artificial Textiles"; Prof. Fourneau, on "The Progress of Therapeutic Chemistry"; Prof. Butenandt, on "New Problems in Biological Chemistry"; Prof. Seyewetz, on "Chemistry and Photography"; Dr. S. E. Sheppard, on "Optical Sensitising of the Silver Halides"; Dr. Fr. ter Meer, on "New Developments in Chemical Technology"; Prof. G. Egloff, on "Petroleum—its Chemical and Industrial Significance"; Prof. D. M. T. Bogert, on "Chemistry and Defence"; Prof. H. Mark (not present) on a similar subject; Prof. Fr. Fischer, on "Chemistry and the Motor"; and Prof. Portevin, on "Metallurgy in Transport".

The President's opening speech and summaries of the above addresses in various languages were collected in a small volume and distributed at the end of the Congress, while in *La Chimica e l'Industria* for May (20, 251; 1938) will be found notes on the very numerous individual contributions to the sections together with photographs and short biographies of the presidents, vice-presidents and opening lecturers of each section.

Thus, not only was the Congress well organized, but it was also carefully documented. In addition to the above-mentioned documents, Prof. Parravano made a gift to the members of a valuable collection he had compiled of Italy's chemical achievements, "La Chimica in Italia" (535 pp. illustrated).

It was surely with pardonable pride that the Italians took pains that the sights of their incomparable city should be shown to the visitors. Opportunities were given for the Congress members to view the excavations of the Forum Romanum and the other fora recently opened up, and to visit the reclaimed Campagna. The excavations at Ostia and the Lido of Rome were visited, an expedition was made to the Villa d'Este at Tivoli and Frascati, and in Rome itself the Augustean Exhibition with its admirably arranged presentment of Rome throughout the ages was thrown open. For the ladies, tours were arranged daily to see in detail the churches, historical monuments, museums and villas of Rome.

For the efficient work of the secretariat only the highest praise can be given , frequent comment was made on the courtesy and instant helpfulness shown to members.

Among the social events must be mentioned the reception by the Governor of Rome, the symphony concert, the gala performance in the opera, at which were performed a new opera, "Il Rey" and, what will always remain in the memory of the visitors, "Cavalleria Rusticana" conducted by its composer, Mascagni, with Gigli singing the chief part.

Tours were arranged after the Congress and these included visits to chemical and electrochemical works, notably Prince Genori Conti's factories for boric acid and the production of carbide and cyanamide at Terni. Here enormous quantities of water-power are developed and used for the production of calcium carbide, which is converted into the fertilizer cyanamide by heating it in the presence of nitrogen obtained from fractionation of liquid air.

It will thus be gathered that the Tenth was a most successful Congress, in which was displayed the present state of knowledge in most branches of chemistry, in incomparable surroundings and with an abounding hospitality under the direction of the genial president, His Excellency, Prof. Parravano.

Among those from Great Britain and Eire attending the Congress were Sir Robert Mond, Sir William Pope, Sir Robert Robertson, Sir Gilbert Morgan, Profs. Donnan, Barger, Dillon, Dodds, Heilbron, Hinshelwood, Ingold, Nolan, Norrish, Robinson, Thorpe, Reilly, Dr. Fox, Dr. Lampitt, Dr. Jordan, and Messrs. W. A. S. Calder, A. Marshall and J. D. Pratt. The British visitors and the ladies with them met together at a luncheon and were entertained to dinner by Sir Robert and Lady Mond with their customary gracious hospitality.

The Eleventh Congress of Chemistry will be held in London in 1941 about the time of the celebrations of the centenary of the Chemical Society.

Towards the end of the Congress, the Council of the International Union of Chemistry met, and received reports from its numerous committees. President Parravano demitted his office, and as president of the Union for the ensuing term, Prof. M. T. Bogert, of Columbia University, New York, was elected. M. Jean Gérard, the very efficient secretary of the Union, was re-elected to that office.

R. ROBERTSON.

Obituary Notices

Dr. W. Eagle Clarke, I.S.O.

THE latter half of the nineteenth century saw the foundations laid of modern knowledge of bird migration, and Dr. Eagle Clarke was a leading exponent of the new methods in Great Britain. The idea that birds followed definite routes had stimulated fresh collection and study of records in Europe, and when the British Association for the Advancement of Science formed a Bird Migration Committee in 1880, Eagle Clarke was chosen to prepare the final reports, the last of which was presented to the Southport meeting in 1903. In the earlier days, intensive observation of the movements of birds in limited areas and co-ordination of results from many areas provided, the information upon which interpretation of migratory journeys depended, for bird-ringing was not tested as a scientific method until Mortensen's efforts in Denmark in 1899.

Eagle Clarke developed particularly two effective ways of studying migration. By living in lighthouses and lightships and by enlisting the services of lightkeepers he was able to catch bird movements in full swing, and his repeated visits during seasons of migration to Fair Isle, isolated between the Orkney and Shetland Islands, gave that tiny resting place something of the fame which Gatke's observations had already brought to Heligoland. The results of his observations were published in two volumes, "Studies in Bird Migration" (1912).

From the time of his first papers in 1879, Dr. Clarke added continuously to the knowledge of British birds, but he also found fresh material on ornithological excursions to Brabant, Slavonia and Hungary, the Pyrenees and the delta of the Rhone, Iceland and the Faroes, and identified collections from Jan Mayen, Franz Josef Land and Hudson's Bay, from the Philippines and the Antarctic voyage of the *Scotia*.

Most of Clarke's working life was spent in the service of the Royal Scottish Museum, Edinburgh, where he finally succeeded Dr. R. H. Traquair as keeper of the Natural History Department in 1906. He was responsible there for the modernizing and enlivening of the exhibits, and his all-round knowledge of the vertebrate groups set the high standard of mounting which characterizes the galleries of that Museum. In addition to the volumes already mentioned, he published jointly "A Handbook of Yorkshire Vertebrata" (1881), Bartholomew's "Zoogeographical Atlas" (1911), edited Colonel Wardlaw Ramsay's posthumous "Birds of Europe and North Africa" (1923), rewrote Saunders' "Manual of British Birds" (1927), and for many years edited the *Annals of Scottish Natural History* and its successor the *Scottish Naturalist*.

Dr. Clarke's work gained him many marks of recognition. He received the I.S.O. in 1920; the University of St. Andrews made him LL.D.; the British Ornithologists' Union chose him as the first recipient of the Godwin-Salvin Medal; and he was an honorary member of the American Ornithologists' Union and of the Ornithological Societies of Vienna and Budapest.

Dr. Clarke was born in 1853, he resigned his keepership in the Royal Scottish Museum in 1921, and after a long period of failing health he died on May 10, in his eighty-sixth year. He did a great deal to stimulate the study of animal life in Scotland, and there must be many who, like the writer, owe much of their interest in natural history to his enthusiasm and kindly encouragement. JAMES RITCHIE.

Dr. E. Goulding

DR. ERNEST GOULDING, who retired from the service of the Imperial Institute in 1935 when holding the post of vice-principal in the Plant and Animal Products Department of the Institute, died in London on February 15 in his sixty-eighth year. Born in 1870, the fourth son of the late William Purdham Goulding, of Finsbury Park, he was educated at Tollington Park College and at the School of the Pharmaceutical Society, Bloomsbury, which he entered as a Bell scholar. He graduated B.Sc. in the University of London in 1898, he took his D.Sc. (Lond.) degree in 1903, and was a fellow of the Institute of Chemistry, and also of the Chemical Society.

Goulding was intended for the profession of a pharmacist, but after his training at Bloomsbury and a period of research work at the School, in 1896 he joined as an assistant chemist the staff of the Scientific and Technical Department of the Imperial Institute under the direction of Prof. (now Sir Wyndham) Dunstan. For some years, he was engaged on the general work of the developing activities of the Institute, but before long he began to specialize in the study of cotton and of the hard and soft long vegetable fibres, in relation to the development of the production of these materials in Empire countries. The work on cotton, carried out in association with F. W. Barwick, was an important factor in the establishment of the now flourishing cotton-growing industries in Uganda and other British countries, and the early investigations of the long fibres proved of great value when Goulding took over the secretaryship of the Imperial Institute Advisory Committee on Vegetable Fibres which, with the assistance of the technical staff of the Institute, has done important work on these fibres, notably in the case of sisal. Goulding thus acquired an outstanding knowledge of vegetable fibres and wrote his "Cotton and other Vegetable Fibres" for the Imperial Institute series of handbooks. It was a great satisfaction to him that in 1936, after his retirement, he was invited to give the Mather Lecture of the Textile Institute, choosing as his subject "Textile Fibres of Vegetable Origin: Forty Years of Investigation at the Imperial Institute". It is mainly for his work on fibres that Goulding will be professionally remembered, but his long service in editing the *Bulletin* of the Imperial Institute must also be recorded.

As a research chemist, Goulding showed much ability, and he was fortunate in enjoying an early period of comparative freedom for such work before the development of technical investigation and administrative work absorbed his time. Jointly with Prof. Dunstan, he published between 1894 and 1901 a series of papers of which seven were concerned with derivatives of hydroxylamine. A study of the volatile oil of the bark of *Cinnamomum pedatinervium* formed his thesis for the D.Sc. (Lond.) and led to the publication of a number of joint papers on volatile oils prepared in collaboration with junior colleagues.

Goulding was a man of cheerful kindliness and modesty, combined with an unassuming firmness on matters of principle. He was active in Church work, being for many years vicar's warden and lay reader at St. Cuthbert's, Wood Green. He was much interested in Church music and also in Esperanto. He married twice: first, in 1905, Charlotte, daughter of the late William Larney of Finsbury Park, who died in 1907; and secondly, in 1908, Kathleen Irvine, elder daughter of the late Nathaniel Irvine Hawkes, of Crich, Derbyshire, who, with her son E. Irvine Goulding, survives him. S. E. C.

WE regret to announce the following deaths:

Prof. J. J. Abel, For. Mem. R.S., formerly professor of pharmacology in Johns Hopkins University, on May 26, aged eighty-one years.

Mr. G. S. Ram, O.B.E., formerly senior electrical inspector in the Factory Department of the Home Office, on May 21.

News and Views

Social Relations of Science

THE Council of the British Association has had under consideration the correspondence and leading articles which have recently appeared in NATURE on the subject of the "Social Relations of Science", and also a resolution forwarded from an informal meeting of those specially interested in the question, in which the Association was asked to establish within its own organization a special Department which would hold meetings, not necessarily confined to the annual meetings of the Association, to consider and discuss the social and international relations of science. The Council resolved to support this proposal, and appointed a committee to formulate a scheme giving effect to it, for presentation to the General Committee (with which the decision as to action will lie) at the forthcoming Cambridge meeting.

National Institute of Industrial Psychology

IT is a tragedy that, just when increasing attention is being given to the human factor in industry, the National Institute of Industrial Psychology, which, more than any other single institution in Great Britain, stands for the scientific study of the human factor in occupational life, should be threatened with disbandment after seventeen years of continuous and successful work. At least £2,000 is required to avert the Institute's disbandment, and to meet the expense of the Institute's unpaid national work a sum of not less than £6,000 per annum is required or an endowment which would provide this sum. In his presidential address to the British Association at its Blackpool meeting, Sir Josiah Stamp pointed out the anomaly of leaving to private support an enterprise of such outstanding national importance, and the situation becomes all the more anomalous in view of recent departures for the encouragement of research into social problems. The great services which the Institute has rendered to private firms through its fee-earning service should not be allowed to overshadow the importance of the work it has undertaken, sometimes voluntarily, for the departments of State, such as the Civil Service Commission, the Home Office (Prison Commission), Post Office, War Office, Admiralty, Royal Air Force, Ministry of Agriculture, Board of Education, Ministry of Labour, etc. Moreover, the experience gained in service rendered to particular firms in industry has itself a national value as providing a basis for further work and as giving to the whole of industry a new viewpoint on the value of applying psychology to working conditions.

THE supreme national importance of the work of the Institute is beyond question, whether in relation to the selection and training of staff for industry and commerce, the study of problems of environment and working conditions, causes of grievances and their removal and labour turnover, or in the wide field of vocational guidance. Much more work bearing on the national welfare still awaits it in all these fields and demands adequate financial support for this expansion. The present headquarters are cramped and inadequate for progress. For the needs of the immediate present and for future progress, for the new building and its endowment, £250,000 is required. To abandon the work already being done would be a national disaster, but our national status and prestige are no less involved in seeing that sufficient support is coming from all sides to ensure that the Institute is enabled to carry out and develop its work unhampered by financial stringency, so that it may give the full measure of service to national welfare which lies within its powers.

Statistics of Employment in Great Britain

ACCORDING to the report of the Ministry of Labour for the year 1937, for the second year in succession there was an exceptionally steep rise in the numbers of insured persons in the industrial field, the total, excluding juveniles under sixteen years of age and persons insured under the special agricultural scheme, reaching 13·4 millions, an increase of 350,000 on 1936. The increase was particularly marked in the age group 16–17, boys accounting for more than 50 per cent and girls for more than 80 per cent of the total net increases for their respective sexes. The total increase in the numbers of boys and girls during the last two years was more than 427,000, and it is a remarkable illustration of the improvement in industry that the whole of the new labour which has become available at these ages has been absorbed. The usual seasonal decline in employment was much less marked than usual, and thereafter the number of insured persons in employment increased steadily to a peak of 11,672,000 in August, when a change was made in the method of counting. Thereafter a slight decline in employment continued to the end of the year, the average level of employment for the year being about 500,000 higher than in 1936.

THE unemployment figures, except in December, were consistently below the 1936 totals, the average for the year being more than 250,000 below 1936, and the incidence of unemployment among insured workers fell from 12·9 per cent in 1936 to 10·6 per cent in 1937. Two fifths of the unemployed men are less than thirty-five years of age and a further two fifths more than forty-five years, the corresponding figures for women being three fifths and one fifth. A satisfactory feature of the year was that a high proportion of the improvement in employment occurred in the Special Areas.

Difficulty continued to be experienced in meeting the demands for certain types of skilled workers, notably in the building trade, engineering trade and in hotel employees and domestic servants. Reference is made in the report to the popularity of the physical training classes for the unemployed as well as to an increase in the number of areas affected by a shortage of juvenile labour, particularly in the age group 14–15. In many districts the shortage was due not only to lack of supply but also to the reluctance of parents to allow their children to take certain types of employment. Attempts made by employers to overcome the shortage included the employment of older juveniles, substitution of girls and young adults for boys and the creation of new opportunities for boys to be absorbed into the adult branches of trades. Although some trades in which apprenticeship is a common method of recruitment showed an increase in numbers, notably engineering and shipbuilding, there was no sign of a general revival of the system of apprenticeship.

Science and the Soviet Fisheries

THE progress of the Soviet fishing industry and the part played therein by science are graphically illustrated at an exhibition opened in the new building of the All-Union Institute of Sea Fisheries and Oceanography in Moscow. Various exhibits show the means by which the catch of sea fish has been almost doubled in recent years, reaching 1,650,000 tons in 1937. A big modern fishing industry, equipped with up-to-date canneries, cold-storage facilities, refrigerator vessels and a fleet of trawlers, has been built up in the last twenty years. The production of tinned and frozen fish during the first and second five-year plans has been trebled, while the output of smoked fish is twenty-three times its former figure. An important feature in the development of the Soviet fishing industry is its extension to new regions. Before the Revolution, the Caspian and Azov Seas were the main fishing centres. To-day, an extensive fishing industry has been built up in the Far East and in the White and Barents Seas. The Far East has 41 canneries, with an annual output capacity of 150 million tins, as well as large floating crab canneries and a whaling fleet. The growth of the fishing industry in the White Sea is illustrated by the fact that the catch in the Murmansk Region last year was nearly 280,000 tons, as compared with 13,000 tons in 1913.

THE development of the Soviet fishing industry has called forth a corresponding development of scientific research in this field. Before the Revolution, there were only three scientific stations to serve the industry. To-day, scores of scientific institutes, stations and laboratories are studying problems relating to fishing. The All-Union Institute of Sea Fisheries and Oceanography, which directs all the scientific work in this field, is an institution the annual budget of which runs into 16 million roubles. Special interest is attached to a section of the exhibition showing the work of Soviet men of science beneath the surface of the sea. For two years, scientists, descending to the bottom in divers' suits, have been studying the delta of the Volga, the northern part of the Caspian and of the Sea of Azov, determining the location of schools of fish and their movement and observing the working of the nets. A bathysphere for the study of sea bottoms at great depths, a model of which is on display, is now under construction. Soviet men of science are introducing new methods in the processing of fish. The time required for salting has been reduced from two days to just a few seconds by the introduction of a method whereby brine is injected into the fish.

Phenology of 1937

THE Royal Meteorological Society has produced its annual phenological report at a welcomed early time this year, and Major H. C. Gunton, who is responsible, for the first time, for it, has not only made this issue to observers in April (which enables a convenient comparison with the following year upon which observations are beginning) but also considerably improved and altered the arrangement of the mass of details in the report, a number of very detailed and somewhat complicated graphs producing a better comparison between meteorological events and plant, insect and bird records than was hitherto possible without considerable detailed study. The records of the report chiefly show the lateness of wild-life in the colder and early-wetter and later drier-than-usual weather of 1937. The sudden departure of swifts in early August is of importance, for whatever the reason, it was true that the majority of swifts left the country during a rise in temperature, and the same thing happened in the last drought year; they left before the hottest day of the first heat-wave in early August. Because of the mildness, seed and berry-eating bird winter visitors, like redwings and fieldfares, were few early in the winter; the March cold caused an influx of waxwings in the north and siskins in the south. After a south-west gale, a wave of incoming migrants was noted on May 23, and on the whole, summer migrants left early.

Royal Meteorological Society: Phenological Studies

THE Royal Meteorological Society has circulated its 500 odd phenological observers in the British Isles a description of a new organization for phenological-ecological research, so that the observations will have an increased specialized value for the various subjects undertaken. The organization consists of the Royal Meteorological Society, Royal Entomological Society, British Ecological Society, South-Eastern Union of Scientific Societies, the Natural History Museum, Ministry of Agriculture and Fisheries, Bureau of Animal Population, Rothamsted Experimental Station, Society for British Entomology, British Ornithologists' Union and the British Trust for Ornithology. An executive committee will have power to co-opt additional specialists and set up panels to deal with separate branches of observational work, as migration, etc. It is hoped to explore locally as well as nationally the possibility of further collaboration of botanist, ornithologist and entomologist for the more accurate observation of the different subjects under identical climatic conditions. H. Fairfield Smith, of the Galton Laboratory, University College, London, also makes his report of the preliminary statistical investigation of the flowering dates of plant records in the Phenological Reports of the Royal Meteorological Society (*Quart. J. Roy. Met. Soc.*, Jan. 1938) showing the standard deviations in restricted localities appear to be about 5–7 days for late spring and summer plants, rising to 13 days for early spring and autumn flowering plants. The country-wise standard deviation of locality means for hazel and hawthorn in 1933 was about 4–5 days, and regression of flowering date on altitude about 1·3 days per 100 feet. Temperature appears to be the dominating meteorological factor determining flower dates, which vary within a locality as a function of climatic as well as of individual plant and environmental factors.

Smithsonian Archæological Expeditions

Two expeditions of the Smithsonian Institution of Washington, it is announced, have taken the field for the operations of 1938. Dr. F. H. H. Roberts, jun., has left for the Lindenmeier site in northern Colorado, where he will continue his work of excavation on the camp site once occupied by Folsom man; and Dr. Aleš Hrdlička is on his way to the Aleutian Islands, where he will carry further the archæological and ethnological investigations on which he has been engaged on behalf of the Smithsonian Institution in each year since 1926, with the object of determining the character and course of the early migrations of man to the American continent. It will be remembered that Dr. Hrdlička, after devoting several seasons to the Eskimo problem, and the succession of cultures in the far north, has in his recent expeditions turned to the Aleutian islands, which he regards as one of the original migration pathways into North America. Here he has found in the craniological material excavated evidence of two distinct types of man, of which the later is distinguished from the earlier by an increase in the breadth of the skull, just as he had found two forms of Eskimo skull, also differentiated by an increase in breadth in the later type. The evidence as a whole, he maintains, points to the fact that all this northwestern region of the continent was a "nursery of peoples", constituted by several related strains of Asiatics, from which either the pronounced Eskimo or the typical Indian could easily have developed.

Dr. Roberts's problem is also concerned ultimately with the question of the character of early man in North America, for one of the main objectives of the fourth season's excavation on the Lindenmeier site will be an intensive search for the skeletal remains of Folsom man, of which no trace has as yet been found on any of the several sites which have been investigated by various explorers. Further, a change in orientation in the study of the Folsom culture may be necessary. Hitherto it has been accepted that Folsom man followed the bison which in turn, followed the retreating glaciers northward to take advantage of the pasture which sprung up behind the melting ice. The recent discovery of what are believed to be relics of the Folsom hunters so far north as Saskatchewan, and of the same date as the Colorado culture, is difficult to reconcile with the hypothesis most generally held that at this period the region in which these northern relics have been found was covered with glacial ice some hundreds of feet thick. This discovery would appear to lend support to the theory of some geologists that an ice-free corridor extended from Alaska southward, in which vegetation was probably dense, and in which men and animals migrated freely.

Studies of the Later Iron Age

Although it is a commonplace that archæology is a 'young' science, this can be appreciated in its fullest implication only when a comprehensive survey is made of some one department of archæological studies such as that of the La Tène culture in Mr. J. M. de Navarro's Sir John Rhys Memorial Lecture for 1936 before the British Academy ("A Survey of Research on an Early Phase of Celtic Culture", Humphrey Milford, pp. 42, 1937. 3*s*. net). The La Tène culture, especially in its artistic manifestations, has so high a place in the development of protohistoric studies, and has been the subject of so much detailed investigation, which is recorded in a considerable literature, that it is difficult to realize that La Tène, the later of the two type stations or rather sites which have given their names to the principal divisions now recognized in the Iron Age, was first investigated so recently as 1856, though sites and objects now regarded as belonging to that civilization were being discovered for some years before.

The credit of recognition of the full significance of La Tène belongs to Sir A. Wollaston Franks, whose contribution to John Kemble's "Horae Ferales" (1863), discussing a series of La Tène objects, was the first to envisage the ethnical aspect of that civilization in its true light, although Thurnham in "Crania Britannica" (1857) had already grouped together certain La Tène metal types as 'Late British' and assigned them to a bronze and iron transition period. It was, however, Franks who first recognized the geographical extension of the La Tène culture and identified it with the Celts. Among later contributors to the archæological aspect of Celtic studies, to whom Mr. de Navarro refers, three names stand out—Sir Arthur Evans, for the account of his excavation of the Late-Celtic urnfield at Aylesford, Kent (1890), and Paul Reinecke, to whom is due the first comprehensive survey of La Tène culture (1902); but in the remarkable recent development of archæological study of the later Iron Age, of which Mr. de Navarro takes account, the influence is pre-eminent of J. Déchelette, whose "Manuel d'Archéologie Celtique" appeared in 1914, and whose untimely death in the Great War is still mourned as one of archæology's gravest losses in that struggle.

Mummification Technique in Ancient Egypt

A PIECE of evidence bearing on the methods and apparatus in use in the processes of mummification in ancient Egypt, but which apparently has suffered neglect, has been rescued from the rest-house of the Department of Antiquities at Medinet Habu, where it has remained in the garden for many years, and has been placed in the Cairo Museum (*The Times*, June 6). It is a limestone table, on which the operation of embalming took place, and is officially described as unique. It measures eight feet five inches long by three feet four inches wide, and resembles the traditional form of the bed on which mummies were exhibited at funerals. Representations of the legs and feet of lions are carved in relief at the corners, and at the head were lions' heads similarly carved. A raised border surrounds the table, and at the foot, where the feet of the body lay, there is a sufficient depth to allow for the retention of several quarts of the embalming liquid. A small hole pierced at the end of the table allowed the liquid to be drained away from a semi-circular basin-like depression. The table is eleven and a half inches only in height, and it is therefore assumed that the embalmers worked in a squatting position.

Astronomical Exhibits

ON April 27 a number of astronomical exhibits were on view at the meeting of the British Astronomical Association held at Zion College. It would be impossible to describe all of these, but three were of sufficient interest to merit short notices in the May issue of the Association's *Journal*. Mr. D. A. Campbell showed an ingenious drive for small telescopes. This consisted of a sand-clock, a device at the base of the apparatus regulating the flow of well-sifted silver-sand. A piston of lead rested on the top of the sand, and this, as it sank, pulled a cord which finally actuated the driving shaft of the telescope. Dr. J. L. Haughton exhibited a microscope which measured star images. The main object of the instrument was to determine stellar magnitude by measuring the diameter of the photographic images, and for this purpose an accurately machined screw thread just over 1 cm. in length was used. Mr. A. Coleman showed a solar eyepiece attachment, and has a fairly long description of the apparatus, which should be read by those who are interested in solar work. It minimizes certain disadvantages which are inherent in the usual combination of a solar diagonal with a suitable dark glass over the eyepiece.

Iodine Educational Bureau

THE Nitrate Corporation of Chile Ltd. is organizing an Iodine Educational Bureau to promote the knowledge and use of iodine in the agricultural, medical and industrial fields. It collects all available scientific information in respect of iodine, and the information will be placed at the disposal of the medical profession and scientific agricultural circles, as well as commercial interests, including feeding stuffs manufacturers and livestock breeders. In addition, the Bureau will collaborate with scientific institutions in experimental research to extend the knowledge of iodine, with special reference to its use in human and animal nutrition. It will not engage in any selling activities. The Bureau will be under the direction of Dr. Francis C. Kelly, who has been associated with Sir John Orr for the past six years as deputy director of the Imperial Bureau of Animal Nutrition at the Rowett Research Institute in Aberdeen. Dr. Kelly is a graduate of the University of Aberdeen. Following two years in the Colonial Service as biochemist to the Medical Department of Kenya Colony, he became technical adviser to the Chilean Iodine Producers' Association in 1928. In 1930 he was appointed a member of the Iodine Estimation Sub-committee of the Medical Research Council of Great Britain. When the Imperial Bureau of Animal Nutrition was established in 1932, Dr. Kelly was appointed deputy director. He is also secretary of the international abstracting journal, *Nutrition Abstracts and Reviews*. Dr. Kelly will become director of the Iodine Educational Bureau in September. His technical assistant will be Miss Ethelwyn M. Mason, of the New Zealand Department of Agriculture, who has been carrying out iodine research work at the Rowett Institute since 1934. The offices of the Iodine Educational Bureau will be at Stone House, Bishopsgate, E.C.2.

'Dowtherm'

DURING the Great War, synthetic phenol was manufactured by sulphonating benzene, but a continuous process for vapour phase chlorination has been employed at the Dow Chemical Co.'s works in the United States for some time now. The chlorobenzene is afterwards hydrolysed with caustic soda and some diphenyl oxide is obtained as a by-product. Diphenyl oxide has a melting point of 27° C. and in order to be useful as a commercial fluid for heat transmission it must not set solid in the piping when the plant is allowed to cool. Although diphenyl has a melting point of 70° C., yet a eutectic mixture, known as 'Dowtherm', consisting of 26·5 per cent diphenyl with diphenyl oxide, melts at 12° C. This compound can be used for heating purposes in a similar manner to steam but with the additional advantage of higher temperatures for the same pressure. The boiling point at atmospheric pressure is about 258° C. and at 135 lb. per square inch gauge pressure it gives a temperature of 400° C. against 181° C. for steam. At 370° C. the temperature can be controlled to within about 1° C. by simply manipulating a throttle valve. The use of condensing vapour for heating results in considerable economy in plant design since the hot liquids in use hitherto have very low heat transfer coefficients. The vapours are not toxic, although leaks can be readily detected since the vapour is exceedingly pungent. It gives a means of accurately controlling the reaction temperature in the manufacture of dye intermediates and is used in the distillation of fatty acids and glycerine, the deodorization of edible oils, the evaporation of caustic soda, the processing of varnishes, the saponifying of greases and the melting of asphalts and bitumen. Owing to the low surface tension and viscosity of Dowtherm, all joints have to be made extremely carefully. The licence for development in Great Britain is held by Messrs. W. J. Fraser and Co., Ltd., of Dagenham, Essex.

Norwegian Arctic Research

It was some ten years ago that the Norwegian Government, having acquired by treaty the sovereignty of Spitsbergen, instituted a department to deal with the scientific exploration of Spitsbergen, Bear Island and other arctic regions, including areas outside Norwegian jurisdiction. This department, Norges Svalbard-og Ishavs-Undersokelser, under the direction of Dr. A. Hoel, has now published a record of the ten years of its activity (*Skrifter om Svalbard og Ishavet*, No. 73). Earlier Norwegian work was recounted in a previous publication (No. 1, *loc. cit*; 1929). Almost every summer expeditions have been at work in Spitsbergen and East Greenland and occasionally in other islands, as Jan Mayen, Bear Island and White Island. In Svalbard (Spitsbergen, North-East Land, Bear Island, etc.) 560 sq. km. have been mapped on the land and 40,000 sq. km. from the air, and in East Greenland 9,200 sq. km. and 30,000 sq. km. In addition, large areas of the arctic seas have been charted and much oceanographical work accomplished. But no aspect of research has been overlooked, and the department has even erected navigation beacons and lights and introduced the musk-ox and the arctic hare to Spitsbergen. Winters have been used for working up results, and already the publications of the department number over seventy. The greater part of the cost is met by a State grant, but private contributors also help. The volume makes a fine record of careful scientific work.

Electrical and Allied Industries Research Association

The seventeenth annual report of the British Electrical and Allied Research Association (E.R.A.) proves that the research scientific worker is becoming indispensable to the industry. It is his work that enables the producer to acquire new principles, data and methods which he can embody in his technique and products. The producer passes these benefits on to the distributor, and finally the consumer derives benefits from greater efficiency, trustworthiness and utility. The work enables the industry to gain substantial immunity from breakdowns and the consequent and ever-present risk of black-outs and extensive damage. The activities of the Association are expanding very satisfactorily. Nearly half the research work of the E.R.A. is now conducted by its own staff. Its success is built up largely upon the gratuitously given labours of its eighty committees comprising about 500 voluntary workers. It carries out researches in co-operation with many scientific and engineering institutions. The principal income of the Association consists of the following annual grants: Department of Scientific and Industrial Research, £24,500; electricity supply undertakings, £32,932; manufacturers, £19,737. In addition, the Institution of Electrical Engineers gives £1,000 and so also does the B.B.C. The accounts show a surplus for the year of £13,500 after transferring £5,000 to the reserve account, but it is pointed out that practically all this sum is already required in connexion with particular researches in hand and is not available for next year's commitments. The Department of Scientific and Industrial Research and other important contributors are urging the Association to establish a more adequate reserve.

The Belfast-Stranraer Telephone Cable

In 1853, the British and Irish Magnetic Telegraph Company laid a cable between Port Patrick and Donaghadee. This cable proved to be successful and was one of the forerunners of the Atlantic cable in laying which Lord Kelvin played a leading part. Until last year, the telephone and telegraph traffic had been carried by four telegraph cables laid in 1870, '79, '88 and '93 for telegraph working but afterwards converted to telephone working, and a 'continuously-loaded' cable made in 1921. In addition, a loaded cable connects Blackpool to the Isle of Man and thence to Ballyhornan, Northern Ireland. These cables were made by Siemens Brothers and Co., Ltd., and its associated company, Submarine Cables, Ltd., which claim to be the only British organization that undertakes the design, manufacture and installation of all types of submarine and land cables as well as the necessary carrier-current equipment. In the Engineering Supplement to *Siemens Magazine* of January a description is given of two more submarine cables completed last September, their opening coinciding with a special low charge for calls carried by submarine cable to Northern Ireland. As each of these cables can carry four calls simultaneously, there are eight circuits available to help carry the increased traffic brought about by the tariff reduction. It is possible to increase further the carrying capacity by the addition of more carrier equipment. One of the two new cables serves for transmission from Belfast to Stranraer and the other cable for transmission in the opposite direction. In addition to the submarine cables, there is a radio link connecting Ballygomartin, near Belfast, and Port Patrick.

The New Commonwealth Society

The annual report of the New Commonwealth Society for the year ended September 30, 1937, refers to considerable progress in the development of international sections, new groups or sections having been formed in the United States, Austria and Czechoslovakia, and arrangements made for the Swiss Europa Union to perform the functions which would otherwise be carried on by a Swiss Section of the Society. The existing groups in Germany and Hungary have been considerably developed, and development in other countries during the period has to some extent outpaced the progress of the British section. Disappointing results have followed the introduction of facilities for the enrolment of group associate members, but the first international conference organized by the Society, held at Pontigny, August 13–23, was an outstanding success, as was a New Commonwealth Society Youth Camp at Llandinan in August, which included German, Dutch, Czechoslovakian, Norwegian, Hungarian, Greek, Swiss and British representatives. Four new pamphlets were issued during the year, and the British Section concentrated its attention on an attempt to lay the foundations of an area organization throughout Great Britain. The report of the New Commonwealth Institute for the same period refers to the initiation of a Monthly Information Bulletin and to the formation of four special research committees, dealing respectively with legal, military, political and psychological questions. The Legal Research Committee adopted as a basis for its discussions Prof. Strupp's study and proposals for an International Peace Convention, and considerable progress has been made in the establishment of an adequate research library on problems of peaceful change and collective security.

Journal of Pomology and Horticultural Science

In view of the increasing number of contributions to the *Journal of Pomology and Horticultural Science* received from overseas, it is felt that the scope of the journal, hitherto the official organ of the Long Ashton and East Malling Research Stations, should be extended to provide a medium for the publication of the results of horticultural research of wider interest. The editors have accordingly obtained the services of the following as associate editors: M. B. Davis, Central Experiment Farm, Ottawa, Canada; Dr. C. Barnard, Division of Plant Industry, Council for Scientific and Industrial Research, Canberra City, F.C.T., Australia; L. W. Tiller, Department of Scientific and Industrial Research, Wellington C.1, New Zealand; Prof. E. E. Cheesman, Imperial College of Tropical Agriculture, Trinidad. Intending contributors overseas are asked to submit their papers in the first instance to the associate editor in their respective countries.

Agricultural Research

The annual volume for 1937 of the *Journal of the Royal Agricultural Society of England* has now been published and includes as in recent years the "Farmer's Guide to Agricultural Research". The latter has been a feature of the Society's publications for the past twelve years, and consists of a number of valuable summaries of recent research work in the leading branches of agriculture, each section being prepared by an acknowledged expert on the subject. The various sections and the authors responsible for them are the same as in the previous issue. Space does not allow of reference to all the many interesting articles in this number of the journal, but mention may be made of the account of two centuries of Cheshire cheese farming, which gives a vivid and often humorous picture of agricultural life in England during the period under review. The Leckford Estate, Ltd., forms this year's subject in the series of notable farming enterprises.

Polar Exhibition

A preliminary circular has been issued of the projected International Exhibition of Polar Exploration which is to be held at Bergen from May until September, 1940, under the patronage of the King of Norway and the presidency of the Prime Minister, the Ministers of Foreign Affairs and Commerce and the chairman of the council of the city of Bergen. The aim is to present a general survey of exploration, natural conditions and inhabitants and resources in arctic and antarctic regions. Polar regions of all States are to be included. Exhibits will consist of charts, models of vessels and aeroplanes, instruments, equipment, diaries, photographs and paintings. Whaling, sealing, trapping and tourist traffic will also be represented. Buildings are to be erected for the exhibition, which will be held contemporaneously with a national exhibition of arts, crafts, fisheries and communications. The offices of the Polar Exhibition are Telegrafbygningen, Bergen, Norway.

National Baby Week Council and Physical Fitness

The National Baby Week Council holds, and rightly so, that "physical fitness begins in the maternity and child welfare centre", which will be its slogan for this year. The centres cater for the well-being of the expectant mother, the nursing mother, the infant and child up to five years of age. A good start towards physical fitness can, and should, be given in those centres. The Council emphasizes that physical fitness cannot be obtained by physical exercise alone, and that nutrition, better housing and other reforms also bear a close relation to the whole problem. The Council will gladly advise representatives of organized bodies, or any individual requiring advice. Correspondence should be addressed to the Secretary, National Baby Week Council, 117 Piccadilly, London, W.1.

British Health Resorts Association

A new edition of the official handbook of the British Health Resorts Association has recently been issued (British Health Resorts—Spa, Seaside, Inland; including those of the British Dominions and Colonies. London: J. and A. Churchill, Ltd. 2*s.* 6*d.* net). The publication gives a brief, authoritative and impartial account of British health resorts, as contrasted with the purely holiday resort. The book is supervised by a medical advisory committee, contains a chapter on "Climate, Health and the British Resort", and gives general information which will enable medical men and their patients to make their choice of a suitable place.

National College of Physical Training

A site of more than two hundred acres on high ground at Merstham, Surrey, has been selected for the National College of Physical Training, which is to be erected under the Physical Training and Recreation Act for the purpose of training teachers and leaders. The land is protected on all sides from building encroachment, not only by natural features, but also, through the foresight of the local authorities, by town planning schemes, while close by are areas acquired in connexion with the 'Green Belt'.

Scholarships for the Study of Tuberculosis

THE Italian Fascist National Federation against Tuberculosis has placed at the disposal of the International Union against Tuberculosis six scholarships at the Carlo Forlanini Institute in Rome. These scholarships are of the value of 2,000 lire each, plus board and lodging, and are intended to enable foreign medical practitioners to study at the Carlo Forlanini Institute. They will be awarded by preference to young physicians already familiar with tuberculosis problems who wish to improve their knowledge of this branch of medicine. Candidates should send their names, ages, qualifications and professional experience to the Secretariat, Union internationale contre la Tuberculose, 66 Boulevard St. Michel, Paris, not later than July 1.

Royal Society of Arts: Prizes for Navigation

THROUGH the Thomas Gray Memorial Trust, the Royal Society of Arts offered last year a prize of £75 for an invention, publication, diagram, etc., which was considered to be an advancement in the science or practice of navigation, proposed or invented in the period January 1, 1932–December 31, 1937. Thirty-six entries were submitted. The judges were of the opinion that none of the inventions put forward was deserving of the full prize, but they decided to make the following awards: £25 to W. Sommerville, of Benton, Northumberland, for his system of instruction and examination in the rule of the road at sea; £25 to Lieut.-Commander P. V. H. Weems, Annapolis, Maryland, U.S.A., for his second-setting watch. A prize of £25 for an essay on "The Stability of Ships" has been awarded to H. David, of Ely, Cardiff. The following prizes are offered for 1938: a prize of £25 for an invention, publication, diagram, etc., which is considered to be an advancement in the science or practice of navigation, proposed or invented in the period January 1, 1933–December 31, 1938; a prize of £25 for an essay on a navigational subject. Further information can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, London, W.C.2.

Announcements

SIR ALDO CASTELLANI has been elected an honorary member of the Hanseatic University of Hamburg.

DR. FRIEDRICH PASCHEN, professor of experimental physics in the University of Berlin, has been made an honorary member of the Rumanian Academy at Bucharest.

A PORTRAIT MEDAL designed by Dr. Robert Tait McKenzie, Canadian physician and sculptor, has been struck to celebrate the fiftieth anniversary of the foundation of the American Society of Anatomists in memory of its first president, Joseph Leidy, who died in 1891.

AN Order of Public Health has been created by a decree of the French Government, to be awarded by the Ministry of Health to those who have made outstanding achievements in public health or social service. It will consist of the three ranks of knights, officers and commanders.

THE eighth International Congress of Military Medicine will be held at Luxemburg on July 1–4. In addition to the usual discussions on military medicine, the following subjects will be dealt with: (1) legislation on aerial protection; (2) scientific study of aerial protection; (3) demonstration of medical aviation.

THE National Institute of Industrial Psychology's vacation course in psychological methods of vocational guidance will be held on August 1–13 at the London School of Economics, where a course will also be held during the same period on the administration of Binet-Simon tests of intelligence. The fee for the former course is five guineas and for the latter course three guineas. Further information can be obtained from the Secretary of the Institute of Industrial Psychology, Aldwych House, W.C.2.

THE summer meeting of the American Association for the Advancement of Science will be held in Ottawa on June 27–July 2. Science and Society Conferences are being organized by the Section on the Social and Economic Sciences, under the general direction of Dr. Harold G. Moulton, and the first conference was held at Indianapolis last December on the subject "Fundamental Resources as Affected by Science". The subject of the Ottawa Conference will be "Science and the Future".

THE programme of the summer school in physics to be held at the University of Reading under the auspices of the Institute of Physics on July 7–9 has recently been issued. The following lectures will be given, and these will be followed by discussion: Prof. J. A. Crowther, "Physics in Biology"; Dr. C. E. Wynn-Williams, "Some Electronic Devices and their Applications"; Dr. O. Klemperer, "The Theory and Practice of Electron Optical Devices"; Dr. E. A. Guggenheim, "Thermodynamics of Low Temperatures"; Dr. W. F. K. Wynne-Jones, "The Significance of Interfacial Potentials"; Dr. C. G. Sumner, "Interfacial Potentials in Systems of Industrial Importance". Membership of the School is open to all interested. Further information can be obtained from the Secretary, Institute of Physics, 1 Lowther Gardens, Exhibition Row, London, S.W.7.

WE are informed that the brochure entitled "The Story of Vitamin B_1", referred to in NATURE of June 4, p. 1006, is issued by Messrs. Merck and Co., Inc., of Rahway, New Jersey.

ERRATUM.—The great eruption of Mt. Pelé on May 8, 1902, referred to by Dr. C. T. Trechmann in NATURE of March 12, p. 435, occurred at 8 a.m., not 8 p.m. as stated.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1060.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Thermal Conductivity at Low Temperatures

IN continuation of our experiments on quartz and potassium chloride[1], Mr. Biermasz and I have determined the conduction of heat in quartz crystals of varying dimensions. (A complete account of this work will appear in *Physica.*) The object of the investigation was to study the dependence of the conductivity on the dimensions of the crystal[2]. It was found that both in the case of potassium chloride and silica (at temperatures 2·5°, 2·9° and 3·3° K.) the heat resistance is a definite function of the radius R; when R tends to zero the resistance becomes infinite more quickly than $1/R^2$, or in other words, the 'specific' resistance becomes infinite. With increasing thickness, on the other hand, the specific resistance approaches a constant value asymptotically; for potassium chloride this value is almost reached for $2R \sim 1$ cm.; for silica this will be the case for $2R \sim 3$ cm.

It is not astonishing that such an asymptotic value is reached. If there were no scattering of the elastic waves at all, then it would be impossible to establish a temperature gradient in the crystal and the conductivity would be infinite[3]. In order to obtain a finite temperature gradient, one has to assume that the elastic waves are scattered, and with increasing cross-section of the rod the scattering by the surface of the cylinder will gradually become less and less important relative to the scattering in the bulk of the material. We will assume that the resistance is due to scattering by the surface, scattering by the mosaic structure and to scattering of the elastic waves by one another. Further investigations will be needed to show the part played by each of these factors separately.

It seems interesting to investigate the behaviour of thin rods of metal and to see whether a separation of electronic conduction and lattice conduction can be effected, and whether a correlation between these conductivities can be found.

W. J. DE HAAS.

Kamerlingh Onnes Laboratory,
Leyden.
May 9.

[1] *Physica*, **5**, No. 4, 320 (1938).

[2] Peierls, *Ann. Phys.*, (3), **5**, 1055 (1929).

[3] "Vortrage uber die Kin. Theorie der Materie", by Debye, 19 (1914).

Neutron-Electron Interaction proposed by Kikuchi

IT is known that a Geiger-Muller counter operated near a source of fast neutrons gives a rather large number of counts. Kikuchi, Aoki and Husimi[1,2], working with a D-D source of neutrons, have postulated that these counts arise in part from a direct interaction of fast neutrons with electrons in the thin lead foil surrounding their counter. However, the recent discovery by Kallmann and Kuhn[3] that gamma-rays are emitted in the D-D reaction seems to offer a simple and more satisfactory explanation for the phenomena observed by Kikuchi and co-workers. Confirmatory evidence is the discovery by Bonner[4] of two groups of neutrons from the D-D reaction.

Even when the gamma-rays from a D-D source are absorbed with lead[5], or when a radium-beryllium source of neutrons is used with a sufficient thickness of lead to remove the primary gamma-rays from the source[6], a counting rate much in excess of the natural background of the counter is observed. We have shown that two thirds of the counts caused by a radium-beryllium source of fast neutrons, suitably enclosed in lead, can be accounted for by the gamma-rays excited in lead by the inelastic scattering of fast neutrons. An appreciable part of the remaining third will be due to recoil nuclei within the counter gas. Internal conversion of the gamma-rays produced in the lead foil surrounding the counter (and in the iron wall of the counter) can account for the remainder of the counts only if one assumes an average internal conversion coefficient as large as 15 per cent. In a study of the radiation accompanying thin, non-radioactive, gamma-ray sources, we find, however, that internal conversion coefficients of this magnitude do occur in the heavier elements for gamma-rays of moderate energy. Recent experiments by Alvarez[7] also lead to internal conversion coefficients larger than those previously expected.

Takeda[8] also studied the counts caused by the neutrons from a radium-beryllium source surrounded by a large block of lead. He concluded that less than half his observed counts could be accounted for by the gamma-rays excited in the lead block by the neutrons, and hence that the direct interaction of neutrons with electrons proposed by Kikuchi and co-workers was responsible for the remainder of the counts. However, he failed to correct for the decrease in the natural background of his counter caused by the test lead (placed above the counter) which he used to estimate the fraction of the counts which were due to gamma-rays excited in the lead block. When such a correction is made, the results of Takeda appear to be in agreement with our own.

G. T. SEABORG.
D. C. GRAHAME.

Department of Chemistry,
University of California,
Berkeley, California.
April 30.

[1] Kikuchi, Aoki, Husimi, NATURE, **138**, 841 (1936).

[2] Kikuchi, Aoki, Husimi, *Proc. Phys.-Math. Soc. Japan*, **18**, 727 (1936), **19**, 734 (1937).

[3] Kallmann and Kuhn, *Naturwiss*, **26**, 106 (1938).

[4] Bonner, *Bull. Amer. Phys. Soc*, **13**, No. 2, 22 (1938).

[5] Gibson, Seaborg, Grahame, *Phys. Rev.*, **51**, 370 (1937).

[6] Seaborg, Gibson, Grahame, *Phys. Rev.*, **52**, 408 (1937).

[7] Alvarez, *Phys. Rev*, **53**, 606 (1938).

[8] Takeda, *Proc. Phys.-Math Soc Japan*, **19**, 835 (1937).

Sodium in the High Atmosphere

BERNARD has described in NATURE[1] his observations proving that the yellow radiation of the night sky and of the twilight-sky, 5893 A., can be identified with the two sodium *D* lines. With regard to this communication we wish to make the following comments:

(1) Attribution of the yellow radiation at night to the sodium was examined for the first time by Dufay[2]. Interstellar sodium was first in question, but rough measurements of the ratio of intensity at the zenith and near the horizon, and, in particular, the variation of intensity from night to night, brought evidence that the radiation was emitted in the upper atmosphere. Furthermore, a long series of observations made by Garrigue[3] at the Pic du Midi put the atmospheric origin of the yellow radiation beyond all doubt.

(2) After further observations made at Montpellier, Cabannes and Dufay[4] pointed out the probable complexity of the 5893 radiation. In the same paper, the authors examined the hypothesis of an emission by sodium atoms in the atmosphere and announced that interferential analysis was in progress.

(3) Increasing intensity of the yellow radiation at twilight had been previously discovered by Currie and Edwards[5] at Chesterfield (Canada), during the International Polar Year, 1932–1933. Bernard[6] attempts to show that the observations of Currie and Edwards did not concern the 5893 radiation. The wave-length measured by Currie and Edwards was indeed 5940 A., but their measurements were not precise and they concluded that "this radiation is due to a luminescence distinct from the aurora and is probably the radiation 5893 A. observed by Vegard and Tönsberg in the night-sky light". Bernard's argument, therefore, does not seem convincing to us.

(4) We have analysed the yellow radiation at night and at twilight, following two different methods:

(*a*) A Fabry-Perot interferometer was adjusted in front of a small two-prism spectrograph of which the camera lens has a relative aperture *F*/1 and 25 mm. focal length. A lens of 6 cm. or 10 cm. focal length projects the fringes on to the slit. With exposures of 20 hours or more, at night, we have observed very crowded fringes on the yellow radiation. The aspect of these fringes was exactly the same as that of the fringes given by the sodium flame. The first positive result at night was thus obtained with a 27-hour exposure between February 28 and March 4, 1938.

We have carried out the same experiments at twilight, when interferential analysis of the 5893 radiation is much easier than at night, because of its stronger intensity.

(*b*) At the same time, a second Fabry-Perot étalon was used without a spectrograph, and placed in front of a camera lens of 25 mm. focal length and relative aperture *F*/1. An orange filter (Schott glass *OG*2, 2 or 4 mm. thick) absorbs the green line 5577 A. In order to be free from the red line 6300, plates of which the sensitiveness is small at 6300 were used. Interferential fringes were thus photographed at twilight with exposures of 15–30 minutes. Using alternately air spaces of 0·30 mm. and 0·15 mm. thickness between the half-silvered surfaces, one or two systems of fringes appeared. In every case their diameters differed by almost 0·01 mm. from the diameters of the sodium fringes photographed on the same plate. The D_2 fringes are, as in the laboratory, about twice as intense as the D_1 fringes.

Bernard's observations are identical with our own, when following this second method. Our results[7] were communicated to the Academy of Sciences at the same meeting, March 21, 1938, as those of Bernard. Interferential fringes photographed at night without the use of a spectrograph are then weak, but, some days later, fringes obtained at night with a 22-hour exposure were as strong as those taken previously at twilight.

In conclusion, we wish to point out that the identification of the sodium *D* lines in the atmosphere, suggested by our previous experiments, was made simultaneously by Bernard and ourselves.

J. CABANNES.
J. DUFAY.
J. GAUZIT.

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Observatoire de Lyon.
May 10.

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[1] NATURE, 141, 788 (April 30, 1938).
[2] *C.R.*, 194, 1897 (1932).
[3] *C.R.*, 202, 1807 (1936).
[4] *C.R.*, 206, 221 (1938).
[5] *Terr. Mag.*, 41, 265 (1936).
[6] *C.R.*, 206, 1137 (1938).
[7] *C.R.*, 206, 870 (1938).

Adsorption of Gaseous Mixtures at Solid Surfaces

IN a recent paper[1], the statistical mechanics of gaseous adsorption at solid surfaces has been developed using the method of partition functions. The imperfection of the adsorbed phase was taken into account and adsorption isotherms appropriate to various models of the adsorbed phase were developed.

The method can be extended quite simply to gaseous mixtures. The partition function for a gaseous system consisting of N_1 molecules of a gas *R* and N_2 molecules of a gas *S* is

$$H(\theta) = \{h_1(\theta)\}^{N_1}\,\{h_2(\theta)\}^{N_2}\,B(\theta),$$

where $h_1(\theta)$ and $h_2(\theta)$ are partition functions for the molecular internal and translational energies of *R* and *S* respectively, and $B(\theta)$ is the partition function for the potential energy of the whole system; which includes not only the volume term but also a term which accounts for the potential energy of those molecular interactions which are responsible for gaseous imperfection. For a gas mixture in a potential field φ, we can write

$$\log_e B(\theta) = (N_1+N_2)\log_e V e^{\varphi/RT} - \frac{1}{V}\Big[\beta_1 N_1^2 + 2\beta_{12}N_1N_2 + \beta_2 N_2^2\Big] - \ldots,$$

where β_1, β_2 and β_{12} are the usual virial coefficients. Writing suffix *g* and *a* for the gaseous and adsorbed phases respectively and assuming the gas phase to be perfect, it is now easy to prove that:

$$\log_e \frac{x_1}{p_1} = \log_e \frac{V_a}{RT} + \log_e \left\{\frac{h_a(\theta)}{h_g(\theta)}\right\}_1 + \frac{\varphi_1}{RT} - \frac{2}{V_a}\Big[\beta_1' x_1 + \beta_{12}' x_2\Big] - \ldots$$

$$\text{and } \log_e \frac{x_2}{p_2} = \log_e \frac{V_a}{RT} + \log_e \left\{\frac{h_a(\theta)}{h_g(\theta)}\right\}_2 + \frac{\varphi_2}{RT} - \frac{2}{V_a}\Big[\beta_2' x_2 + \beta_{12}' x_1\Big] - \ldots,$$

where x_1 and x_2 are the amounts of *R* and *S* adsorbed per unit area at partial pressures of p_1 and p_2 respectively, and φ_1 and φ_2 are the adsorption potentials of *R* and *S* respectively: V_a is the adsorption volume. The values of $\{h_a(\theta)/h_g(\theta)\}$ can be evaluated as shown in the paper mentioned already and β_1', β_2' and β_{12}' are closely related to the three-dimensional virial coefficients.

These equations are very similar to those for adsorption from a single gas, namely,

$$\log x/p = K(T) - K_1 x - \ldots ,$$

but K_1 is, in the case of mixtures, a function of the composition of the adsorbed phase. For low surface concentrations we obtain the well-known results

$$x_1/p_1 = k_1(T) \qquad x_2/p_2 = k_2(T).$$

By suitable approximations these virial adsorption isotherms can be converted into the Langmuir isotherm for mixtures

$$x_1 = \frac{a_1 b_1 p_1}{1 + a_1 p + a_2 p_2}$$

with detailed expressions for the constants a_1, a_2 and b_1.

The application of the virial adsorption isotherms to careful measurements made over a wide range of experimental conditions so that $\{h_a(\theta)/h_g(\theta)\}$ and β_1' and β_{12}', etc. can be evaluated should enable us to obtain important information concerning the state of molecules in the adsorbed phase.

F. J. WILKINS.

Imperial Chemical Industries, Ltd.,
Billingham.
May 1.

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[1] Wilkins, F. J., *Proc. Roy. Soc.*, A, 164, 496, 1938.

Defect Lattices and Catalytic Activity

A RECENT X-ray examination of the nickel-aluminium system[1] revealed the existence of the following phase-structures: Ni_3Al, Ni_2Al_3, and $NiAl_3$, in addition to the solid solutions of aluminium in nickel and nickel in aluminium. Ni_3Al is face-centred cubic and has a superlattice in which nickel atoms are at the centres of the cube faces while aluminium is at the cube corners. NiAl is body-centred cubic with aluminium at cube corners and nickel at cube centres. It was found that alloys with the NiAl type of phase structure were progressively more deficient in nickel atoms at cube centres, leaving vacant sites as the aluminium content of the alloy was increased. The absence of one third the number of nickel atoms changes the composition from NiAl to Ni_2Al_3 and produces a debasement from cubic symmetry to trigonal. The δ-phase structure Ni_2Al_3 can best be thought of as a deformed NiAl type. The empty sites in the structure are regularly distributed in planes perpendicular to the trigonal axis.

On treating the alloy Ni_2Al_3 with sodium hydroxide solution, one is able to dissolve out the aluminium. It has been found possible to change the composition of Ni_2Al_3, which corresponds to 59·2 per cent nickel (by wt.), to about 80 per cent nickel and yet *retain* the *trigonal* symmetry of the crystal. If the alloy were in its normal equilibrium state, it would of course consist of two phases, β and α′, which have the NiAl and Ni_3Al types of phase structure.

Further treatment with sodium hydroxide solution ultimately results in the collapse of the δ-structure. An alloy with 95 per cent nickel gave an X-ray spectrum showing the Ni_2Al_3 pattern along with that of two face-centred cubic structures. With less than about 0·5 per cent aluminium, only one face-centred cubic phase remains. It appears that the action of the caustic soda solution is to remove aluminium atoms from the lattice, leaving vacant sites, but that the structure ultimately collapses and tends to form the face-centred cubic structure of nickel.

Apparently, in the process, no intermediate body-centred cubic structure is formed. A further interesting point is that the X-ray spectra are reasonably sharp, indicating that most of the material consists of relatively large particles of the order of 1,000 A.

The research is being continued with a series of binary and ternary alloys of the Ni_2Al_3 (δ) type and also with γ-alloys, which can also be characterized as having a defect lattice formed from a CsCl-type of structure.

The structures described above bear an interesting relationship to the action of these metals as catalysts. Nickel catalysts prepared from nickel aluminium alloys (Raney nickel) are used extensively in industry for hydrogenation purposes. These defect lattices all possess a very large highly unsaturated surface (on account of the lattice defects), and electron transfer processes should be considerably enhanced. It has been demonstrated previously that simple electron transfer processes play an important part in the catalytic decomposition of hydrogen peroxide on metal surfaces[2]. It can also be shown that in hydrogenation, reaction with molecular hydrogen and in the Cannizzaro reaction of aldehydes, which are both strongly catalysed by this nickel catalyst, the essential elementary processes on the surface of the catalyst can be described as electron transfer reactions (that is, oxidation-reduction processes in a chemical sense).

A full account will be published elsewhere.

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[1] Bradley, A. J., and Taylor, A., *Proc. Roy. Soc.*, A, 159, 56 (1937). *Phil. Mag.*, 23, 1049 (1937).

[2] Weiss, J., *Trans. Faraday Soc.* 31, 1547 (1935).

Similarity and Dissimilarity

CLASSIFICATION is based upon perception of similarity. The following experiment, carried out with the help of about forty observers, in connexion with a course of lectures on scientific method, was designed to get information on the readiness with which similarities are noted.

Various objects were exposed in pairs to those taking part in the experiment. The typed instructions given to each observer were: "Two objects will be placed on the lecture bench and you are asked to compare them. Write down any points of comparison that occur to you, setting them down in the order in which they occur. Any points of comparison *whatever*, relating to the two objects, are asked for. Brief phrases in 'telegraphic English' will suffice." In order that the observers should be unprejudiced, care was taken not to mention either classification, similarity or dissimilarity. A time of 3 minutes was found to be convenient for the comparison of such pairs of objects as an orange and an apple, or an open pen-knife and a pair of scissors.

At the end of the experiments, the answers to three questions were included in each report: "(1) Have you ever taken part in a similar experiment? (2) Have you ever read of similar experiments? (3) By 'compare', did you understand that both similarities and differences were to be included?" The scripts containing answers of 'No' to the first two questions and 'Yes' to the third question were then analysed in terms of the number of similarities and of differences in the comparisons made. The results, with three groups of observers, were as follows:

No. of observers	8	11	9
No. of pairs of objects	3	5	4
No. of points of comparison ..	112	230	131
Similarities	34	53	20
Dissimilarities	78	177	111

It would appear, therefore, that when unprejudiced observers spontaneously make comparisons between pairs of objects, they tend to note many more dissimilarities than similarities.

Those who are accustomed to study scientific method from a philosophical as distinct from a scientific point of view may be inclined to criticize these results, saying that more dissimilarities than similarities are noted in a given time because the objects possess more dissimilarities. But a scientific study of a subject must be based upon observables. How, in terms of observables, are we to know the total number of similarities and dissimilarities possessed by a pair of objects? When attention was directed to many unnoted similarities, they could all be recognized as such by the observers taking part.

In biological experiments variations are invariably found with the individual. It is therefore significant that for no unprejudiced observer was the number of similarities equal to or greater than the number of dissimilarities. Of prejudiced observers, six who tried to include only similarities, gave 95 points of comparison, of which 14 were dissimilarities, in spite of the effort to include similarities only. Two other prejudiced observers, who tried to include dissimilarities only, gave no similarities. The mean numbers of points of comparison per person for each pair of objects were:

Unprejudiced	4 6
Dissimilarities only . ..	4 6
Similarities only	5 3

Although these results are presented here for their relevance to the *scientific* study of scientific method, they would appear to have some bearing also on social problems. Not only do some individuals show great talent for selecting differences in dealings with their fellow men, but also, in international affairs, nations at the present time are stressing a few points of difference instead of their many points of similarity.

I should be grateful to hear of any other experiments bearing on the perception of similarity or the *scientific* study of scientific method.

W. H. George.

University College,
Southampton.
May 11.

Karrer's Theory of Coupling

In 1915, Karrer[1] put forward the view that the coupling of aromatic tertiary amines with diazo-compounds to form alkylamino azo-compounds takes place through the preliminary combination of the diazo-compound with the nitrogen of the amino group. The experimental basis for this theory was the reported observation that when either di-butylaniline or di-*iso*amylaniline reacts with diazo-sulphanilic acid, an alkyl group is eliminated with the formation of the corresponding monoalkylamino azobenzene sulphonic acid.

It is unfortunate that Karrer did not specify more exactly which of the di-butylanilines he employed. We have repeated Karrer's experiments with both the dibutylanilines described in the literature, namely, di-*n*-butylaniline and di-*iso*butylaniline. Both are found to couple normally without the loss of a butyl group. This confirms an earlier observation by Reilly and Hickinbottom[2] that di-*n*-butylaniline reacts normally with diazosulphanilic acid. It is also found that diazosulphanilic acid couples with di-*iso*amylaniline without the loss of an alkyl group.

It is concluded that Karrer's observations were at fault and that there is no experimental basis for Karrer's theory of coupling. This conclusion is supported by the observation that methyl *tert*-butylaniline also couples with diazo-compounds without the loss of an alkyl group, although it has been shown earlier that the *tert*-butyl group is only loosely bound to the nitrogen[3].

During the course of this work, it was also found, contrary to Karrer's observations, that the two dibutylanilines and di-*iso*amylaniline react with nitrous acid in aqueous acid solution to form *p*-nitroso compounds.

W. J. Hickinbottom.
E. W. Lambert.

Department of Chemistry,
University, Birmingham.

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[1] Karrer, *Ber.*, **48**, 1398 (1915).

[2] Reilly and Hickinbottom, *J. Chem. Soc.*, **113**, 99 (1918)

[3] Hickinbottom, Nature, **131**, 762 (1933)

Enzymatic Removal of Bound Carbohydrate from Normal Horse Serum Pseudoglobulin

By the use of the preparation 'Luizyme' (Luitpoldwerke, Munich, to which I am indebted for a sample) part of the bound carbohydrate can be removed from horse serum pseudoglobulin. The enzyme is active at pH 5 in $M/2$ acetate buffer. Owing to inhibition by the products of digestion, the action comes to an end within four hours at 37°, and it was necessary to submit the protein to successive treatment with fresh lots of enzyme. Ammonium sulphate (40 per cent saturated) was used at every stage as protein precipitant, and repeated reprecipitation was shown not to effect removal of carbohydrate. The slight proteolytic activity of the enzyme preparation under these conditions is quite insufficient to account for the splitting of carbohydrate from the protein.

The effect of successive digestions, shown in the accompanying table, on the amount of bound carbohydrate estimable by the method of Sørensen and Haugaard[1], suggests a specific removal of one part of the galactose-mannose-glucosamine complex. The protein recovered after ten digestions did not differ markedly in its properties from the original protein, either in solubility, in ultra-violet absorption or in its potentiometric titration curve. Ultra-centrifugal sedimentation showed it to be rather heterogeneous, though at least a third of it had an unchanged sedimentation velocity.

No. of successive digestions	Per cent of total estimable carbohydrate remaining (± 3 per cent)
1	80
5	56
5	51
8	50
10	49

Precipitin tests with anti-horse globulin sera showed certain differences—increased flocculation time, decreased precipitability and changed optimum proportions—compared with the original protein. These differences might be due to loss of bound carbohydrate or to slight proteolysis, but they seem small in consideration of the extensive treatment of the protein and the considerable change of carbohydrate content.

These results, repeated on several samples of protein, suggest that the part of the carbohydrate removed may not be important in determining the properties of serum pseudoglobulin.

I am grateful to Prof. J. R. Marrack for the precipitin tests, to Mr. E. R. Holiday for measuring the ultra-violet absorption and to Mr. J. St. L. Philpot for measuring the ultra-centrifugal sedimentation.

ALEXANDER G. OGSTON.

Research Laboratories,
London Hospital, E.1.
May 10.

[1] *Biochem. Z.*, **260**, 247 (1933).

Schütz's Law and the Clotting of Blood

IT seems worth while to point out a misunderstanding of Schütz's law, which has been found in works on blood clotting, and which has been accepted in reviews on this subject[1,2].

Fuld[3] (cf. later Tsunoo[4]) first applied Schütz's law to the clotting of blood plasma. Now, the results obtained by Schütz[5] show that the amount of albumin digested in a given time is proportional to the square-root of the amount of enzyme, that is,

$$[P] = \text{const.} \times \sqrt{[E]}. \qquad (1)$$

In Schütz's law the reaction time t does not appear as a variable, and so the law cannot, of course, be used for the characterization of time relations. In blood-clotting, t and $[E]$ are the only measurable quantities, while $[P]$ is constant, and it follows that the original law of Schütz is of no value in these circumstances. To extend the formula, t must be incorporated, based upon experiments, and in this way Arrhenius[6] obtained the equation:

$$[P] = \text{const.} \times \sqrt{[E] \cdot t}\,; \qquad (2)$$

but this is not the law used by Fuld[3]. The rule referred to by Fuld as Schütz's law can be formulated as

$$\frac{1}{t} = \text{const.} \times \sqrt{[E]}, \qquad (3)$$

and on comparing (3) with (1), it appears evident that an incorrect use of $[P]$ and $1/t$ as interchangeable measures of reaction velocity has led to this misunderstanding. Bodansky[7] has recently shown similar confusions to exist in general in enzyme chemistry.

A detailed study on the clotting time of blood is to be published soon.

TAGE ASTRUP.

Biological Institute,
Carlsberg Foundation,
Copenhagen. May 11.

[1] Hammarsten, O., "Lehrbuch d. Physiol Chem.", 204 (1926).
[2] Wohlisch, E., *Ergeb. Physiol*, **28**, 571 (1929).
[3] Fuld, E., *Hofmeisters Beitr. chem. Physiol.*, **2**, 514 (1902).
[4] Tsunoo, S., *Pflügers Arch.*, **210**, 334 (1925).
[5] Schutz, E., *Z. physiol. Chem.*, **9**, 577 (1885).
[6] Arrhenius, S., "Immunochemie", 44 (Leipzig, 1907).
[7] Bodansky, O., *J. biol. Chem.*, **120**, 555 (1937).

Cancers of Infancy and Anærobic Glycolysis

CRAMER[1] has directed attention to the fact that the retinoblastoma, which appears almost exclusively in infants, and the chorion-epithelioma arise from tissues that have a type of metabolism resembling that of tumours.

Besides the retinoblastoma, the neuroblastoma and nephroblastoma are also tumours of the first few years of life, and in recent years it has been shown that brain and kidney medulla[2] have a high glycolysis. Thus these tissues also have a metabolism resembling that of embryo and of tumour, and this may have some connexion with the occurrence of these tumours in the early years of life. Whether the nephroblastoma arise from the medulla of kidney is doubtful, but in my opinion these relations are of the utmost importance and should be borne in mind by pathologists and workers who hope to unravel the causative mechanism of cancer.

It is irrational to work on the hypothesis that cancer afflicts cells and tissues of all ages through the same mechanism, when the cancers of infancy may constitute a separate category by virtue of the peculiar metabolic properties of the tissues of their origin.

E. E. FAERBER.

Department of Physiology,
University of the Witwatersrand,
Johannesburg. April 28.

[1] Cramer, *Cancer Review*, **346**, 354 (1928).
[2] Dickens and Weil-Malherbe, *Biochem J.*, **30**, 659 (1936).

Dissolving Action of Micro-Organisms on Milk-Wool

IN NATURE of April 9, Prof. Jan Smit and B. Van der Heide gave the results of some work which they have carried out on the action of micro-organisms on milk-wool. This communication was brought to the notice of Messrs. Snia-Viscosa, of Milan, the manufacturers of, and Comm. Ferretti, the inventor of, "Lanital", the trade name given to the so-called casein or milk-wool made by the Ferretti process. In reply, they state that although "Lanital" has been in commercial use for some years, no case of attack of "Lanital" by micro-organisms has come to their notice; on the contrary, it is found that whereas wool is attacked by moths, "Lanital" is not.

W. H. GLOVER.

Messrs. Courtaulds, Ltd.,
Coventry. May 16.

Synthesis of α-Tocopherol (Vitamin E)

WE have described[1] the synthesis of a compound, obtained by letting phytyl-bromide react with trimethyl-hydroquinone. We also expressed the opinion that this substance might be the racemic form of α-tocopherol.

In the biological test this compound gave excellent vitamin-*E* activity in doses down to 6 mgm., the smallest tested so far. By means of brom-camphor sulphonic acid, the racemic compound can be split up into the optically active forms. The brom-camphor sulphonate of the synthetic compound shows the same melting point as the corresponding α-tocopherol derivative (48–50°), and mixed together there is no depression. The optical activities are identical: $[\alpha]_D = +30° (\pm 2°)$ in alcohol.

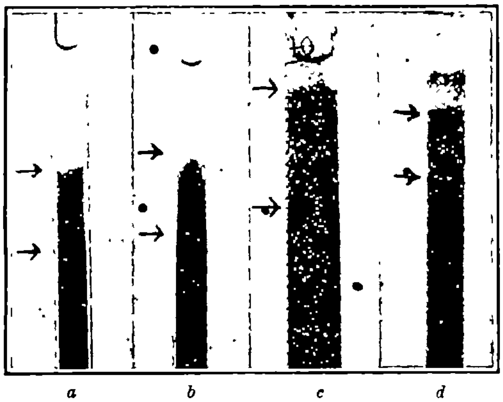
P. KARRER.
H. FRITZSCHE.
B. H. RINGIER.
H. SALOMON.

Chemisches Institut
der Universität, Zürich.
May 13.

[1] *Helv. chim. Acta*, **21**, 520 (1938).

Stratified Blood Sedimentation—Isolation of Immature Red Cells

DURING sedimentation tests, blood often forms a clearly demarcated zone of red cells above the main sedimenting column[1]. Typical appearances are shown in the accompanying photographs.



STRATIFICATION IN BLOOD SEDIMENTATION TESTS IN SECONDARY ANÆMIA OF (*a*) TUBERCULOUS ADENITIS, (*b*) BRONCHOPNEUMONIA, (*c*) AND (*d*) ANÆMIA IN DOG.

Red cells of the upper zone, or of the diffuse upper cloud when the stratification is not clear cut, are all immature. In some cases, the upper zone contains up to 85 per cent of reticulocytes, less than ½ per cent being found in the main sedimenting column. Withdrawal of the upper zone and resedimentation enables the relatively few immature cells carried into the lower column to be separated.

The formation of the upper zone is due to the low aggregation tendency of the red cells comprising it, but these also have lower electrophoretic speeds, usually two thirds to a half that in the lower main column, the same ratio being found in man and dogs, when measured in isotonic sucrose solution buffered at *p*H 7·4. The low electrokinetic potential thus evidenced should favour aggregation, so that the non-aggregation indicates a marked deviation from the normal erythrocyte surface. Here, however, the usually more spherical shape of the upper zone corpuscles must also be considered. Typically the upper zone red cells have the same absolute electrophoretic speeds as leucocytes in the same animal, the surface resemblance being also shown by the low aggregation tendency of leucocytes.

In some cases, the upper zone contains only 2–3 per cent of reticulocytes, and in others no reticulocytes but a few red cells showing punctate basophilia. The identity of the upper zone constituents in these cases was established as immature red cells by (*a*) their electrophoretic speeds, (*b*) their occasional deeper generalized basophil staining than cells in the lower column, and (*c*) their diminished aggregation tendency, which is the cause of the differential flotation.

Sometimes a third uppermost zone forms; it usually contains red cells with electrophoretic speeds generally half the normal value. This third zone is apparently derived by selective flotation of cells from the stratum of immature cells and could sometimes be induced artificially. The electrophoretic speed always increases from top to bottom strata, and also when there are no definite strata but merely an upper cloud. The simple approximately 2 : 3 ratio corresponds to the reticulocyte phase of maturation. In later phases the electrophoretic speed difference is less marked although the diminished aggregation tendency persists.

Stratification was never seen in normal subjects, but was found in 37 of a series of 56 patients, and in splenectomized or desanguinated dogs. Of the human patients exhibiting the phenomenon, 35 showed some degree of secondary anæmia.

Stratification is an indication of bone marrow reaction and is of importance in revealing young cells not identifiable by staining. It occurs in association with normal and increased sedimentation rates as measured to the top of the lower main column. Both when stratification is present and when absent, a new factor, the age of the red cell population, must be considered in relation to sedimentation rates, and indications have been found that young bloods sediment more slowly than old ones, other factors being equal.

Even when stratification does not appear, immature cells are concentrated in the upper limit of the sedimenting column. Centrifugation without sedimentation also causes immature red cells to be concentrated in the upper limit of the centrifuged deposit.

J. G. STEPHENS.

Sir William Dunn School of Pathology,
Oxford. May 6.

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[1] Stephens, J. G., *J. Physiol.*, 92, 39 (1938).

Motor Spirit from Coal

OUR attention has been directed to the article by Messrs. J. L. Strevens and A. C. Cross in NATURE of May 7 on "Motor Spirit from Coal". We have no desire to enter into any controversy on a subject ably and impartially covered, in our view, by the Falmouth Committee, but we cannot help correcting at least two misstatements.

It is stated that "the octane rating of this spirit [produced by hydrogenation] is 70 plus". The hydrogenation process is elastic enough to enable us at Billingham to produce regularly no fewer than four different types of spirit: aviation (87 O.N.), ethyl spirits (81 O.N.), Straight No. 1 spirits (75 O.N.) and commercial grades (68 O.N.). All these petrols are used directly, without admixture with other materials, for their appropriate purposes.

Again, it is stated that "phenols so essential to the nation's needs in times of peace and war can only be obtained from coal distillation processes and the tar industry, and not from hydrogenation or synthesis". When coal is hydrogenated it gives a much greater yield of phenol than when it is carbonized; typical figures per 100 tons of coal treated are: hydrogenation, 0·9 ton; distillation, 0·03–0·04 ton according to temperature of carbonization. In actual fact, during 1937 the production of phenols manufactured on the hydrogenation plant and sold was more than 850 tons. This figure is well below the present capacity of the plant.

J. E. JAMES.
(Secretary.)

Imperial Chemical Industries Limited,
Millbank, London, S.W.1.

IN reply to Mr. James's letter, we have to make the following comments.

In the 1936 report of the Imperial Chemical Industries, Ltd., it was mentioned that plant had been installed for the recovery of two further by-products, phenol and cresol, and in the 1937 report that the phenols production from that plant had amounted to 850 tons.

As it is usually accepted that complete hydrogenation-reduction of phenols present in coal oils and coal derivatives leads to the ultimate production of hydrocarbons, it seems that the commercial hydrogenation of mixtures of coal and coal oils is incomplete and there naturally remains end-products still containing unconverted phenols. Every additional source of phenol production is of great national importance.

Our authority for the statement on octane ratings of 70 plus for the motor spirit produced by hydrogenation was Prof. W. A. Bone and A. N. Himus's most recent treatise on "Coal: its Constitution and Uses" (1936), p. 564, wherein the figure given for the No. 1 straight undoped spirit is 71–73. Aviation spirit was never under consideration in the article because, so far as octane rating is concerned, this is standardized at 87, and every spirit must conform to it, whatever the method adopted to reach this rating.

The modifications to plant that have been necessary at Billingham to permit of the production of straight 75 octane No. 1 spirit were briefly referred to in the Company's annual report for 1937.

JOHN L. STREVENS.
A. C. CROSS.

11a Maresfield Gardens,
Hampstead, N.W.3.

The Piltdown Bone Implement

MR. REID MOIR[1] mentions the theory that the bone implement from the Piltdown gravel was made by a rodent mammal, not by man. One of the finest examples of bone gnawed by rodents (presumably porcupines) is a fossil skull of the extinct panda, *Aelureidopus baconi*, which is exhibited in the British Museum (Natural History) not far from the implement. It is therefore easy to compare the work of rodents with that ascribed to man.

ARTHUR S. WOODWARD.

Hill-Place,
Hayward's Heath.
Sussex.
May 25.

[1] NATURE, 141, 926 (May 21, 1938).

Eggs of Stick Insects

JUDGING by a recent correspondence in NATURE[1], a number of readers are interested in rearing the common stick insect (*Carausus*). In any quantitative work on *Carausus*, it is a tedious operation to secure the eggs which are deposited among the debris of the breeding cage where, on account of their 'protective' devices, they may easily escape observation.

One of my students, Miss C. McK. Campbell, has devised a very easy method of securing the eggs, which may be of use to others. She plunges the whole of the floor contents of the breeding cage into a vessel containing water, stirs well, to break the surface film and so thoroughly wet each egg, and then allows the whole to settle. The eggs fall to the bottom, the debris floats. The supernatant material having been poured off the eggs can be carefully dried, counted and stored.

SISTER MONICA.

Notre Dame Training College Laboratory,
Dowanhill, Glasgow, W.2.
May 17.

[1] NATURE, 138, 886, 1058 (1936); 139, 156 (1937).

Stability of Intermetallic Compounds in the Molten State

THE atomic nature of solutions of cadmium in molten cadmium chloride (so-called 'pyrosols') was proved by an investigation of the partition coefficient of cadmium between molten cadmium chloride and a molten metal phase, such as bismuth[1].

The solutions of sodium in molten sodium halides (for example, sodium bromide or iodide) are being studied at present on similar lines by investigating the partition of sodium between molten sodium bromide and molten lead at 770° C. in sealed tubes of Supremax glass. These systems also prove not to be colloidal. The partition curves reveal, however, the existence of strong interatomic forces in the metal phase which render a detailed analysis of the curves difficult.

A striking behaviour is observed when molten bismuth is used in the metal phase instead of lead. Bismuth, like lead, is not soluble in molten sodium bromide. However, when alloyed with sodium, considerable quantities of bismuth (up to several per cent) pass into the salt phase. Bismuth and sodium form compounds of considerable stability[2], the maximum in the phase diagram being at 775° C.* Obviously one of these compounds, presumably Na_3Bi, is soluble in the molten salt. A similar phenomenon is observed when a sodium alloy of antimony or tin is used as a liquid metal phase. The maxima in the phase diagrams of these metals with sodium are at 856° C. and 580°. On the other hand, thallium, cadmium and lead do not pass into the salt phase when alloyed with sodium. These metals also form intermetallic compounds with sodium, but the maxima in the phase diagrams are at much lower temperatures (Na-Tl : 305° C., Na-Cd : 385° C., Na-Pb : 405° C.). Obviously these compounds are practically entirely decomposed at the temperature of our experiments, which is 350°–450° higher. The results obtained by the partition coefficient method therefore suggest that compounds of sodium with heavy metals may be stable at temperatures up to about 200° above the melting temperature of the compound, but decompose at higher temperatures.

E. HEYMANN.
H. P. WEBER.

Chemistry Department,
University of Melbourne.
May 1.

* Only such compositions have been investigated in which the metal phase is liquid at 770° C.

[1] Heymann, E., and Friedlaender, E., *Z. physik. Chem.*, A, 148, 177 (1930). Farquharson, J., and Heymann, E., *Trans. Farad. Soc.*, 31, 1004 (1935).

[2] Seith, W., and Kubaschewski, O., *Z. Elektrochem.*, 43, 743 (1937).

Illusion of Convergent Beams of Light

IN a recent letter[1] under this title, Dr. A. H. Rosenthal describes an optical illusion produced by the rotating beam from a lighthouse. We studied this phenomenon last year[2], and we think that both perspective and photometry are required for its explanation. Diffusion laws show that the brightness of the beam is great near the opposite horizon; this fact, together with the apparent convergence, gives to the observer a strong impression that the lighthouse is just beneath the horizon.

G. COLANGE.
Y. LE GRAND.

Ecole Polytechnique,
Paris V.
May 16.

[1] NATURE, 141, 836 (1938).

[2] Colange and Le Grand, *Comptes rendus*, 204, 1882 (1937).

The Editor of Nature has very kindly let me see the interesting communication from MM. Colange and Le Grand and the paper to which they refer.

The phenomenon is exactly the same as that observed by me, and the paper seems to provide a most plausible explanation for it.

Besides the purely geometrical cause for the increased brightness of the beams towards the opposite horizon, contributing strongly to the illusion of an 'anti-phare', another cause might be the usual density gradient of the haze towards the sea, and therewith an increase of the amount of light scattered back to the observer per unit volume from the beam, towards the opposite horizon.

A. H. Rosenthal.

68 Ladbroke Grove,
London, W.11.

A Binocular Illusion

Waking under my mosquito net one morning during a visit to India, I was surprised to find that the wall of the net before my eyes appeared to consist, not of a single vertical sheet of netting, but of three or more sheets. On closer examination, I found that these seemed to be arranged like the successive slats of a venetian blind, and supposed this to be a binocular illusion—a variant of that mentioned by Prof. H. H. Dixon[1]—the nth mesh seen by one eye combining successively with the $(n-1)$th, nth, $(n+1)$th . . . mesh fixed by the other eye.

The first minute after waking from sleep, when vigilance and control are weak, is doubtless conducive to the involuntary experience of this type of illusion. For, on returning to Cambridge I asked a group of physicists if they knew of the possibility of such binocular illusions, and the only affirmative reply came from one to whom a patterned bedroom wall-paper had afforded a similar experience (complicated by the activity of a house-fly).

Ronald W. Gurney.

Bristol.
May 9.

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[1] Nature, 141, 792 (April 30, 1938).

Points from Foregoing Letters

The dependence of heat conductivity of quartz on the size of the crystals has been determined by Prof. W. J. de Haas at very low temperatures (2·5°, 2·9° and 3·3° K.). The heat resistance was found to approach asymptotically a constant value. The author assumes that the resistance is due to scattering of the elastic waves by the surface and by the mosaic structure, and to scattering of the elastic waves by one another.

G. T. Seaborg and D. C. Grahame find that internal conversion of the gamma rays of moderate energy, with a conversion coefficient as high as 15 per cent, occur in the heavier elements. In view of the observation by Kallmann and Kuhn that gamma rays are emitted in the D-D reaction, the authors suggest that gamma rays may be responsible for the rather large number of counts observed in a Geiger-Muller counter operated near a source of fast neutrons, and that it may be unnecessary to assume, as Kikuchi and Aoki have done, that a direct interaction between fast neutrons and electrons takes place.

Commenting on the observation reported by Bernard, identifying the yellow radiation of the night sky and the twilight with the sodium line, Prof. J. Cabannes, Prof. J. Dufay and J. Gauzit refer to findings by previous investigators who had come to the same conclusion, and describe similar work which they themselves had carried out and published simultaneously with Bernard.

Using the method of partition functions, the statistical mechanics of the adsorption of gaseous mixtures is discussed by Dr. F. J. Wilkins with due allowance for the imperfection of the adsorbed layer. Adsorption isotherms for the separate gases are derived.

X-ray examination of nickel-aluminium alloys has shown the existence of three phases, Ni_3Al, Ni_2Al_3, and $NiAl_3$, with distinct structures. Dr. A. Taylor and Dr. J. Weiss find that by treating with sodium hydroxide solution it is possible to remove aluminium atoms from the lattice leaving vacant sites; when only 0·5 Al remains the structure ultimately collapses and tends to form the face-centred cubic structure of nickel. Electron transfer processes are probably considerably enhanced in certain nickel structures with different lattices which possess a very high unsaturated surface, and this may explain the activity of such substances as catalysts in hydrogenation.

Many more dissimilarities than similarities were noted in a series of experiments made by Dr. W. H. George, in which about forty unprejudiced observers spontaneously made comparisons between pairs of objects. Reference is made to the bearing of the results on classification and on social problems.

Dr. W. J. Hickinbottom and E. W. Lambert find that the two known di-butylaniline couple normally with diazosulphanilic acid without loss of a butyl group. Their findings do not agree with those upon which Karrer based his theory of coupling of aromatic tertiary amines.

About half the bound carbohydrate in horse serum pseudoglobulin can be removed, according to A. G. Ogston, by digestion with a special enzyme. The pseudoglobulin so treated shows increased flocculation time and decreased precipitability, but on the whole its properties are not greatly changed considering the considerable change in carbohydrate content.

E. E. Faerber suggests that the cancers of infants, which affect tissues such as the retina, constitute a separate category, by virtue of the peculiar chemical reactions in the tissues affected.

The upper stratum of red corpuscles seen in blood sedimentation tests is stated by J. G. Stephens to be composed of immature cells with surfaces resembling those of leucocytes. Although the upper stratum frequently contains abundant reticulocytes, other immature red cells, not recognizable by staining, are also thus revealed by their differential sedimentation.

Dr. E. Heymann and H. P. Weber use the partition method to test the stability of intermetallic compounds in the molten state (with sodium as one component). Such compounds appear to be stable up to about 200° C. above the melting point, but decompose at higher temperatures.

Research Items

Africa and Melanesia in Transition

PROF. RICHARD THURNWALD, as a result of his recent travels in Melanesia and Africa, has instituted a comparison of conditions among the natives of the two regions in respect of their reactions to contact with Europeans (*Africa*, 11, 2; 1938). The two peoples are similar in their poverty of technical equipment and traditional knowledge, while their political and economic organization is weak. They lack resistance in their contacts with Europeans. They differ owing to the fact that in Africa the peoples of Bantu stock have been in contact for centuries with pastoral peoples occupying the greater part of the territory south of the Sudan, who have passed on to the Bantus elements of their culture and their blood. The Melanesians, on the other hand, have received cultural elements from Asia, China and the Indies. As regards the natives of East Africa, mention must also be made of their contacts with the Arabs, lasting over some centuries and leading to the founding of Zanzibar and the establishment of the cross-bred Swahili people and language. No such preliminary contacts occurred in Melanesia. The Chinese trading centre on Celebes has left no trace in New Guinea. The gap between old and new is therefore much wider in Melanesia than in Africa. When the Europeans came to Africa they had to meet the resistance of the dominant races—Arabs, Swahili, Masai, and the Ful. After some quarrels, these aristocratic herdsmen offered their dependants for the labour required by the Europeans. Hence foreign labourers were not introduced into Africa. The aristocratic rule of Polynesia and Micronesia was mitigated by the fact that all strata of the population were equally agriculturists. Hence the lower classes, imitating the attitude of the higher, refused to labour for the Europeans, and foreign races were imported for the purpose. After surveying the various points of contact—missions, education and administration—it would appear that the chief difference between the two regions lies in the stage of the process of contact which each has attained.

Teeth and Jaws of *Dryopithecus*

THE Yale-Cambridge Expedition to the Siwalik Hills of 1935 under Dr. H. de Terra secured a small but valuable collection of fossil apes' teeth and jaws, which have been made the subject of a study by Dr. W. K. Gregory, Dr. Milo Hellman, and Dr. G. Edward Lewis (Carnegie Institution, Washington, 1937. Pp. 27+8 plates). Comparison has been made with other specimens lent, or represented by casts, from India as well as with those collected by the expedition of 1931–33. The number of new or supposed genera of fossil apes has been increasing with every fresh collection made, and it was hoped that it would be possible by this study to demonstrate synonyms. It was evident that the range of difference in size, form, and detail of molar patterns was great, and that there had been a wide generic radiation of the anthropoids in the region now the Siwaliks. Some progress has now been made in this direction, while evidence has been supplied on the phylogenetic sequence of certain species. Taken as a whole, the Siwalik anthropoids were of a distinctly infra-human grade of evolution, but in particular features, now one now another, they approach and even overlap the outer zone of human variations. For example, the second and third molars of *Brahmapithecus thorpei* in respect of breadth indices even surpass some human teeth. It has been shown that the lower molars of Siwalik anthropoids also exhibit many minor variations of what has been called the *Dryopithecus* pattern. It is important to emphasize (1) that the extinct anthropoid apes ranged over an enormous area in the eastern hemisphere—from Spain to India and China, and from Egypt to South Africa; (2) that the group is exceedingly variable, at least in details of jaw and dentition; (3) that while the Siwalik genus *Ramapithecus* and the South African *Australopithecus* are still simian by definition, they are almost at the human threshold at least in respect of their known anatomical characters. Nor can we find that the peculiar features in the teeth of *Sinanthropus* and later hominids are anything more than specializations of later date than the opposite characters found in the upper Tertiary anthropoids of the Siwaliks.

Blood Groups in China

IN the course of an extended series of anthropological investigations among the peoples, Chinese and aboriginal, of the Province of Szechwan, West China, Prof. W. R. Morse of the West China University College of Medicine, Chengtu, with his colleagues, has recorded a number of observations on the blood groups of the Ch'wan Miao and the Szechwanese (*Man*, May 1938). The Ch'wan Miao are one of a number of Miao tribes, and number about 100,000. The Province of Szechwan is an ancient centre of anthropological significance. The Chinese population is neither autochthonous nor homogeneous. The Chinese did not enter the territory until about 200 B.C., when they first appeared in small number; but the aboriginal tribes already had a highly developed civilization with temples, schools, and irrigation, so far back as 1200 B.C. The Ch'wan Miao have been very considerably permeated by the culture of the Chinese; but they have a distinct unwritten language, which differs considerably from that of the Chinese, as also do their folk-lore, songs and music. They have a peculiar bamboo wind instrument of a composite character, which sounds very much like the Scottish bagpipes. The clothes and hats of the women are often beautifully decorated, while some of the men also wear embroidered clothes, but more commonly dress as do the Chinese. Neolithic stone implements have been found here in considerable numbers. Observations of the blood grouping were made on 205 Ch'wan Miao (157 males, 48 females) and 1,292 Chinese of the Province. As compared with the Szechwanese the Ch'wan are very low in *A* and high in *B*. The figures are as follows:

	O	*A*	*B*	*A B*	Total
Ch'wan Miao	74	23	80	28	205
per cent	36·1	11·2	39·0	13·7	
Szechwanese	487	375	289	141	1·292
per cent	37·7	29·0	22·4	10·9	

The blood grouping was done chiefly by Mr. S. C. H. Yang, assisted in part by Dr. Y. T. Beh.

Structure of Fœtal Asiatic Elephant

Prof. W. C. Osman Hill illustrates and describes the external features of a mid-term fœtus of Asiatic elephant which has been studied radiographically (*Ceylon J. Sci.* (B), 21, Pt. 1, 31). Comparison of the fœtal mandible with later stages of development suggests that the growth of this bone indicates repetition of phylogenetic history as Eales found in the African elephant. The state of ossification of the limbs is relatively less advanced than in other ungulates, and in this respect is more in keeping with the development of the human skeleton. On the other hand, the heart (described in the following paper) lags in development, and its condition in the advanced fœtus is comparable to that in a human embryo of the fifth week of intra-uterine life. Even in adult life the heart retains a number of primitive features concerned with form and structure, such as the great transverse breadth relative to other dimensions, the relatively large size and globular form of the ventricles, the apical bifurcation, certain arrangements in the interior of the right atrium, the absence or incipient nature of the atrial appendages, and the poor differentiation of the papillary muscles. Various other points of anatomical interest are referred to in this account.

Starlings colonizing Canada

The common starling (*Sturnus vulgaris*) was first recorded in the Toronto region in 1920; about two years later the second record was made. That was the beginning of a settlement, which slowly increased in numbers and in extent during the next three years to 1925, in which year a speeding up in the progress of the movement was noted. The second five-year period, 1925–30, was a boom period when the possible nesting sites which had been tenantless in 1920 were taken over by starlings, with the exception of the noisy downtown business blocks, where only a few birds had taken occupation (*Canadian Field Naturalist*, 51, 124; 1937). The authors, L. L. Snyder and J. M. Spiers, state that the numbers of starlings in the area reached "super-saturation" in 1928, and afterwards in 1932 and 1935, suggesting a population cycle over approximately a three-year period. In the course of seasonal fluctuations, March shows a marked rise in numbers of birds. This is caused by the influx of migrants, as ringing methods have helped to establish; but shortly thereafter the emigrants which are to breed in the far north set out, and Toronto's starling population falls to the low winter-level. In May incubation reduces the numbers to half the winter population. July sees the appearance of family flocks which combine for roosting purposes into the enormous flocks of September. The month of smallest numbers is November, owing to a previous southward migration, but a fairly constant number remains in Toronto over winter.

British Fleas and their Hosts

Gordon B. Thompson has recently given an analysis of the hosts of the thirty-four species of fleas that are known to occur on British mammalia (*Entomol. Mon. Mag.*, May 1938). The author stresses the necessity for workers who publish records of these parasites to be especially careful to give full data as to their hosts, which is more important than a record of a locality alone. He divides the mammalia-fleas into four groups: (1) fleas with marked host specificity; (2) those associated with man and domestic animals; (3) bat fleas; and (4) fleas parasitic on small mammals. It may be mentioned that the plague flea, *Xenopsylla cheopis*, except for five records in 1911 off *Rattus norvegicus* captured at Guy's Hospital, has only been taken off rats in seaport towns. The flea *Orchopeas wickhami* is not truly British, since it came into this country with the introduction of the grey squirrel. Of the bat fleas, most of them are known from more than a single species of host, and the same remark applies to those fleas which are parasites of the smaller mammalia.

Rose Literature

A copious summary of "Writings on the Rose" has recently appeared from the pen of Mr. H. R. Darlington (*J. Roy. Hort. Soc.*, 63, Pts. 3 and 4, March and April 1938). The account traces the documented history of the rose from the decline of the Roman empire. Monastic writings provided the main sources of early information, but the accounts were often derived from classical sources, and showed little actual observation. Medical men began to take an interest in the medicinal value of the rose, and from the middle of the sixteenth century the medical aspects predominate in the literature. By 1650, the garden value of the rose gradually superseded its medicinal virtues, and the century 1750–1850 was a period of intensive writings by nurserymen and botanists. A great increase in the popularity of roses followed a little later, greatly stimulated by that "trinity of ecclesiastical writers, Dean Hole, Foster-Melliar and Pemberton", and this growing appreciation by a wider public has culminated in the great wealth of rose literature at the present time.

Storage of South African Fruit

According to the report of the Low Temperature Research Laboratory, Cape Town, for the year ending June 1938, the new laboratories and offices adjacent to the cold stores at Cape Town are now in use, and the cold stores at East London and Port Elizabeth are completed or nearing completion. Navel oranges and other citrus fruits are shipped from East London, apples, pears, grapes, plums and peaches from Cape Town and Port Elizabeth. Both refrigerated and non-refrigerated but ventilated cars have been used for transport by rail from the orchards to the cold store at the shipping port. The slight superiority of grapes transported in refrigerated cars seems insufficient to justify the extra cost. The investigations carried out in the laboratory have led to the conclusion that the defects in stored plums and the woolliness in peaches are due to too low temperature of stowage. The use of impermeable wrappers for grapes has resulted in an improvement in their quality, but the wrappers encourage mould, against which iodine has proved the best preventive. The rate of ripening of apples in store may be retarded by spraying them with a weak solution of maleic acid in water or in an alcoholic solution of benzyl cinnamate.

A Fungus Disease of the Viola

A fungus which causes a disease of the viola has been studied by Miss Marie E. Campbell (*Ann. App. Biol.*, 25, No. 1, 115–121, Feb. 1938). The organism is *Ramularia deflectens*, and it produces dark-coloured lesions upon the leaves of infected plants in early spring. Sclerotia-like bodies, which are really undeveloped pycnidia, are found below the epidermis of leaves attacked by the fungus, and mature pycnidia with pycniospores have appeared in culture. Pathogenicity of *R. deflectens* has been established by infection experiments, but the disease is apparently not serious. The host plant appears to overcome the disease during summer, and no practical measures of control seem to be necessary.

Land-locked Fjords in Norway

In a short paper in *Skrefter av Det Norske Videnskaps-Akademi i Oslo, I Mat.-Naturv. Kl.*, No. 7, 1937, Dr. K. M. Strom describes and discusses the peculiarities of Saltfjord and Skjerstadfjord near Bodo in northern Norway. The former is a deep-water basin communicating freely with coastal waters, but the latter communicates with Saltfjord only by three narrow sounds. One is dry at low water, one has a depth of 11 metres and the third has a depth of 26 metres. Skjerstadfjord itself has a maximum depth of 523 metres and has several tributary fjords opening into it. Of these, Valnesfjordvatn has a communicating channel with a depth of only 1·5 metres at low water, and Overvatn opens by a 3-metre channel. Overvatn has a maximum depth of 346 metres and is notable for its greatest depths occurring when the fjord is narrowest, which suggests a striking example of the power of glacial erosion to scoop a deep channel where the ice stream is narrowed. Overvatn, in particular, shows some interesting hydrographical features. The uppermost twelve metres are practically fresh. Below that there is increasing salinity to 21·65 and 22·95 per mille at the bottom. Below 90 metres oxygen is absent, but sulphuretted hydrogen content is low. There is probably no complete renewal of bottom waters; but a partial renewal appears to occur from time to time. Bottom waters with a temperature of 5·33° C. seem to represent cooling during winter and spring by convection currents from the surface.

Evaporation over Catchment Areas

This is the title of a paper by D. Lloyd, read before the Royal Meteorological Society on April 27, 1938. In it a statistical analysis is made of the general annual rainfall over eight British drainage areas, and the annual total loss over each of these areas (obtained by subtracting the run-off from the general rainfall) in relation to various causes of variation of the loss such as fluctuations in the annual sunshine and temperature and differences of percolation associated with different geological formations. Another factor considered is the general rainfall itself, which provides the opportunity for evaporation. The statistical method adopted is that of carrying out separate multiple correlation analyses for different areas and this is held to be more rigorous than the alternative of analysing all samples combined, which last would involve the assumption that the various functions in the regressions are constant for different areas. It was found that the partial regressions of loss on rainfall, temperature and sunshine are probably the same over several of the different areas, and that the loss for a given rainfall temperature and duration of sunshine is the same in all impermeable areas, to which loss must be added the loss during percolation to arrive at the total that may be experienced in any area. A table is given which shows the magnitude of the constants in the different regressions; for example, in the relationship between loss and temperature the variation of loss is given as 1·1 in. for each degree Fahrenheit departure of average temperature from 48° F., for the range 40–52° F., with average speed of the wind, while the annual loss increases by 0·6 in. for each hundred hours of sunshine above a yearly total of 1,450 hours in about latitude 52° N.

K-Electron Capture and Isomerism in Radio-Silver

A study of the radioactivity of the nucleus ^{106}Ag obtained by fast neutron bombardment of silver has enabled M. L. Pool and E. C. Campbell (*Phys. Rev.*, **53**, 272; 1938) to construct a tentative energy-level diagram for the nucleus. The two isomeric nuclei have periods of 24·5 min. and 8·2 days. The 8·2-day period is supposed to belong to the ground state of the ^{106}Ag nucleus. It can decay by *K*-electron capture, or by positron emission to ^{106}Pd or by electron emission to ^{106}Cd. The relative probabilities of these processes are 640, 1, 40. γ-Rays are associated with the first two, arising from excited levels of ^{106}Pd. The 24·5 min. period is supposed to arise in a metastable level of ^{106}Ag. It goes by a positron emission to ^{106}Pd. In order to give the metastable state a sufficiently long lifetime with respect to γ-emission, theory requires a large difference of angular momentum between the states, and in the present case the 24·5 min. state probably has nuclear spin zero and the ground state a spin greater than 5. Alternative explanations of the experimental facts, involving a nucleus ^{105}Ag instead of an isomer, are discussed and shown to be unlikely.

The South Equatorial Current of Jupiter

Mr. A. Stanley Williams has shown that there had been a continual decrease in the velocity of Jupiter's south equatorial current between 1880 and 1910, and that this decrease had probably continued until 1926 (*Mon. Not. Roy. Astro. Soc.*, **96**, 5, March, 1936). On this latter point, however, there was some doubt, as there was a scarcity of conspicuous spots on or about the south equatorial belt, and this region of the equatorial current was generally quiescent. The recent memoir of the Jupiter Section of the British Astronomical Association, February 1937, shows that the decrease in velocity has been a practically continuous one, extending from 1880 to 1931. Mr. Williams has recently continued the discussion of the subject, and points out that between the years just mentioned the decrease in velocity amounts to as much as 40 km./hr. (*Mon. Not. Roy. Astro. Soc.*, **98**, 5, March, 1938). A mean curve affords no indication of periodicity, and a curious feature is the pause and slight increase in velocity in 1900, for which it is difficult to offer any explanation. This south equatorial current is about 275,000 miles long and 4,500 miles broad, its depth being unknown. Mr. Williams assumes the latter to be 10 miles—probably an underestimate—and considers that its average density is about that of our own atmosphere. The question arises: What can be responsible for the decrease in velocity of this enormous current? The great change of energy which is necessary seems quite independent of any solar action, and it probably arises in the planet itself. Observations fail to disclose any connexion with the 11-year sunspot period or with the period of the planet's revolution around the sun. It seems fairly obvious that disturbances involving considerable energy changes are taking place on the planet Jupiter.

Fuel Research Station

Annual Visitation

MORE than three hundred representatives of science and technology visited the Fuel Research Station at Greenwich on May 31. The chairman of the Fuel Research Board, Sir Harold Hartley, was unfortunately unable to be present, and the visitors were received by Dr. F. S. Sinnatt, the director of fuel research. Nearly two hundred and fifty representatives of the Institution of Gas Engineers visited the Station on June 1.

The Fuel Research Station is the headquarters of the fuel research organization of the Department of Scientific and Industrial Research, and is equipped not only with laboratories but also with large-scale plant. In all processes involving heat treatment of coal, the rate of heating has considerable influence, consequently the scale effect is of importance. The aim of the Station is to obtain results that can be directly translated into practice by industry, and this involves the use of plant of a size comparable with that used in industry.

Coal is a variable and complex substance, and the first requisite for its scientific utilization is a knowledge of the properties of the various seams. These are being studied in nine laboratories situated in the principal coal fields. The normal method of examination consists in obtaining a pillar of coal from the coal face, and this is transported to the laboratory, where it is examined in detail. Variations that occur throughout the thickness of the seam are thus ascertained. A section of such a pillar was shown, with an X-ray photograph of a slice cut from the same pillar. This shows the banded structure of the coal, and the distribution of the inorganic matter in the various bands. A number of specimens illustrated the great variations to be found in coal and its associated impurities. When a sufficient number of sections has been examined, it becomes possible to form a picture of the seam over the whole coal field and to predict with some certainty the characteristics of the seam in areas not yet worked. Examples were shown of 'Iso-vol' maps from two different coal fields, showing the volatile content of a seam as it varies from point to point. The areas are clearly indicated from which coal specially suitable, for example, for coke making, gas making, or steam raising, can be obtained.

Modern methods of utilizing coal have increased the importance of a knowledge of the inorganic constituents present, and methods for the examination and analysis of coal and its associated impurities are continually being studied and improved. When coal is burned a certain amount of 'ash' remains, and this is easily determined, but does not necessarily represent in amount the inorganic matter originally present. An exhibit illustrated the changes that take place during ignition, the method of determining the amount of inorganic matter in the original coal, and the actual composition of the coal substance itself.

Various examples of the more common minerals concerned were exhibited. A list of the less common constituents that have been met with was on view, together with specimens of coal containing barytes and galena. Micro-analytical methods for determining the amounts of some of these rarer constituents were shown. Both the normal methods of analysis and modifications for special cases were on view.

One of the difficulties in the examination of coal is the preparation of a fair sample. In the first place, the gross sample taken must be truly representative of the bulk consignment. In the second place, this sample must be reduced to the small sample of finely ground coal which is required in the laboratory, without losing its representative character. New facilities for the rapid and convenient reduction of gross samples have recently been provided.

An investigation of general interest concerns the burning of coal in the open domestic grate. The experiments are being carried out in two specially built rooms of gas-tight construction, so that the air can only enter by one path where it can be precisely measured. The radiation from the fire and the smoke produced are recorded. The results show that the quality of the coal, the size of the coal, the relative amounts of air passing through the fire and entering the flue by passing over the fire, the brickwork surrounding the fire, and the design of the grate all have a significant influence on the amount of smoke emitted.

Two vehicles—a one-ton and a five-ton lorry—were shown, which have been converted to run on producer gas from solid fuels. The first is fitted with a producer made by a British firm and has been used for comparing the efficiencies of different types of fuel—charcoal, cokes of various kinds, and anthracite. The second is fitted with a producer designed at the Fuel Research Station to study the principles involved in the design, with the view of making a more flexible producer. It is giving promising results.

The synthesis of hydrocarbons from carbon monoxide and hydrogen is being studied in several plants, including one producing about 5 litres of liquid hydrocarbons a day. The primary products consist of motor spirit, diesel oil and waxes of high melting point, together with heavy hydrocarbon gases. Lubricating oils, esters and soaps have been prepared from the primary products.

One of the water-gas plants at the Station has been modified so that coal can be used instead of coke. Non-caking coals, either high or low in volatile matter, can be used. This forms one means for the total gasification of coal. Experiments are in progress on raising the calorific value of the water gas, by treating a portion with a catalyst so as to produce hydrocarbon gases. Another modification enables a gas to be made with a higher proportion of hydrogen, and so more suitable for the synthesis process.

Other plant on view included the chamber ovens being used for experiments on the carbonization of blends of coal; the hydrogenation plant, used for studying the suitability of different coals and the action of catalysts; the coal cleaning plant; the plant for boiler firing by pulverized fuel; and the marine boiler for examining bunker coals.

A striking demonstration showed the 'dust proofing' effect of a small quantity of oil when sprayed over coal.

Royal Observatory, Greenwich

Annual Visitation

THE annual report of the Astronomer Royal to the Board of Visitors was presented at the annual visitation of the Royal Observatory, Greenwich, on June 4. The following abstract gives briefly the chief points of the report, which specifies in detail the various activities of the Observatory during the year ending April 30, 1938.

Reversible Transit Circle. The new instrument has been subjected to a very detailed investigation before being put into routine use on a definite programme. The causes of certain discordances, which had been revealed by tests, have been tracked down in the micrometer system and reduced to a negligible amount by minor alterations and critical readjustment. The determination of the division errors of the circle (to be carried eventually to each 5′ division) has been continued. Altogether much useful information is being accumulated on possible sources of systematic error in meridian observations.

Work with the *Airy Transit Circle* has completed during the year an observing programme commenced in 1931 and containing all stars down to mag. 7·5 in the Draper Catalogue between declination 0° and +24°, as well as the stars in Boss's Preliminary General Catalogue between +64° and the pole. Out of about 7,000 stars, more than 6,000 have been observed six or more times.

The departure of the position of the moon from the position given by pure dynamical theory continues to increase; there is no indication of any sudden change in the earth's rate of rotation.

Cookson Zenith Telescope. A determination of the constant of nutation derived from the Greenwich observations made with this telescope from 1911 to 1936 gives 9·217″ ± 0·004″. This value, in conjunction with Oort's value of the constant of precession, gives a ratio of 1 : 81·59 for the mass of the moon to that of the earth. The discussion of the observation of the minor planet Eros, made at the 1931 opposition, should lead to a very precise determination of the mass of the moon and should provide a valuable check on the constant of nutation.

During the year, 271 plates were taken for the latitude variation programme.

28-inch Refractor. The comparison image micrometer, which recently replaced the ordinary bifilar micrometer of this refractor for double star measures, has proved very satisfactory, especially for stars with separation less than 1″. An interferometer has been constructed in the Observatory workshop and is intended for bright binaries that are too close for the comparison-image micrometer.

Thompson 26-inch Refractor. 1,151 plates for the determination of stellar parallax and 105 plates for proper motion determinations were secured. Another 29 parallaxes have been completed.

Yapp 36-inch Reflector. For colour temperature work, 215 comparisons of 79 stars with standard stars have been secured with the slitless spectrograph. Observations on γ Cassiopeiæ, which shows colour temperature variations, are being continued. The Hilger slit spectrograph was mounted in position and tested over a period of nearly two months.

Observations of Eros. A large amount of work has been done at Greenwich on plates taken at various observatories during 1931. The number of positions of the planet to be computed from measures made at Greenwich is more than 1,300.

Astrographic Equatorial. The star field of the total solar eclipse of October 1, 1940 (visible in the southern hemisphere) and two near-by comparison fields have been taken to decide upon the suitability for the observation of the Einstein displacement at this eclipse.

Photoheliograph. The sun was photographed at Greenwich on 284 days. The 1937 daily series assembled from the Greenwich, Cape and Kodaikanal photographs is complete except for one day. The sun's activity in its 11-year cycle, as measured by the frequency of sunspots, is passing through its maximum phase—the highest since 1870. Three spot groups of exceptionally large area (3000 millionths of the sun's hemisphere) occurred during the year.

Spectrohelioscope. Observations of bright chromospheric eruptions on the sun, of which the association with sudden radio fade-outs seems now to be definitely established, continue to be one of the special objects for investigation. The highest radial velocity of a dark hydrogen marking observed during the year was 325 km./sec. outwards from the sun.

Eclipse Expedition, 1940. The Admiralty has authorized the sending of an expedition to South Africa for eclipse observations. It is proposed to study the change from line absorption to emission near the sun's limb by means of a slit spectrograph guided on the moon's limb. It is also planned to study the Einstein displacement with an equatorial camera designed to shift very rapidly from the eclipse field to a check field and back several times during totality.

Time Service and Chronometers. Astronomical determinations of time were made on 109 nights with the small reversible transit. A system of intercomparison of the five free pendulum clocks at Greenwich (and in addition the one at the National Physical Laboratory) has provided a 'mean clock' as datum for prediction of clock error. An increase in accuracy of the time signals disseminated from Greenwich has resulted from this procedure. The rhythmic radio time-signals transmitted at Rugby, the hourly time signals to the G.P.O. and the six dots to the B.B.C. sent every quarter hour have been maintained. The hourly signals to the G.P.O. have been used for the automatic correction of the Talking Clock, which has proved a remarkable success.

It is hoped that the quartz crystal oscillator clock, which is being made at the National Physical Laboratory, will shortly be installed at the Observatory.

The performance of the Westminster clock, which is not corrected by any signals from the Observatory, shows that the error of the signal to Greenwich did not exceed $0{\cdot}2^{s}$ on 131 days; on 18 days the error was greater than $1{\cdot}0^{s}$.

There has been a considerable increase in the amount of testing to be done at the Observatory of Admiralty chronometers and watches; additional chronometer watches will shortly be delivered for testing and purchase. The Observatory now has its own adjusting and repair shop with a small technical staff. The equipment includes an automatic watch rate recorder, by means of which a watch may be tested in all positions and its rate read off in a few seconds.

The Nautical Almanac. During the year, the *Nautical Almanac* for 1938 and that for 1939 have been published. The new *Air Almanac* has been published over an experimental period; from the experience gained, it will, from next January, appear in a completely new form in which the essential data required by the airman can be obtained with much greater ease. Because of the consequent increase in bulk, the *Air Almanac* for 1939 will be issued quarterly. Besides the work on these almanacs, considerable preliminary work and calculation have also been done on other publications to be issued shortly from the Office. The occultation supplement—"The Prediction and Reduction of Occultations"—was published last August and includes a complete description of the occultation machine and the new method of reduction in use at the Office. The extensive occultation predictions for 1940 have been completed.

Magnetic Observations. The mean values of the magnetic elements at Abinger for 1937 are:

Declination, West .	11° 10·4′
Horizontal intensity	0·18522
Vertical intensity .	0·43031
Inclination	66° 42·7′

During the year there were 25 magnetic disturbances reaching storm intensity, of which 3 disturbances were classified as "great storms". A La Cour magnetograph has been installed, and its value was notably illustrated by recording the extreme ranges of *D*, *H* and *V* during the exceptionally violent storm of April 16. The electrification of the railway line through Holmwood to Portsmouth has given rise to grave concern owing to the very marked disturbances of the traces during experimental running of trains. "If," the report adds, "disturbances of the same magnitude prove to be normal, when the regular service is in operation, it will be a matter for serious consideration whether the further continuance of magnetic work at Abinger is justifiable."

Meteorological Observations. For the twelve months ending April 30, 1938, the mean temperature was 51·0° F., which is 1·5° higher than the average of seventy-five years 1841–1915. The month of March was the warmest March ever recorded at Greenwich, being 7·1° above the average. The total rainfall for the twelve months was 19·50 inches, which is 4·74 inches less than the average. Regular records for measurement of the amount of solid matter polluting the air have been continued as well as the measurement of the gaseous pollution of the air by sulphur dioxide. At one time, during the period November 25–28, the amount of solid matter reached 4·4 milligrams per cubic metre, that is, about 7 lb. in the volume of air contained in a cube with one hundred yards edge.

In his concluding remarks, the Astronomer Royal referred to the long series of observations made with the Airy Transit Circle—the fundamental instrument of the Royal Observatory for more than eighty-seven years. More star transits have been obtained with this instrument than with any other meridian instrument. The Prime Meridian Conference which met at Washington in 1884 recommended the adoption of the meridian passing through the centre of this instrument as the initial meridian for longitude. Even if no further observations are made with the Airy Transit Circle, it will be retained in its present position because of its historical interest.

Staff changes include the resignation of Dr. R. v. d. R. Woolley to take up the appointments of chief assistant at the University Observatory, Cambridge, and John Couch Adams astronomer in the University of Cambridge; the resignation of Mr. W. M. H. Greaves to take up the appointments of Astronomer Royal for Scotland and professor of astronomy in the University of Edinburgh; and the retirement of Mr. C. R. Davidson after more than forty-one years of service at the Observatory. Dr. Woolley has been succeeded by Dr. R. d'E. Atkinson and Mr. Davidson by Dr. A. Hunter. Miss F. M. McBain has been appointed assistant and Mr. W. E. Candler temporary assistant at the Nautical Almanac Office.

Tides of the British Seas*

WHILE the tides generated by the sun and moon in an ocean covering the whole earth uniformly would be relatively simple in form, the actual tides are very much complicated by the distribution of the continental land masses and the irregular coast-lines.

The tides of the British seas are largely derived from the tides generated in the Atlantic Ocean. As the tidal wave enters a shallower channel like the English Channel its speed is reduced and its range increased. Consequently in the seas about the British Isles there is a larger range of tide than there is in mid-Atlantic.

The earth's rotation has a considerable influence upon the form of the tidal wave. A wave running up a straight non-rotating channel with parallel sides and uniform depth would have its crests straight across the channel and of uniform height. If, however, the channel is made to rotate, the wave crests, while still straight across the channel, are no longer of uniform height, but are higher on one bank than on the other. Similarly the troughs are deeper on one bank than on the other. When the direction of propagation of the wave is reversed, the phenomenon is reversed, the higher end of each crest being now on the opposite bank. This is roughly exemplified in the English Channel, where the tidal ranges are higher on the French side than those on the English side; and in the St. George's Channel, where the tidal ranges are higher on the Welsh coast than on the Irish coast.

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* Substance of a lecture by Prof G. R. Goldsborough, F.R.S., to the Newcastle-on-Tyne Astronomical Society, delivered on March 3.

The phenomenon becomes still more interesting when, in the rotating channel, there are two sets of waves proceeding in opposite directions. The effect of uniting the two waves which will have the higher part of their crests on opposite shores is to produce a set of amphidromic points. These are points at which there is no tidal rise and fall of the water level. The points are (under uniform conditions) placed at equal distances down the centre line of the channel. Leading from each amphidromic point is a tidal crest which sweeps round the amphidromic point rather like the hand of a clock (though not necessarily straight) in the period of the tidal oscillation. The channel is thus divided up into separate, independent and similar systems. The tidal range increases as we pass from the amphidromic point outwards along the tidal crest.

The main amphidromic point in the North Sea is over the Dogger Bank, and the tidal crest sweeps down the English coast from north to south and then up the Belgian coast from south to north. A modification is made by the existence of a smaller system of the same kind in the Flemish Bight.

Similar phenomena are found in the English Channel though the amphidromic point is in Wiltshire; and in St. George's Channel where the amphidromic point is in Wexford.

Referring to the effect of wind in altering the mean water level, both theory and observation show that the wind blowing steadily along the surface of the open sea causes a surface drift of the water in a direction inclined at 45° to the right of the wind in the northern hemisphere and a general drift at 90° to the right of the wind direction. In the southern hemisphere the corresponding effects are 45° and 90° to the left of the wind direction. The combination of a strong north-west wind with the perigean tides affords an explanation of the recent flooding of the East Anglian coasts.

Child Nutrition

A NORTHUMBERLAND and Durham Conference on Child Nutrition, organized by the Children's Minimum Council, was held in Newcastle-on-Tyne on May 14. Prof. V. H. Mottram, professor of physiology in King's College of Household and Social Science, University of London, who was one of the principal speakers, posed five questions to which the scientific nutrition expert should be able to give unequivocal answers: namely,

(1) What is meant by an adequate diet?

(2) What is the minimal cost of such a diet?

(3) Is the cheapest adequate diet either dietetically or psychologically possible?

(4) Even if this diet of minimal cost were practicable, could everyone afford it?

(5) Is there indisputable evidence that many children are not able to get adequate nourishment?

In his answer to the first question, Prof. Mottram covered dietetic ground familiar to most readers of NATURE. He stressed in particular the value of milk and fruit as sources of the 'protective' factors of diet. The cheapest diet containing all the necessary constituents in adequate amounts and proper proportions consists of cheese, coarse brown bread and raw cabbage. This would entail no cooking and very little preparation, but would be neither easy to eat nor very digestible. One must consider not only the theoretical value of a diet as purchased but also its 'availability', satiety value and psychological effect. Hunger may be the best sauce, but monotony drives appetite away.

Even so, this primitive and unappetizing pabulum (one dare not dignify it with the title of diet) would cost at least 4/9 per 'man' per week, a sum beyond the purse of more than a tenth of the population of Britain. That is, from purely *theoretical* considerations many people are markedly underfed, while many more—about two fifths to one half—must have dietaries lacking in some of the so-called protective foods. There is no difficulty about the supply of sufficient energy-giving foodstuffs. Calories are cheap—a thousand for a penny—but vitamin-containing foods are relatively expensive.

Is there, however, *actual* evidence of under-nutrition? Nutrition has been given a wider connotation in medical literature than in common speech, which from the point of view of the man-in-the-street is a pity as undefined terms or terms used to cover various meanings lead, and in this instance have led, to bitter wrangling. Using the common meaning of the word, evidence can be produced that malnutrition is too common to be neglected if we wish for a fit nation now or in the immediate future. For example, some 25 per cent of the children in or around London suffer from a lack of a fat-soluble vitamin derived from milk, butter, carrots, etc. This is shown by defective vision in twilight. Even university students, because of the absence of citrous fruit and/or fresh meat in their diet, have been known to show the signs of latent scurvy or even actual scorbutic gums. Lady Mellanby has demonstrated that bad teeth in children were to a great extent due to a low intake of the vitamin D complex found in summer milk and butter.

To some extent, these defects are being overcome by the provision of school meals and milk in schools, and by the provision of cheap or free milk to necessitous nursing mothers and their infants. There is, however, no service to cover the gap between the infant welfare period and the school age. During these three years, irreparable damage may be done. "The schools", said Prof. Mottram, "start with damaged goods". The process of repair is more costly than proper building and, as Lady Mellanby has proved for teeth, 'repair' generally means covering up shoddy material and jerry building with layers of good material. No matter how soundly this later building may be done, the whole structure is rotten at the core.

Miss Rathbone, M.P. for the Northern Universities, urged that immediate action should be taken to remedy this state of affairs, and dealt with the various reasons why schemes at present in operation are only partially effective.

D. B.

Science News a Century Ago

An Unsuccessful Induction Experiment

On June 5, 1838, Faraday made one of his unsuccessful experiments. He experimented, as he tells us in his Diary, "with the view of finding some action on insulating dielectrics analogous to the currents by induction produced in conducting bodies". The arrangement of his apparatus is not without interest, for it is very reminiscent of that used in the famous experiment of August 29, 1831, when he made the discovery of electro-magnetic induction. He had "a ring of iron in form of a cylinder" of two inches external diameter, upon which was wound "80 feet of silked copper wire". The ends of this coil were connected to "a voltaic battery of 10 prs. of 4 inch plates, Wollaston's double coppers, well excited", which was to supply the inducing current.

Little cylindrical cores of shellac and sulphur, with disks of tinfoil pasted to the ends as contacts, were placed within the iron ring, and connected by wires to a galvanometer at some distance. The wires connecting the inducing coil to the battery were then alternately connected and disconnected. At first there seemed to be a deflection of the galvanometer, but it was found to be spurious, and traced to direct magnetic action of the iron ring on the galvanometer needle. After a number of trials, no inductive effect of any kind could be detected with any of the dielectric cores, and Faraday's concluding entry for the day was: "So I cannot thus find any action on insulating bodies analogous to those which occur in conducting bodies: no transverse induction."

The Ashmolean Society

At a meeting of the Ashmolean Society, Oxford, on June 11, 1838, one of the papers read was by Mr. P. Duncan, of New College, who gave some notes on the Columbidæ. These birds, he said, arranged by Cuvier under the order Gallinæ, may be considered as a link between the Gallinaceous and Passerine birds. Only one genus of them has been recognized, which is divided into three sub-genera, according to the relative strength of the bill and proportions of the feet.

There are upwards of 100 species—15 of the Gallinaceous pigeons, 86 of the ordinary and 10 of the Vinago. None of the division Vinago have been found in Europe, North Asia or either of the Americas. The pigeons with the slender bills are not found in Europe, where the most prevalent variety are the common pigeons with moderate bills. The Gallinaceous, distinguished by their short and robust bills, are found in Africa, the islands of the Indian Archipelago and the South Sea and in New Holland. It is to the pigeon that the multiplication of the nutmeg-tree is referred, as they do not digest the seeds of certain fruits. The Nicobar pigeon is distinguished for its brilliant plumage; it runs along the ground and builds its nest like a partridge; it inhabits Sumatra. Of the ordinary pigeons the ring pigeon is the largest and is migratory; they prefer larch to beech or oak woods. The stock pigeon has an affinity to the former kind but they fly in larger flocks and emigrate about October. The author of this paper, Philip Bury Duncan (1772–1863), was keeper of the Ashmolean Museum from 1826 until 1855.

St. John Long's Liniment

At a meeting of the Medico-Botanical Society on June 13, 1838, reported in the *Lancet* of June 30, Dr. Macreight described the composition of the liniment used by the notorious quack St. John Long, the secret of which was sold for £10,000. Dr. Macreight and Mr. Fownes found on analysis of the liniment that it consisted of oil of turpentine and acetic acid held in suspension by yolk of egg. Dr. Macreight said that he had employed the liniment pretty extensively during the last month and found the results consequent on its application exactly the same as from Long's, the effects being what might be naturally expected from any moderate stimulus applied to the skin with dextrous manipulations. Dr. Macreight attributed the successful results obtained by St. John Long partly to legerdemain and partly to the principle that when a substance does not act as a corrodant the surface will ultimately become accustomed to it.

Dinner to Sir John Herschel

On May 17, 1838, Sir John Herschel arrived in England after his four years sojourn at the Cape of Good Hope, and on June 15 he was entertained to dinner in London. The Duke of Sussex presided, and among the four hundred persons present were a large number of noblemen and eminent men of science. In proposing Sir John's health the Duke said: "Prompted by filial duty, and wishing to establish in perpetuity the fame and character of his father—an inheritance which no revolution but nature itself can destroy—he lent himself to what he thought his duty—abandoned his country and his countrymen, left friends behind, took friends with him. He did all this, I say, for the purpose of establishing his father's fame, and recording to posterity the merits of a man whose name, I trust, never will, and never can be forgotten!" At the conclusion of his speech, the Duke presented Herschel with a fine vase. Replying to the toast, Herschel said: "Perhaps it may be expected of me, that I should say something of what I have done among the Southern stars . . . I believe there is scarcely a corner in that part of the southern sky which I have not twice searched over, with almost the power of a microscope, and it may be easily supposed in the course of a rummage of that kind what an extraordinary turn out there must have been".

Biot on Polarized Light

In the *Athenæum* of June 16, 1838, is a note which says: "M. Biot in a memoir read to the Academy of Sciences, proposes the application of polarized light to detect the variations in isomerical substances; among several instances this distinguished philosopher adduces, gum arabic, which when dissolved in water gives a rotation of molecules to the left, but in applying sulphuric acid, this rotation gradually changes to the right, while a precipitate is found at the bottom of the vessel which contains it. M. Biot suggests the test of polarized light to all chemical combinations as opening a new and extensive field of the most delicate observations. Would it have been believed, says M. B., some years back that the impressions produced by the vibrations of a musical instrument on liquids in motion, should be the best means of evincing the physical mode of operation by which their flowing is operated."

Societies and Academies

London

Royal Society (*Proc.*, A, 166, May 19, 1938).

T. H. Havelock : The lift and moment on a flat plate in a stream of finite width.

J. de Graaff Hunter : Some experimental observations for longitude made by theodolite fitted with a shutter eyepiece.

L. Landau and G. Rumer : The cascade theory of electronic showers.

W. Cochrane : Polish on metals.

H. G. Howell and N. Coulson : The spectrum of thallium chloride.

F. Hoyle : β-Transitions in a coulomb field.

A. C. B. Lovell : The electrical conductivity of thin metallic films. (3) Alkali films with the properties of the normal metal.

P. L. Kapur and R. Peierls : The dispersion formula for nuclear reactions.

G. S. Rushbrooke : A note on Guggenheim's theory of strictly regular binary liquid mixtures.

Alex Müller : The dielectric polarization of a long chain ketone at constant volume and variable temperature.

Dublin

Royal Dublin Society, April 26.

G. F. Mitchell : A recent bog-flow in County Wicklow.

A. G. G. Leonard : A preliminary account of investigations on atmospheric pollution in Dublin. Systematic measurements of deposited solids have been carried out for the first three months of this year, and show that the solid matter falling on Leinster Lawn (Dublin City South) was deposited at the rate of 50 tons per square mile in that time. This included about 17 cwt. of tar. The rainfall during the period was 3·94 in.—an exceptionally low figure. Measurements of suspended impurity have been made hourly during February and March; the results obtained show a close approximation to those found at Westminster during winter months. Pollution due to sulphur showed a slight decrease from January to March.

Paris

Academy of Sciences, April 11 (*C.R.*, 206, 1153–1206).

Henri Deslandres : The universal constant of band spectra. The attribution of the lines of the band to causes other than the rotation of the molecule.

Georges Giraud : New extension of a type of problems relating to equations of the elliptic type.

Marcel Brelot : The problem of Dirichlet and sub-harmonic functions.

Boris Germansky : The systems of Fekete points of an arc of a circle.

Léopold Escande : New theoretical researches on flow through an immersed gate valve.

Mme. Marguerite Moreau-Hanot : The transport of ions by a gaseous current. The expansion of an ionized gaseous column.

Hans von Halban, jun. : The energy and intensity of the photoneutrons of beryllium and of deuton.

Roger Servant and Belling Tsaï : A direct reading apparatus for the measurement of magnetic fields.

Pierre Lambert and Jean Lecomte : The infrared absorption spectra of isomeric fatty hydrocarbons. Data are given for two isomeric pentanes and 17 isomeric octanes. The infra-red absorption spectra between 500 and 1,450 cm.$^{-1}$ can be utilized for the identification of the hydrocarbons in mixtures.

Marcus Brützcus : The structural formulæ of unsaturated hydrocarbons.

Etienne Canals and Pierre Peyrot : The Raman spectra of some crystalline powders.

Louis Roger : The study of a complex compound of lead and lithium iodides.

Maurice Marie Janot and Robert Goutarel : Corynantheine.

Denis Duveen : Anionotropic changes of the (+) and (−) α-phenylallyl alcohols.

Conrad Kilian and Xavier Langlois : The discovery of a sea urchin of Cretaceous age (middle or upper) in the Enneri Chelemma at the northern Touareg-Tebou borders of the French Sahara.

André Eichhorn. The caryological study of some species of *Phaseolus*.

Jacques Roi : Some colonies of Eurasiatic remains at the stage of *Quercus ilex* (eastern Mediterranean region).

Philippe L'Héritier and Georges Teissier : A peculiar hereditary mechanism in *Drosophila*.

Paul Ancel and Paul Wintemberger : The determinism of bilateral symmetry in the egg of vertebrates.

Albert Peyron, André Bonnard and Bernard Lafay : The gemellary or parasitic origin of tumours with multiple tissues in the sacro-coccygian region.

François Artigas : The emission of an ionizing radiation by the dry material of plants.

Paulo de Berredo Carneiro : The active principles of curare.

Jean Chevé : The properties of a meningococcic endotoxin obtained by the method of A. Boivin.

Capetown

Royal Society of South Africa, April 20.

J. W. C. Gunn : Therapeutics, past and present.

W. S. S. Ladell : Effect of alcohol and alcoholic extracts on growth of tissues *in vitro*.

J. F. Schofield : A preliminary study of the prehistoric beads of the Northern Transvaal and Natal.

F. Rich : Some Transvaal desmids.

Geneva

Society of Physics and Natural History, March 17.

René de Saussure : The structure of geometries in Euclidian space of three dimensions. The author gives an account summarizing his works on geometry published in the "Archives des sciences physiques et naturelles" of Geneva from 1898 to 1921. These works have led to the creation of two new geometries, that of the "feuillets" and that of the "feuillets-cotés".

Georges Tiercy : The solution of the equation of the transfer of energy and the problem of radiative equilibrium. The object of this note is to establish, by a calculation different from the usual one, a known formula giving the value of the intensity of the radiation as a function of the opacity.

Georges Tiercy and Charles Golaz : The velocity of the wind as a function of the altitude. Is an approximate solution, with η constant, suitable ? This question is answered in the negative, since the solution would then contain only periodic terms, and this is not in agreement with observation.

Paul Rossier : (1) The identity of the hypotheses of Armellini and Russell on the theory of the colour index. The first assumes the constancy of the effective wave-length, the second the concentration of the sensibility of the eye on one unique wave-length. These two systems are equivalent. (2) The isodiametric curves in a Hertzsprung-Russell diagram. These curves are practically parallel straight lines.

Emile Cherbuliez and Mlle. Maria Fuld Researches on the acidolysis of esters. The study of the displacement in an ester of the acid radical by that of another acid (acidolysis) shows that the mechanism of this reaction is not that of the saponification of the ester by the traces of water always present in these substances entering into reaction, a saponification which would be followed by an esterification of the free acid added by the alcohol resulting from this saponification. This conclusion follows from the fact that gaseous hydrogen chlorine, which accelerates both reactions (esterification and alcoholysis), is without action on acidolysis.

Don Zimmet : Ascorbic acid, acetylcholine and the blood pressure. Small quantities of acetylcholine produce a marked lowering of the blood pressure when this substance is introduced into the body by intravenous injection. This effect may be largely diminished or even completely prevented by subsequent intravenous injections of ascorbic acid.

Moscow

Academy of Sciences (*C.R.*, 18, No. 4–5 ; 1938).

N. W. Adamoff : A method of successive approximations.

M. Lavrentieff : Theory of tracks.

S. Halpern : Conditions under which the problem of Cauchy, for a system of equations with partial derivatives of the first order, would be correctly stated.

B. Gnedenko : Convergence of distribution laws of sums of independent quantities.

V. Kondrachov : On certain evaluations in the case of groups of functions corroborating some integral inequalities.

N. Achyeser : The best approximation of analytical functions.

M. Krein : Some points in the theory of the best approximation of periodic functions.

B. D. Kaminsky : Curves on a surface with normal constant curvature.

J. Sirvint : Integral transformations of the space *L*.

L. Neuschuler : Tables of products of minimum space.

S. M. Rytov : Transition from the wave optics to geometrical optics.

A. F. Belajev : Production of detonation in explosives under the action of thermal impulse.

M. S. Kondakowa and M. M. Katznelson : 1-propyl-2-methylvaleric acid and the 1,2 dimethylcapronic acid.

F. M. Šemiakin and A. N. Belokon : (1) New colour reactions between tetravalent cerium and salts of aromatic acids. (2) New drop reactions of vanadates and molybdates with α-nitroso-β-naphthol.

D. S. Beliankin and V. P. Ivanova : Behaviour of montmorillonite at high temperatures.

A. P. Vinogradov : Biogeochemical provinces and endemics.

W. I. Vernadsky : Terrestrial alumophosphorous and alumosulphurous analogues of kaolinic alumosilicates.

O. E. Zviagincev : Osmiridium with a cubic crystalline lattice.

S. N. Aleshin and E. Igritskaia : Availability to the plant of phosphates adsorbed by soil.

F. D. Skaskin : Concerning the physiology of the critical period. The lack of water in the soil.

V. G. Alexandrov and O. G. Alexandrova : Structure of shrivelled ('meagre') grains of hard wheat.

D. M. Steinberg : Comparative data on wing regeneration in butterflies.

Rome

National Academy of the Lincei (*Atti*, 26, 305–354 ; 1937).

U. Cisotti : Sources in disperse media.

N. Obrechkoff : Zeros of some polynomials.

G. Facciotti : Concerning the 'asphericity' at an ordinary point of a surface.

F. Fiorentini Campolieti : A particular dynamic solution of the cosmological problem (1).

G. Lampariello : Extension of Jacobi's virial theorem and relationships of minimum kinetic energy.

E. Volterra : Calculus of arched suspension bridges.

O. Zanaboni : Concerning the approximation due to de Saint-Venant's principle in isotropic prismatic solids.

E. Ghigi : Constitution of Liebermann's benzanthrone.

V. Paroli : Observations on the embryology of *Tamarix gallica* L.

Atti, 26, 355–432 ; 1937.

T. Levi-Civita : Families of isoparametric surfaces in ordinary Euclidean space.

O. Scarpa : Cathodic growths which are observed in the electrolytic refining of tin.

P. Vincensini : A class of convex functions.

C. Pauc : Triangular inequality in the generalized spaces of Minkowski.

N. Aronszajn : Some problems concerning the spaces of Minkowski and the general vectorial spaces.

F. Fiorentini Campolieti : A particular dynamic solution of the cosmological problem (2).

G. Lampariello : Substantial variations in the motion of a continuous system.

F. Tricomi : Theory of the elastic arc with a circular directrix.

G. Zanotelli : The form of the vibration of light in a medium subjected to an alternating magnetic field.

P. Guareschi : Considerations concerning molecular potential energy (1). Calculation of molecular heats of liquids (2).

G. Tedeschi : Rate of dissolution of lead in acids (3).

V. Montoro : Preferential orientation of crystallites in some abnormal deposits of electrolytic copper.

A. Corradetti : An Asiatic species of *Anopheles* found in Abyssinia (*A. dthali* Patton, 1905).

V. Puntoni : Studies of the genus *Trichosporon* Behrend.

U. Amaldi : Memorial lecture on Salvatore Pincherle.

Vienna

Academy of Sciences, January 27.

S. Meyer: Radioactive constants of uranium and radium.

H. Hausner: (1) Relation between irradiation and photosynthesis in *Elodea densa*. Empirical formulæ are given for the gas evolution as a function of the duration of illumination and for the rate of evolution of gas as a function of the intensity of illumination. (2) Variation of the production of oxygen with the intensity of illumination in photosynthesis by *Elodea densa*. The percentage of oxygen in the evolved gas increases steadily with the intensity of illumination.

E. Melan: Distribution of stress in a Mises-Hencky continuum.

K. Graff: Selective absorption in the neighbourhood of Cassiopeia. The existence of one, or possibly two, absorbing clouds is deduced from the variation of colour excess with distance. The density of the cloud shows that it is not gaseous, but dust-like.

A. Kailan and F. Kunze: Action of ultra-violet light on halogen substituted fatty acids in aqueous solution. The quantum yield and dissociation constant are found for fourteen acids.

R. Skrabal: Velocity of saponification of methyl di- and tri-chloracetates.

M. Pestemer and H. Flaschka: Influence of the position of the substituent on the ultra-violet absorption of benzene chromophores (3).

Washington, D.C.

National Academy of Sciences (*Proc.*, 24, 107–164, March 15).

A. G. Steinberg and M. Abramowitz: The bar 'locus' and the $v+$ reaction in *Drosophila melanogaster*.

H. S. Jennings: Sex reaction types and their interrelations in *Paramecium bursaria* (1). Four sex reaction types have been discovered in two clones under investigation. Individuals of any one type will clot and conjugate only with individuals of the other three types. (2) Clones collected from natural habitats. Examination of clones obtained from different localities showed nine sex reaction types, falling into two independent groups the members of which do not conjugate with each other.

C. M. Osborn: Role of the melanophore-dispersing hormone of the pituitary in the colour changes of the catfish. Experiments on reactions to black, intermediate and white backgrounds of fish from which the pituitary has been removed indicate that this hormone causes about two thirds of the darkening reaction. Removal of pituitary does not inhibit colour change, but limits the range of shades the fish may assume.

W. J. Crozier, E. Wolf and Gertrud Zerrahn-Wolf: Duplexity theory of visual response in vertebrates. Plotting flicker frequency against log critical intensity for a turtle gives a smooth probability integral curve. There is no 'rod-effect' hump shown by similar curves obtained with other vertebrates, and this fact is correlated with the absence of rod cells from the retina of the turtle.

W. J. Crozier and A. H. Holway: Law for minimal discrimination of intensities (3). Experimental results on visual intensity discrimination support the view that the observed variations are due primarily to the fluctuating reactive capacity of the organism rather than to experimental error.

C. P. Haskins and E. V. Enzmann: Determination of the magnitude of cell 'sensitive volume' associated with the white-eye mutation in X-rayed *Drosophila* (3). Plotting percentage of affected eyes against duration of irradiation with a single wave-length of X-rays at 4°, 26° and 46° C. gives for males a straight line. That for females is different. The minimum limiting volume of a single locus for white eye is found to vary from $1\cdot 09 \times 10^{-18}$ to $1\cdot 50 \times 10^{-18}$ c.c. at 4° and 46° respectively.

W. J. Robbins and F. Kavanagh: Specificity of (1) pyrimidine and (2) thiazole for *Phycomyces Blakesleeanus*.

H. Shapley: Problem of the expanding universe. A discussion of a survey of the galaxies to the eighteenth magnitude in the south galactic polar cap, from plates made with the 24-inch Bruce doublet at Bloemfontein, and other data, leads to the view that there is, at present, no need to dispute on the grounds of nebular counts the attribution of red-shift to recession.

G. Birkhoff. Dependent probabilities and spaces (1).

E. Hille: Semi-groups of transformations in Hilbert space.

M. Ward and R. P. Dilworth: Residuated lattices.

Forthcoming Events

Wednesday, June 15

Board of Greenkeeping Research, at 10.—Annual Conference and opening of the Permanent Implement Exhibition at the St. Ives Research Station, Bingley, Yorkshire.

Thursday, June 16

Royal Society, at 4.30.—Prof. C. K. Ingold, F.R.S.: "The Structure of Benzene" (Bakerian Lecture).

International Conference of Naval Architects and Marine Engineers, June 16–18. To be held in London.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Headmaster of the Schofield Technical Institute, Mexborough—E. B. Stockdale, Education Office, Mexborough (June 18).

Assistant in Electrical Engineering in the Stockton-on-Tees Technical School—The Director of Education, Shire Hall, Durham (June 17)

Two Lecturers in the Civil and Mechanical Engineering Department of the Woolwich Polytechnic, London, S.E 18—The Secretary (June 17).

Lecturer in Metallurgy in the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3—The Principal (June 18).

Lecturer in Chemistry in the Acton Technical College, High Street, W.3—The Principal (June 24).

Assistant in Statistical Research in the University of Cambridge—The Secretary, Faculty of Economics, Marshall Library, Downing Street, Cambridge (June 27).

Junior Scientific Officer at the Building Research Station, Garston—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (June 27—quote J. 38/6).

Teacher of Metallurgy in the Medway Technical College—The District Education Officer, Fort Pitt House, New Road, Rochester (June 30).

Principal of the Municipal College of Technology, Manchester—The Director of Education, Education Offices, Deansgate, Manchester, 3 (June 30).

Assistant Lecturer in Organic Chemistry in the Manchester Municipal College of Technology—The Registrar (July 11).

Plant Physiologist and a Plant Pathologist to the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (July 15)

Professor of Physiology and a Professor of Pure Mathematics in the University of Cape Town—The Secretary, South Africa House, Trafalgar Square, London, W C.2 (July 23).

Senior Lecturer in Electrical Engineering in the County Technical College, Mansfield—The Principal.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Zoological Society of Scotland. Popular Official Guide to the Scottish Zoological Park. By T. H. Gillespie. Twelfth edition. Pp. 120+1 map. (Edinburgh. Zoological Society of Scotland.) [175

Report of the Hydrographer of the Navy on the Surveys carried out by H.M. Naval Surveying Service and on the Work of the Hydrographic Department for the Year 1937. (H D 330) Pp. 9. (London Admiralty.) [175

Ministry of Health. Departmental Committee on the Cost of Hospitals and other Public Buildings. Final Report. Pp. vi+121. (London: H M. Stationery Office) 2*s* net. [185

Board of Education: Science Museum. Report of the Advisory Council for the Year 1937. Pp. 47+8 plates. (London: H.M. Stationery Office.) 1*s*. 3*d* net. [195

Institution of Gas Engineers. 75th Annual General Meeting, London, 31st May to 3rd June 1938. Communication No. 177: Official Programme. Pp. 16. Communication No. 178: 75th Annual Report and Accounts of the Council of the Institution of Gas Engineers. Pp. 44. (London: Institution of Gas Engineers.) [195

University of Oxford: Committee for Advanced Studies. Abstracts of Dissertations for the Degree of Doctor of Philosophy. Vol. 10 (Dissertations accepted during 1937). Pp. v+277. (Oxford: Clarendon Press; London: Oxford University Press) 3*s*. net. [195

Scientific Journal of the Royal College of Science. Vol. 8: Containing Papers read during the Session 1937–1938 before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society. Pp 93. (London: Edward Arnold and Co.) 7*s*. 6*d*. [205

Amgueddfa Genedlaethol Cymru (National Museum of Wales). Coal in Science and in Industry: Handbook to a temporary Exhibition, May to October 1938. By Dr. F J. North Pp. 18. (Cardiff: National Museum of Wales) 2*d*. [235

Rubber and Agriculture. Special Series, Bulletin A: Report on Pneumatic Tyred Carts and other Equipment in Use on the University of Reading Farm, at Sonning-on-Thames. By Prof. Robert Rae. Pp. 16. (London: British Rubber Publicity Association.) [235

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1938. Pp. 64+6 plates. (Edinburgh: Zoological Society of Scotland.) [235

Freshwater Biological Association of the British Empire. Sixth Annual Report for the Year ending 31st March 1938, including Reports of Council and Director, Articles on Research, Subscription List and Accounts for 1937–38, with Lists of Officers and Staff for 1938–39. Pp. 74+2 plates. (Ambleside: Freshwater Biological Association.) 1*s*. [255

Institution of Gas Engineers. 75th Annual General Meeting, London, 31st May to 3rd June, 1938. Communication No. 179: Presidential Address. By Harold C. Smith Pp. 24. Communication No. 180: Considerations upon the Processing of Coal By E. V. Evans. Pp. 40. 2*s*. (London. Institution of Gas Engineers.) [305

Seale-Hayne Agricultural College, Newton Abbot, Devon. Department of Plant Pathology. Pamphlet No. 48: Fourteenth Annual Report for the Year-ending September 30th, 1937. Pp. 48. (Newton Abbot: Seale-Hayne Agricultural College.) [305

Iron and Steel Institute. Special Report No. 21: Fifth Report of the Corrosion Committee. Being a Report by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation to the Iron and Steel Industrial Research Council. Pp. xviii+448+28 plates. (London: Iron and Steel Institute.) 16*s*. [305

Town Planning Institute. Report of the National Survey and National Planning Committee. Pp. iii+36. (London. Town Planning Institute.) 1*s*. [305

Royal Meteorological Society. Bibliography of Meteorological Literature Prepared by the Royal Meteorological Society, with the collaboration of the Meteorological Office. Vol. 4, No. 4 (July–December, 1937). Pp. ii+171–233. (London: Royal Meteorological Society.) 2*s*. 6*d*. [305

Other Countries

U.S. Department of Agriculture. Circular No. 455: The Toxicity of *Haplophyton Cimicidum* A DC to Fruitflies. By C. C. Plummer. Pp. 11. (Washington, D.C.: Government Printing Office.) 5 cents. [175

Annalen van de Sterrewacht te Leiden. Deel 18, Stuk 1: A Catalogue of Fundamental Declinations derived from Azimuth Observations at a Station on the Earth's Equator. By C. H. Hins and G. van Herk. Pp. 79+4 plates. (Leiden: Sterrewacht.) [175

Suomen Geodeettisen Laitoksen Julkaisuja: Veroffentlichungen des Finnischen Geodätischen Institutes. No. 25: Über die nivellitische Refraktion. Von T. J. Kukkamäki. Pp. 48. (Helsinki: Finnische Geodätische Institut.) [175

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Philosophy of World Affairs

THE impressive appeal for national unity which Mr. Eden uttered at the annual banquet of the Royal Society of St. George contained many passages which should appeal particularly to the scientific worker. Recalling the rectorial address at St. Andrews in 1934 in which General Smuts emphasized the threat to freedom and self-government even then offered by the new experiments on the Continent, and pleading for freedom not as an abstract political ideal but as a creative force inspiring youth to noble action, Mr. Eden reminded his audience that to uphold our ideals and our conception of life called for an effort and a spirit comparable with that made by the totalitarian States for their own purposes. For our faith in freedom, in toleration, in justice, the rule of law and co-operation, we should be prepared to make every contribution in our favour.

The threat to freedom of thought and speech and action grows ever greater, and the danger to-day is that in those countries which cherish liberty and democracy, the organization of defence and a common front against aggression itself tends to develop threats to freedom, which are more insidious even if closely allied to those encountered in the totalitarian State itself.

This factor, to which Walter Lippmann directed attention in his striking book "The Good Society", renders it imperative that the common effort called for from the democratic nations shall have a moral basis. This is not only the surest corrective to the insidious tendency to love "bondage with ease than strenuous liberty", but also the firmest basis for national unity.

There are no two opinions as to the supreme importance of promoting international understanding and good will, nor at the present time as to the importance of rearmament. On all sides, any policy which will lead to an appeasement of national jealousies and relieve political tension is welcomed. It is another question, however, if the expedients adopted prove obstacles in the way of that mutual trust and respect for treaty obligations in the dealings of civilized peoples with one another, upon which alone, as the Covenant of the League proclaims, relations of justice and good will can be permanently established.

The internal success of the totalitarian States has already exposed very clearly their limitations and provoked serious doubts as to how much can be hoped for from planning even in a democratic State. It is not the least service of Walter Lippmann's study of collectivism that he shows clearly its dangers even in a democratic regime. Lippmann indeed contends that planning is impossible in a true democracy, and that it depends on the authoritarian principle, which is a rejection of the wisdom of experience and the acceptance of errors which previous generations had learnt to discard.

Lippmann's contention, however unpalatable as it may be to most schools of political thought, contains too much truth in it to be lightly disregarded. Mankind unquestionably has advanced in knowledge, in the mastery of Nature, in unity, and in personal security through a progressive emancipation from the bondage of authority, monopoly and special privilege. The scientific achievements which have confronted us with some of our acutest difficulties to-day, and which by some are regarded as compelling the establishment of authority, even as they extend its power and range, have indeed become possible only as scientific inquiry was emancipated from authority. Scientific workers already have before them uncomfortable examples of the decay of scientific thought under the authoritarian regime.

If it is by the removal of restraints, rather than by constraints, as Lippmann suggests, that men have been able to adapt themselves to the life of great societies, there is none the less no more vital problem confronting democracy than the selection of just those constraints which are essential to its security without endangering the freedom from which its vitality springs. Because to plan every detail, as in the totalitarian State, means death to individuality and progress, we are not to assume that planning has no place in a democracy. No municipality, no rural or urban community, could avoid disaster for long without some manifestation of the foresight and prevision implicit in the idea of planning. Water supply, food supply, health, transport, and even recreation, all demand a quantitative conception of the needs of a community, and an organized attempt to meet those needs.

What therefore is demanded that our planning shall have some conception of man's spiritual needs, some regard to moral values and be based on co-operation and legislation rather than command. It is the type and purpose of our planning that are vital, and the tragedy of to-day is that the effort being made to eliminate waste, to conserve national resources and to meet national needs, is so often dominated by ideas and purposes that threaten world disaster and violate the moral and spiritual needs of mankind.

Nowhere is this truer than in the international sphere, and Senor de Madariaga's recently published outline of a world commonwealth vividly attests this truth. The most urgent task, as he sees it, is to teach world opinion to appreciate that the only way out of chaos is to lay the foundation for a world community which might establish enduring peace, the inner nature of which is justice. Nationally, as internationally, the problem is fundamentally one of education. When all the resources of the totalitarian State are directed to the mass education of its citizens for nationalist purposes and individuality is warped or crushed, the chief hope of civilization lies in the education of public opinion elsewhere to the need for and possibilities of world co-operation, and in a way which may yet win the consent of the totalitarian regimes themselves.

Effective thinking on the part of the individual voter is indeed the final condition of success, and the realization that there are no longer foreign affairs but only world affairs, that it is now the world that matters and not merely those foreigners who do not belong. Even ministers of world affairs cannot solve the problems raised by those affairs unless and until they combine in a permanent system for carrying them on by constituting, either in the present League of Nations, a reformed League, or a different League, a world council for foreign affairs, which must have behind it, to be effective, a powerful élite of world citizens endowed with the necessary world patriotism to give these world statesmen their inspiration and guidance.

That is essentially the argument of Senor de Madariaga in both his books, whether as in "The World's Design" he is outlining his vision of a world commonwealth or, in "Theory and Practice in International Relations"*, discussing its practicability. Nor is his outlook unhopeful. The mere existence of a machinery of world government in the League is a symbol of unity around which much may coalesce. Senor de Madariaga points also to other factors accelerating progress—the success already achieved in international co-operation in those fields such as health and communications, where the professional interest in getting the problem solved is dominant: the slow creation of a community spirit: the moral pride which makes nations compete for the place of the most virtuous at least in international assemblies.

However threatening the situation may be, it is at least not one for despair, and it throws down a challenge not least to scientific workers. They must make their contribution to the evolution of a philosophy of world affairs in which the elements of competition, co-ordination and organization are brought into a more intelligent and co-ordinated synthesis, which preserves man's moral and intellectual freedom while ministering to his material needs. They have their professional contribution to make in special fields involved in the positive planning visualized by Senor de Madariaga, such as the establishment of a world administration for mandated territories, a world bank and a world trade commission. On them rests the responsibility for much of that research in social problems upon which such co-ordination must be based, and they can at least play a part in the education of their fellows to a vision of world affairs, the consideration of problems from the point of view of an organized and conscious mankind. The ethical declaration for the times recently issued (see

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* Theory and Practice in International Relations. By Salvador de Madariaga. (The William J. Cooper Foundation Lectures 1937, Swarthmore College.) Pp. v+105. (London: Oxford University Press, 1937.) 6s. net.

NATURE, May 7) appears at a timely moment, and claims the allegiance and active support of all scientific workers. All that is noblest in the tradition of science urges them to make their contribution to the primary spiritual problem of creating a historical consciousness of mankind as organized dwellers of the earth and the methodical expression of it in a world State. For only as the method and energy of intelligent mankind bring order into the present chaos of man's activities can their great heritage of truth, justice, toleration and liberty be preserved for mankind.

Science in the Service of Man

Science for the Citizen: a Self-Educator based on the Social Background of Scientific Discovery. By Lancelot Hogben. (Primers for the Age of Plenty.) Pp. 1120. (London: G. Allen and Unwin, Ltd., 1938.) 12*s*. 6*d*. net.

THIS is no ordinary book. Like its predecessor, "Mathematics for the Million", it is a portent of a new understanding and a new purpose in science. We have had in plenty popular expositions of scientific discoveries; we have had attempts at the analysis of the history of science; we have had essays on its social implications; here we have all three together. They gain immensely from being presented as a unity and worked out by a single mind. In this new primer of one thousand pages, Prof. Hogben sets out to teach, to chronicle and to preach the gospel of science.

In his first main purpose, Prof. Hogben succeeds admirably. The presentation of science to the layman has rarely been at the same time so attractive and so comprehensive. Here the unity of conception of the work, the idea of science in the service of humanity, has led to an admirable balance between different branches of science, and has even succeeded in presenting science without the division into set subjects that has been the curse of its teaching throughout the last century and a half. The simplicity and directness of the explanations, and Horrabin's numerous and attractive figures, should ensure for it an even greater popularity and usefulness than had "Mathematics for the Million". The very fact that science is not presented as an explanation of the wonders of the universe but as a means to practical handling of everyday necessities should give it a wide appeal to young and active minds. In one respect, however, there is a relapse towards the older tradition of teaching. The chapters are followed by examples for working out, which are bookwork and calculations and not experiments. The audience for which Prof. Hogben is writing will surely want to do things and not only to work them out on paper.

Quite apart from its other values, "Science for the Citizen" would have to be read for the account it presents of the history of science. Here Prof. Hogben is following the modern tradition of relating the developments of science to social needs. In doing so he has given a new life and a new meaning to the records of the past and made sense of what was before merely a catalogue of mental achievements. For example, the great biological developments of the nineteenth century, the idea of evolution and the discovery of the mechanism of heredity seem no longer isolated advances but part of a renewed interest in the biological and mineral resources of the world, which were opened up by the new means of the industrial revolution, and of the need to improve stocks of animals and plants for the benefit of rapidly growing populations. Necessarily the account is abbreviated and selective, but it contains much new material and will set all scientific workers thinking of how much more needs to be done to make the history of their own fields something alive and able to point the way to future discoveries.

Prof. Hogben distinguishes clearly between three factors in the advance of science: the opportunity, the means and the motive. The opportunity lies in the social circumstances of the time, which are propitious or not to the advance of science; the means are those practical and material techniques drawn from industry or from other parts of science, without which research is impossible; the motives determine the setting of the problem and the concentration of the scientist's attention on it.

> "Whether we choose to call it pure or applied, the story of science is not something apart from the common life of mankind. What we call pure science only thrives when the contemporary social structure is capable of making full use of its teaching, furnishing it with new problems for solution and equipping it with new instruments for solving them. Without printing there would have been little demand for spectacles; without spectacles neither telescope nor microscope; without these the finite velocity of light, the annual parallax of the stars, and the micro-organisms of fermentation processes and disease would never have been known to science. Without the pendulum clock

and the projectile there would have been no dynamics nor theory of sound. Without the dynamics of the pendulum and projectile, no Principia. Without deep-shaft mining in the sixteenth century, when abundant slave labour was no longer to hand, there would have been no social urge to study air pressure, ventilation and explosion. Balloons would not have been invented, chemistry would have barely surpassed the level reached in the third millennium B.C., and the conditions for discovering the electric current would have been lacking" (page 17).

It is, however, in the moral he draws from the study of present and past science that Prof. Hogben is at his best. In his own vigorous and inimitable style, he attacks what seem to him to be the enemies of both science and humanity, and points the way to effective social utilization of the results of science. To him, now as in the past, one of the chief enemies of science has been the use of deductive logic from self-evident principles. This legacy of Aristotle, which the physical sciences have managed to shake off, still hampers and distorts the social sciences and particularly the vital social science of economics.

"The past history of human culture shows that a high level of scientific attainment in isolated fields has flourished when men have been forced to bring their beliefs to the bar of fact and use them as recipes of social conduct. That the social sciences have not passed out of the stage from which the natural sciences were emerging in the time of Kepler is sufficiently evident from the following exposition of 'The Nature and Significance of Economic Science' by Prof. Robbins, which ends: 'In the last analysis, therefore, our proposition rests upon deductions which are implicit in our initial definition of the subject matter of Economic Science as a whole.'

"This passage briefly summarises every attitude to knowledge discarded by the natural sciences in reaching the prestige they now enjoy. The natural sciences owe their prestige to the fact that they provide man with the means of regulating his social conduct. They are able to do this because science rests on a wholesome distrust of logic, except in so far as the results of a logical process are tested continually by return to the real world" (pages 217–218).

The other enemy is introspective mysticism, the denial of the possibility of dealing in practice with the forces of Nature and society.

"The story of man's conquest of Substance and of Power will make it clear that we have reached a situation in which social machinery can no longer accommodate rapid advance in discovering the material amenities which science confers. We are thus faced with two alternatives. One is to devise the social machinery which will ensure the further progress of science by finding social uses for new discoveries. The other is to discredit confidence in the fact-loving method of science. This can be done most effectively by surrounding the work of the scientific investigator with an air of mystery, so that he fulfils the role of the first men of science in human history. The ancient calendar priests were the first scientists and the first civil servants. They ceased to be scientists as they aspired to become masters. The world tires of its masters and finds a growing need for efficient civil servants. So we may hope that the adventure of human knowledge will survive all the efforts to reinstate mysticism in the present period of cultural decay" (page 349).

Behind these two evils he sees the self-interest and greed of ruling minorities, who rather than lose their position will hold back the benefits which science could give to humanity.

"Science for the Citizen" avoids conventional divisions; it follows an order which is neither strictly that of subject nor that of time. It tends to deal first with the simpler mathematical and mechanical sciences and then leads through chemistry to biology. At the same time it tells the story of man's increasing understanding and control over Nature from the beginning of calendar lore at the dawn of history through the conquest of power and matter in the last century, to the beginning of the understanding of our bodies and our society in our own days.

The book is divided into five parts. The first: the conquest of time reckoning and space measurement, covers astronomy, mechanics and optics. For the first time, positional astronomy is presented with the full richness of its social background, and we understand why this apparently remote subject was of such practical and vital interest. One may wonder, however, whether Prof. Hogben's attempt to bring back "the use of globes" into teaching will be successful. These things were important, but for the ordinary city dweller of to-day the stars might just as well not exist.

The second section: the conquest of substitutes, tells the history of chemistry. It does full justice to the great revolution of the eighteenth century, which arising from the needs of the technical problems of the miner and cloth worker, laid the basis of our knowledge of chemistry. It traces the laying of the mysterious 'spirits,' through the operations of which men could escape from thinking concretely about material processes. It is, nevertheless, the least satisfactory part of the book, and the chapter on organic chemistry might well be rewritten in future editions, because though a competent account, it appears in its setting definitely dull.

The section on the conquest of power tells the story of the steam engine and electricity, and does it very well. The ideas of work and energy are fundamentally industrial and economic ideas; to understand them we need to call up again, as Prof. Hogben has done, the atmosphere of enterprising capitalism of the industrial revolution. It is, however, in the next section, the conquest of hunger and disease, that Prof. Hogben really comes into his own. Its two hundred pages are a triumph in the presentation of the whole of biology. Physiology, heredity and evolution fall naturally into their places, and the balance of the different aspects of the subject is well preserved.

In the last section, the conquest of behaviour, Prof. Hogben discusses psychology and the problem of nature and nurture, and draws his social conclusions in a final chapter which would stand by itself as an exposition of the modern outlook of the scientific worker.

Scarcely any scientific worker will agree with everything that is in this book; many will disagree violently with a great deal of it. It offers an easy target to detailed criticism, but most of this criticism will be beside the point. When a man is trying to do something that has been done before we may justifiably say it is well or badly done, but when he is doing something that has never been done before, the important thing is the actual creation, not the defects in it: afterwards, other people may avoid the mistakes and manage things better, the essential thing is to make the first attempt. The very novelty of the task that Prof. Hogben has attempted imposes its own limitations. It would be impossible for him to be equally successful over the whole field; certain parts are definitely weak, in others personal prejudices and predilections would seem to distort judgment. It is a pity that in spite of the several hands through which the manuscript has been, a large number of errors should remain in the text and in the illustrations. Most of them, it is true, are trivial, but one or two of them show that Prof. Hogben has not quite succeeded in the superhuman task of making all science his province.

The historical interpretation is the most difficult to appraise justly because here no one is in possession of enough of the facts, and the inevitable selection gives a definite bias to the work. It would seem to the reviewer, for example, that the importance of chemistry has been consistently underrated. Another more general criticism is the absence, except in the case of genetics, of any account of modern science and particularly of the revolution in physical science of the present century, which in the light of history will probably seem more important than those of the seventeenth and nineteenth centuries. It is true that this revolution has not made its effect felt in practice, but the absence of any mention of it gives the whole book an unexpectedly old-fashioned appearance. On the social side it would seem questionable to the reviewer that it is possible to achieve a rationally run society by the abandonment of localization of industry and by the social control of new industries alone. We are a long way yet from the time when every portion of the earth's surface might have equal natural potentialities or when heavy industries, coal, iron and power, will have ceased to be the keystone of the productive system.

It is made apparent throughout the book that it is the present system that is holding us back. On the kind of system that is needed to replace it Prof. Hogben is equally clear, but on how to get it he has very little to say, perhaps advisedly. The problem has been set; it is for the citizens rather than the men of science to solve it.

"Science for the Citizen" is full of new and suggestive ideas. No scientific worker after reading it can avoid looking at his work in a different way. It does not treat of deep philosophical questions, but instead gives us clear and practical directions, much more congenial to the English mind. These few sentences express plainly what chapters of learned works will find difficult to conceal:

> "Science is not a photographic picture of the real world which exists independently of our views about it, and will continue to exist when we are no longer part of it. It is an ordnance map which guides us in finding our way in it" (page 329).

> "The truths of science are recipes for human action, and science flourishes when it is actively ministering to social needs. It advances conspicuously in periods when men and women are actively engaged in rational endeavour to change their social environment, and is held back when those who participate in it are too anxious to find rationalisations for privilege or political strategy" (page 1057).

These ideas have been too much neglected in the past; it is for us to understand them and make use of them in planning science in the future, a science that can no longer proceed consciously indifferent to its potentialities for human welfare and the need to realize that potentiality.

> "During the past century scientific knowledge has created new potentials of social organisation vastly in excess of anything for which the political education of mankind is prepared. Seventy years ago it was still possible to discuss whether poverty was morally tolerable or materially inevitable. It was still possible to discuss whether war was spiritually edifying or socially escapable. All this

is changed. Poverty in the sense in which it was then defined, the sense in which the word is intelligible to the social biologist, is not materially inevitable. War is not a moral picnic. It threatens to destroy the entire fabric of our civilisation, if we do not eradicate it with as much promptitude and ruthlessness as we have eradicated, or are eradicating, smallpox, malaria, and yellow fever" (page 1081).

Science is a part, and an essential part, of the great struggle in which we are all willy-nilly now engaged. It has something definite to offer, something which, in his conclusion, Prof. Hogben calls the New Social Contract.

"Advancing scientific knowledge has swept away many beliefs which sustained popular aspirations in the formative stages of modern democracy. . . . In their place modern science offers us a NEW SOCIAL CONTRACT. The social contract of scientific humanism is the recognition that the sufficient basis for rational co-operation between citizens is scientific investigation of the common needs of mankind, a scientific inventory of resources available for satisfying them, and a realistic survey of how modern social institutions contribute to or militate against human needs" (page 1089).

We may or may not like this book, but we cannot deny that it raises issues which we all have to face. J. D. B.

Plant Viruses and their Hosts

A Textbook of Plant Virus Diseases
By Dr. Kenneth M. Smith. Pp. x + 615. (London: J. and A. Churchill, Ltd., 1937.) 21*s*.

DR. KENNETH SMITH, having written an earlier volume upon the physiology and general behaviour of plant viruses, has recently completed another book with a pronounced taxonomic flavour. It is here possible to obtain, for the first time, a detailed conspectus of the whole number of plant viruses known at present.

One gratifying feature is that plant viruses are arranged upon a plan of classification which has already reached a considerable degree of success in the hands of Prof. James Johnson of Wisconsin University. Dr. Smith uses a slight modification of the Johnson classification, and employs the scientific generic name of the host, followed by a number, to denote a particular plant virus. Thus 'Nicotiana Virus 1' is the disease formerly known as tobacco mosaic. A list of synonyms is given for each disease, and the text is somewhat of the calibre of a critical fungus flora, in so far as it crystallizes one definite name from a number of varying designations. It is delightful to be guided among the formerly bewildering potato viruses by so sure a hand, and the relations of virus maladies upon tobacco and tomato also become clearer. Properties of each virus are given in relation to external physical and biological agents, to various methods of transmission, and to particle size. The diseases caused by the particular virus are described for the various host plants, and Hutchinson's classification is used both for this and in the general arrangement of the volume.

An appendix, which gives the most characteristic symptoms of virus diseases, is arranged alphabetically by the names of the hosts, and should be particularly valuable for general diagnosis. A chapter upon the insect vectors of plant viruses describes the various species, with all the resources of Dr. Smith's specialist work, and includes notes upon life-histories and geographical distribution. More than a hundred plates embellish the volume, and the author has enlisted the co-operation of numerous research workers in many parts of the world, to provide adequate pictorial representation of the subject. The extensive references to published work are further evidence for the completeness of knowledge collected in the present volume.

A text-book is usually an exposition of a science already organized; a portrayal of clarified thought which has withstood the test of continual teaching. Dr. Kenneth Smith's book actually does the organizing and performs the clarifying. It does more; for it provides a framework into which future results may be fitted. The scheme of classification is already sufficiently accepted by research workers in plant viruses, and is backed in the present volume by a wealth of description. It would seem inadvisable for any research worker to depart from it until the time shall have arrived when it will be possible to give each virus a more satisfactory binomial nomenclature. There is also, at the present time, sufficient information upon virus diseases of plants collected into volumes which are readily available, so that the subject might well enjoy a new popularity with the profession of teaching. Viruses are economically of greater importance, as causal agents of plant diseases, than are bacteria, and the volume under review removes the last excuse for a somewhat neglected exposition to students. J. G.

Biography of Madame Curie

Madame Curie
By Eve Curie. Translated by Vincent Sheean. Pp. xii + 411 + 31 plates. (London: William Heinemann, Ltd., 1938.) 18*s.* net.

INTERESTED as we are in the sources of scientific creation, we must welcome the appearance of a book which is a touching example of filial piety and at the same time an excellent biography of one of the most eminent scientific workers of our epoch. It has considerable artistic and documentary value. I think it gives a fairly complete answer to the question how it could happen that a young girl from a foreign country was called to acquire a fame which made her name a symbol, and to become a leading scientific personality not only in her native and adopted country, but also throughout the world. In fact the book tells us of national, social and hereditary factors which contributed to the formation and development of the exceptional gifts of Mme. Curie's mind and character.

Very few of those who admire this great woman realize that in the second half of the past century women played a great part in Poland. Strange to say, this fact was due to the loss of independence and severe conditions imposed by the Russian domination. Political thought and national feeling were for the most part compressed into family life, with the result that women were often equal to men in assuming full civic responsibility. Another consequence was a great movement towards 'emancipation' and university education for women. Young girls often went abroad to study at a university. This tendency would certainly not be opposed in the highly cultivated Skłodowski's family where all told young Manya of the value of intellectual effort. The moral atmosphere was that of strenuous work, of sense of duty, of patriotism. Strength of will was her inborn quality—the photographs show it clearly on her "stubborn face"—but the experiences of her childhood and youth, the early necessity of earning her living as a governess, hammered this good material and made her a rare example of endurance and tenacity. The following fact illustrates the spirit of self-sacrifice which reigned in this family. When Bronya, the older sister, went to Paris to study medicine, the younger one helped her with money saved from her meagre salary and patiently awaited her own turn. When it came at last, she studied with passion, living confined in the "icy garret", ignoring world and pleasure. What moved her was the desire to be useful to her family, the faith in her abilities and something specifically Polish: ambition fed by the love for her country.

There is scarcely any other scientist's life which shows in such a striking way how great achievements in science are due to the association of moral and intellectual qualities. Of course it was remarkable scientific insight to conceive the idea of radioactivity as an atomic property, but the actual discovery of radium—and what was perhaps more difficult, its purification from two tons of ore—conducted in the famous shed in the worst conditions one can imagine, were only possible owing to the incredible tenacity of this delicate woman; and we still see this strength of will throughout Mme. Curie's later life. Her resolution to face the gravest responsibilities immediately after Pierre Curie's death, that terrible tragedy which might have broken even a strong man's nature, attained to heroism. No less heroic were her activities during the Great War, when moved perhaps by some ancestral influences, she organized, careless of danger, the then neglected X-ray examination of wounded soldiers both behind and practically in the lines of the French armies. Who could fail to admire her continual struggle against illness, the firm decision to work up to the last moment? One might say that she was taken almost directly from the laboratory to her deathbed.

All these facts belong perhaps more to the *vie romancée* than to a scientist's biography. But in Mme. Curie's life romance was mixed with science. When we read Mlle. Eve Curie's book, the beautiful account of the great days spent by the Curies at work, of their holidays, of misery and glory, we do not know what comes first: a story of love or of one of the greatest scientific discoveries of our times. Of the later scientific activity of Mme. Curie, the book tells us not as much as we might desire. This is not a reproach: Mlle. Curie is an extremely intelligent person and a brilliant writer, but she is not directly interested in science. A scientist is, after all, a human being and we want to know how race, milieu, physical and spiritual constitution show themselves in his life and activity.

I have watched Mme. Curie's work for years, but never understood it as well as after reading Eve Curie's book. May I express to her my personal thanks, which will also be shared, as I hope, by scientific workers throughout the world.

L. WERTENSTEIN.

Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und nach ihrer Lebensweise

Begründet von Prof. Dr. Friedrich Dahl. Teil 31 und 32: Spinnentiere oder Arachnoidea. vii: Wassermilben oder Hydracarina (Hydrachnellæ und Halacaridæ). (1) Pp. x+288. 24 gold marks. (2) Pp. 289–574. 24 gold marks. Teil 33: Spinnentiere oder Arachnoidea. viii: Gnaphosidæ, Anyphænidæ, Clubionidæ, Hahniidæ, Argyronetidæ, Theridiidæ. Pp. ii+222. 20 gold marks. (Jena: Gustav Fischer, 1937.)

THE issue under notice of this well-known work deals with six families of spiders and is more substantial than any of its predecessors in this order. It includes descriptions of 169 German species, in 39 genera, with notes on their distribution, both in Germany and elsewhere, and full dichotomic tables for their separation. The classification used is that of Petrunkevitch, 1933; for example, the water spider, *Argyroneta*, occupies a family by itself. The illustrations are a striking feature of the work. There are more than 500 clear line diagrams of genitalia and other pertinent parts, which are invaluable for purposes of identification, and many of which have never been published before. The value of the work to British readers is very great. About ninety of the species described occur in Britain, all being mentioned as so doing, and as a help in naming the species of some of our most important families, this work far surpasses anything previously obtainable.

This is not so forcibly true of the two parts on water-mites, for the Ray Society publications of 1925, 1927 and 1929 have covered the same ground. Dr. Viets' work opens with thirty valuable pages on the habits of water-mites, and he also gives directions for collecting, preserving and mounting them. In the systematic portion, 441 species of German water-mites are described in 92 genera and illustrated by more than 650 clear diagrams. There is a greater uniformity of treatment here than in the part on spiders, which is the work of three contributors, but all three parts should be assured of a welcome proportionate to their undoubted value. T. H. S.

Annual Reports on the Progress of Chemistry for 1937

Vol. 34. Issued by the Chemical Society. Pp. xvi+540. (London: The Chemical Society, 1938.) 13*s*.

IN these annual reports, no attempt is made to present a comprehensive review of the year's chemical publications; to do so would result either in a volume of size so great as to defeat its purpose or in surveys so lacking in detail as to be valueless. Instead, these reports perform the much more useful and attractive service of providing a collection of "proofs of evidence by expert witnesses" concerning selected fields where researches of fundamental importance are being actively prosecuted.

The first report is devoted to radioactivity and sub-atomic phenomena. The second deals with non-radioactive isotopes, chemical kinetics, photochemistry, intermolecular forces and the properties of liquids, and electrochemistry. Inorganic chemistry is represented by chapters on sodium metaphosphates and polyphosphates, the rare earths, compounds of boron, halogen oxides, and the behaviour of elements and compounds at high pressures. Crystallography is represented by sections on lattice defects in polar crystals, crystal chemistry, the structure of liquids and amorphous solids, and molecular crystals. A report on the structure and stereochemistry of simple organic molecules is followed by others on general methods, free radicals, carbohydrates, proteins, triterpenes, heterocyclic compounds, porphyrins, and rubrenes and azulenes. There are substantial sections on animal and plant biochemistry, whilst analytical chemistry is dealt with not only from the general inorganic point of view but also in the special aspects of spectrum and of rock analysis. A. A. E.

John Locke

By Prof. R. I. Aaron. (Leaders of Philosophy Series.) Pp. x+328. (London: Oxford University Press, 1937.) 12*s*. 6*d*. net.

THIS excellent book on a thinker who is a classic in philosophy will give fresh impetus to discussion and controversy. It is not the first part of this work, which deals adequately with Locke's life, or the third part, where we find a good summary of Locke's views on moral philosophy, political theory, education and religion, which may be a ground of dissent; but rather the second part, which deals with the central points of Locke's psychology and systemology. The author's interpretation of the term 'idea', for one thing, scarcely helps to set one's mind at ease about Locke's meaning of this term. There is also the disturbing view that "we now find Locke asserting that sensation is itself knowledge for we know in it the existence of things" (p. 244), which is not supported by any quotations from the "Essay". The author's main purpose is to interpret Locke as a representationalist in his theory of ideas, a view which seems rather to restrict the aim and value of the "Essay". The brief reference made to Locke's views on the positive sciences are coloured by this interpretation. If this is allowed for, Prof. Aaron's book may be regarded as a notable addition to philosophical scholarship. T. G.

Sur les autres mondes

Par Lucien Rudaux. Pp. vi+222+20 plates. (Paris: Libr. Larousse, 1937.)

THIS work is a comprehensive and detailed account of the sun, moon and planets, intended for the general reader. The author adopts the historical method and leads the reader gradually to an up-to-date picture of each of the bodies concerned, with a carefully planned exposition of planetary phenomena. M. Rudaux is also a most accomplished artist and the book is profusely illustrated with diagrams and coloured plates, the latter being mainly imaginative reconstructions of the planetary and lunar scenes. As an example of his pictorial method, we may mention the aspect of Saturn and its rings as seen from one of Saturn's satellites. The author and publishers are to be congratulated on a really magnificent production. W. M. S.

Sewage Discharge and the Mersey Estuary*

Co-operation in Technical Research

THIS handsome and well-illustrated report on the Mersey estuary, which has been issued by the Department of Scientific and Industrial Research, is an example of the working of the best English tradition of co-operation in public affairs. It exhibits the Department in a part for which it is so well equipped—which it might be more often called upon to play—that of an arbiter to determine the scientific facts for the solution of a controversial problem of great public and economic importance. It shows the various public authorities of Merseyside agreeing, in spite of a conflict of interests, to co-operate in order to obtain an independent scientific inquiry; it also shows them evincing their confidence in the Department of Scientific and Industrial Research by inviting it to undertake the investigation. The Department asked the Water Pollution Research Board to be responsible for the scheme of the investigation; so, in a typically national way, another party to the co-operative work was a body of scientific men who gave honorary service.

The problem was the effect upon the estuary of the Mersey of the discharge into it of crude sewage from the large populations of Liverpool, Birkenhead and Wallasey, among others. The volume of the estuary is very great, and matters of health and amenity were not part of the inquiry. The problem was the narrower one of the effect of this discharge of sewage on the estuary as a channel of navigation. The opinion had been put forward that the presence of sewage increased the rate of sedimentation of solid matter in the water of the estuary, and by alteration of the character of the deposit increased also the difficulty of its removal by dredging. Such a possibility led naturally to some competition of interests between the corporations responsible for the sewage discharge on one hand and the authority responsible for the navigation and conservancy of the river on the other. The data for determining whether these possibilities were actualities were not available. Accordingly representatives of the various interests, after meeting in conference in 1932, decided, with admirable judgment, to ask the Department, as has already been stated, to investigate the matter and to give an authoritative pronouncement on the scientific facts. The local authorities and other authorities and companies concerned agreed to bear the costs of the inquiry, and agreed also that "on the issue of scientific fact the result of the investigation should be accepted as conclusive". The understanding come to was thus one which reflected great credit on all concerned, and was a signal mark of confidence in a Government Department. The agreed procedure, in the words of the preface, "might well be followed by others in dealing with controversial problems affecting many interests".

The investigation, which was begun in 1933 and lasted over a period of four years, consisted of a wide-reaching, hydrographical, chemical, and biological investigation of the effects of the discharge of crude sewage. The area to be studied embraced the navigable channels of Liverpool Bay, the tidal pool of the Upper Estuary—with a volume at high water of a spring tide of about 1,000 million cubic yards—and the Narrows which connect the two.

The Mersey Docks and Harbour Board has, since 1861, made quinquennial surveys of the capacity of the Upper Estuary, and its data show that during the period 1906–31 there was a decrease of about 52 million cubic yards. This reduction in capacity naturally led to the suggestion, already referred to, that the presence of sewage had been responsible, by bringing about a deposit of mud of such a consistency that it was not eroded by the tidal stream. In order to investigate this possibility, the records of hydrographical surveys of the Mersey made by the Mersey Docks and Harbour Board were examined, with other hydrographical data, to determine the positions and levels in the Estuary at which accretion and erosion had occurred during this period. The quantities and nature of the sewage and principal trade wastes discharged into the estuary were ascertained, the concentration of polluting substances in the estuary water under different tidal conditions was determined, and an estimate was made of the length of time spent by polluting substances in the estuary before passing out to sea. The concentration of mud and silt eroded by the tide from the bed and foreshore of the estuary and carried in suspension in the moving water was also determined.

Numerous laboratory experiments were then made to observe the effect of sewage on the rate of sedimentation of mud and silt under conditions similar to those which occur in the estuary. The factors studied included the concentration and state of division of the solids, the depth of water through which sedimentation occurred, the temperature and salinity of the water, and the effect of the addition of different proportions of sewage and of suspensions of bacteria derived from sewage. In some series of experiments before the rate of sedimentation of the solids was measured, samples of saline water containing mud and sewage in suspension, were stirred at different speeds, thus reproducing the conditions in the estuary, where water containing silt, mud and sewage-solids in suspension is carried to and fro by the tide.

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* Estuary of the River Mersey. The Effect of the Discharge of Crude Sewage into the Estuary of the River Mersey on the Amount and Hardness of the Deposit in the Estuary. (Department of Scientific and Industrial Research. Water Pollution Research: Technical Paper No. 7.) Pp. xvii+337+8 plates. (London: H.M. Stationery Office, 1938.) 30s. net.

Numerous samples of mud and other solid matter for examination were collected from different parts of the Upper Estuary of the Mersey and from Liverpool Bay. For comparison, samples were also collected from relatively unpolluted estuaries and marshes in Norfolk, Suffolk, Essex, Devon, Monmouth, Cheshire and Lancashire, from the Firth of Tay in Scotland, Lough Foyle in the north of Ireland, from estuaries in Eire, and from the bed of the Irish Sea. The concentration of organic matter and the principal inorganic constituents were determined by analysis, and the relative resistance of the different muds to erosion by a moving stream of water was observed.

One of the most interesting results of the investigation was the conclusion that the most likely source of new mud entering the Mersey Estuary is the bed of Liverpool Bay and of the Irish Sea. As to the quantity of suspended inorganic matter contributed by the sewage, one can calculate from the volume of daily discharge (30–40 million gallons or 180,000–240,000 cubic yards) that the quantity of *inorganic* matter discharged *in a year* is less than 25,000 cubic yards, that is, less than 0·0025 per cent of the capacity of the Upper Estuary. It is also to be noted that the concentration of sewage in the estuary water is not high ; in the greater part it does not exceed 1 per cent by volume, and in no considerable volume of water does it exceed 5 per cent.

Another striking result obtained was that the concentration of organic matter in mud from the Mersey, usually less than 3 per cent, was *no higher* than that of samples of mud from the bed of the Irish Sea, from Liverpool Bay, and from *relatively unpolluted* estuaries, a number of which were examined. The composition of the mud, therefore, provides no evidence that sewage is responsible for its deposition.

The question of the precipitation or deposition of mud in the estuary was naturally of great interest, and one to which much attention was paid in the investigation. It was of course possible, as had been suggested, that there was some physical action between the suspended sewage and the suspended mud, leading to a co-precipitation of material. Elaborate experiments, first with salt water and later with the addition of sewage, were therefore undertaken on the rate of sedimentation of mud from the Stanlow Bank (which includes most of the mud in the Upper Estuary), of mud from Liverpool Bay, and also of muds from various relatively unpolluted estuaries. The result observed was that the rates of sedimentation in saline water of muds from the Stanlow Bank and from the bed of Liverpool Bay were similar, and they were on the whole rather lower than those of muds from a number of unpolluted estuaries. There was thus no evidence that in water without sewage the Mersey muds precipitated more rapidly.

The observations on the effect of sewage on the rate of sedimentation were of especial interest ; they indicate the importance of carrying out such studies under a wide range of conditions if erroneous conclusions are to be avoided. With small depths of fall, the addition of 5 per cent of crude sewage gave a slight but definite increase in the rate of sedimentation. When, however, the sedimentation was followed in columns of 40 ft., the sewage had no effect, although it is to be noted the concentration employed was far higher than that occurring in the estuary. The explanation appears to lie in the state of aggregation of the mud. In settling through such considerable depths as 40 ft., the mud aggregates into large clots with so high a consequent rate of settling that the effect of the sewage becomes negligible. That these conditions apply in the Mersey was shown by the observation that mud carried during the run of the tide in the estuary is generally in the form of large aggregates ; similar aggregates were found for the mud carried in suspension by the water of the comparatively unpolluted estuaries of the Rivers Suir and Barrow.

The question of the ease of erosion of Mersey muds was carefully investigated and from several aspects, though, as has already been stated, the most likely source of any large quantity of new mud which may enter the Upper Estuary is the bed of Liverpool Bay and the Irish Sea. There appeared to be little erosion of mud from the surface of the banks in the Upper Estuary, since these are mostly more than 20 ft. above Liverpool Bay Datum level and so are covered only near high water when the stream velocity is low. Considerable erosion often takes place, however, from vertical faces of a mud bank exposed to the full force of the tidal stream. By the use of a suitable laboratory method the 'erodibility' of mud from different sources was compared, with the result that with Mersey mud the resistance to erosion is *slightly less* than that of mud from estuaries in Suffolk and Essex which are comparatively unpolluted.

The data of dredging operations point in the same direction as studies of mud erosion. Dredging of the sea channels in Liverpool Bay has been carried on since 1880 and records of the operations are available. Those of two dredgers for the period 1909–35 were examined in detail, but the returns gave no evidence of any increase in the difficulty of dredging during those years.

With regard to the changes in capacity of the Upper Estuary; the report accepts the values put forward by the Mersey Docks and Harbour Board. The surveys by the Board show that between 1871 and 1886 the capacity rose by 48 million cubic yards, that is, by 5 per cent. Between 1886 and 1891 it declined by 5·5 per cent of the former value, but rose again in 1906; between that year and 1926 there was a loss of 5·2 per cent. The survey of 1936 shows an increase of capacity over 1931, the decrease on the 1906 value being only 4 per cent. The capacity was approximately the same in 1936 as in 1871, 1891 and 1916, so that the changes do not indicate any regular decrease in capacity with time, such as would be expected from a gradually increasing discharge of sewage.

Finally, results most illuminating for the points at issue were obtained by a consideration of the losses of capacity at different *horizontal* levels, and also of the distribution of mud and of sand. Half the loss of capacity was due to deposits below the level of Liverpool Bay Datum (L.B.D.), and only about 10 per cent to deposits above a level of 20 ft. above L.B.D. Mud, however, is found almost entirely on banks of a height greater than 20 ft. above L.B.D.; banks of lower height are comprised almost entirely of sand. It is thus plain that reduction of capacity does not coincide with the present distribution of *mud* banks.

From the report, it is thus evident that the answer to the question proposed needs no balancing of conflicting evidence. Converging lines of testimony have been drawn from (*a*) the amount of inorganic matter brought into the estuary from sewage, (*b*) the concentration of organic matter in the mud, (*c*) the effect of sewage upon the composition and rate of sedimentation of mud in the condition of suspension in which it is found in the water of the estuary, (*d*) the resistance to erosion of mud from the Mersey in comparison with that of muds from relatively unpolluted estuaries, (*e*) a comparison of the reduction of capacity in different parts of the estuary with the distribution of mud and sand. All these give an unequivocal negative to the question as to whether the discharge of crude sewage has had any effect on the amount and hardness of the deposit in the estuary.

This study of the Mersey Estuary should long stand as a classic one in the field of applied science, not only for the width and scope of the investigation but also for the decisiveness of its results and the civic importance of its findings. Its origin makes it a shining example to other public authorities who may similarly find themselves faced with controversial problems which can be solved by scientific analysis.

The Hebrew Technical Institute, Haifa*

THE Hebrew Technical Institute in Haifa is the centre of technical training and research for the young Jewish community in Palestine. Hebrew is the language of instruction, but the college is open to all, making no distinction of race or creed; and a few Palestine Arabs have availed themselves of this opportunity. The curriculum is extensive, and includes courses leading to university degrees in the technical college proper (500 students), a trade school for training skilled artisans and foremen (250 pupils), special vocational training classes for refugees, courses for agricultural workers, and evening classes. At present there are about a thousand students altogether; examinations are held under the supervision, and with the help of, the Palestine Government. The Institute was founded about thirty years ago; but, owing to the Great War, did not begin its academic work until 1924. Its progress offers an opportunity for the study of the effect of colonization on the development of an educational institution.

Colonization in Palestine does not mean the establishment of foreign trading stations on the coast-line, but the building up of a new national life in all its branches and with all its implications, in a limited area, and under the pressure of thousands of families from the countries of middle and eastern Europe forced to immigrate for economic, social or political reasons. The Jews left Palestine about two thousand years ago and can only return in larger numbers if, both in agriculture and in industry, they make the utmost use of the advances of pure and applied science. Owing to social prejudices and to legal restrictions imposed upon them by the people among whom they lived, the Jews were, for many centuries,

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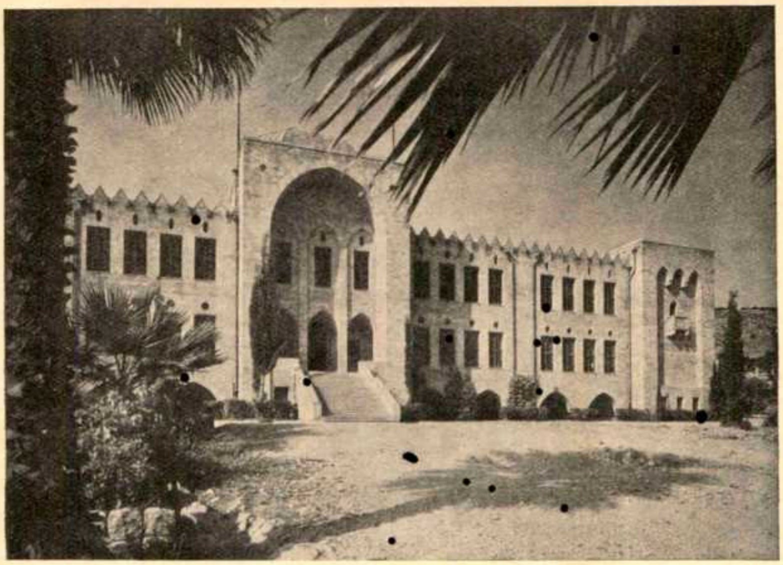
* A booklet "The Hebrew Technical Institute, Haifa; Its Achievements and its Aims (Haifa, 1938)" has just been published and will be sent, free of charge, on application to the Secretary of the Institute, P.O.B. 910, Haifa (Palestine), or to the Hon. Sec. of the Auxiliary Group of the H.T.I., (Mrs.) B. Buckman, 21 Willow Road, London, N.W.3.



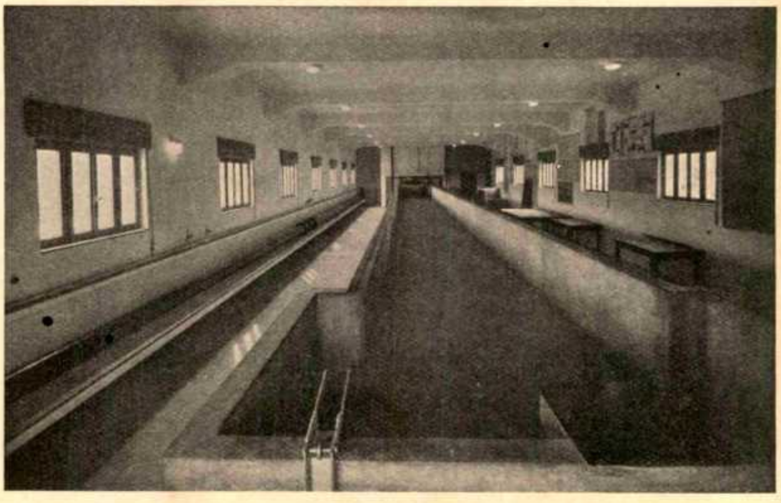
THE HEBREW TECHNICAL INSTITUTE, MAIN BUILDING

debarred from agriculture, trades and professions. In some eastern European countries, these laws were rescinded less than twenty years ago. They have to learn many things anew, and it is difficult to overestimate the importance of technical training in their return to the Holy Land. That they are capable and willing to learn, and that they have not lost their old vigour and enterprise is shown by such examples as the improved production of Jaffa oranges, the introduction of reinforced concrete in the construction of roads and buildings, the electrification of Palestine, and the extraction of potash, bromine and other chemical products from the Dead Sea.

When Jews first returned to Palestine in larger numbers, their first requirements were communication between settlements, houses to live in, reclamation of land, drainage of swamps, provision for water supplies, drainage of towns and villages, and the means of intensive agriculture. Therefore, the two departments first developed in the Technical College proper were those of civil engineering and architecture. With the further development of industry, a third, the Department of Industrial Engineering, was recently opened. This consists of two sections: one for electro-mechanical engineering, and one for chemical technology. The staff of this third department was largely recruited from German-Jewish men of science during the years 1933 and 1934. There are now nine working laboratories, which are used for teaching and research, and two more are being equipped. Besides the general science laboratories, mention should be made of the building materials-testing laboratory, the hydraulics laboratory (erected with the help of the Palestine Government, and probably the finest in the Near East), the metallurgical laboratory and those for electrical and chemical technology. Some laboratories are still housed in temporary buildings, and some are not yet completely equipped. But a good beginning has been made, and this appears to guarantee the success of future developments.

The Institute has just launched a campaign for an extension fund. The increasing number of students who apply for admission necessitates the opening of new departments in order to offer a greater variety of courses. The development of industrial life calls for an extension of research work in almost all branches of exact and applied sciences. Raw materials must be tested, new processes devised, known processes revised, and methods of production developed. The College has recently decided to open post-graduate classes for a limited number of students, in connexion with the expansion of its research departments, as post-graduate studies have often been a help and a stimulus to research.

There can scarcely be a better investment for the Jewish community than to support the



EXPERIMENTAL HALL OF THE HYDRAULICS LABORATORY extension fund of this Institute, which paves the way for the development of industry in Palestine in so many directions. The Institute prides itself on being almost self-supporting. Eighty per cent of its income is derived from tuition fees and fees paid by industry for the use of the laboratories. This is a very good record for an educational institution, and a closer analysis of its income immediately shows the reason for it. Last year's budget amounted to about £20,500. If one deducts from this a non-recurrent grant from the Palestine Government (ear-marked for new buildings and equipment), the income only amounts to £17,200. This is very small for an institution in which one thousand pupils are trained: it is obviously a starvation figure and must imply either curtailing teaching or research activities or both. The outside observer concludes, with a feeling of uneasiness, that the Jews in Palestine are about to repeat the mistakes of European countries against which men of science and engineers have been fighting in recent years. It is a grave mistake to distribute the income of a community in such a way that it is impossible for scientific institutions to develop all their resources. From the point of view of the present as well as of future generations, scientific work gives by far the highest return for money spent. Considering the particular circumstances of colonization in Palestine, and the small number of scientific institutions concerned, there is no reason why they should repeat errors which are only now being overcome in Europe and America.

There is one other point worth mentioning here. The library of the Hebrew Technical Institute is the only technical library in Palestine, and is much frequented by engineers, men of science, teachers and Government officials from all over the country. Unfortunately, the English section seems to be rather small, and a large number of scientific and technical books and journals published in England are lacking. This is not to be wondered at, as anyone will know who has tried to set up a new scientific library with little money. Jews go to Palestine mainly from the Continent, but are prepared to take up English as their second language to Hebrew and to come into more intimate contact with British thought. The library of the Hebrew Technical Institute at Haifa is therefore commended to the generosity of publishers and learned societies in Great Britain.

Cosmic Rays

A DISCUSSION meeting of the Royal Society was held on May 26 on "Cosmic Rays". The discussion was opened by Prof. P. M. S. Blackett, and papers were read by Profs. P. Auger (Paris), E. Regener (Stuttgart), and J. Clay (Amsterdam). After some further specific contributions from workers in Great Britain, a general discussion followed.

It is now generally agreed that cosmic radiation, as observed at the earth's surface, consists of two components distinguished empirically by their different rates of absorption. The 'soft' component, which constitutes about 20 per cent of the total cosmic ray intensity at sea-level and is practically all absorbed at a depth of 10 m. of water below sea-level, is now believed to consist of high-energy electrons which obey Dirac's relativistic theory. The application of this theory to the emission of radiation by such electrons in nuclear collisions, and to the production of electron pairs by radiation, has in fact provided in a remarkably unforced manner a satisfactory explanation of the absorption of the soft component and the phenomenon of electron-showers which accompanies its passage through matter.

The hard or penetrating component, on which most of the discussion was centred, is of considerable interest in that it is now supposed to consist of particles of a 'new' type, possessing electronic charge but a mass greater than that of an electron and less than that of a proton, provisionally referred to as 'heavy' electrons.* This interpretation of the hard component was suggested about a year ago by Neddermeyer and Anderson on rather circumstantial grounds, but more direct evidence has since been obtained for the existence of such a particle in cosmic rays. This evidence comes from the observation, in a Wilson cloud-chamber, of tracks the ionization and curvature (in a magnetic field) of which are not consistent with electrons or protons, but indicate a particle with electronic charge and a mass about 200 times that of an electron (that is, about one tenth protonic mass).

Examples of such tracks obtained by different workers were shown during the meeting. The comparative rarity of these anomalous tracks may be attributed to the small distance the particles travel after their velocity has fallen sufficiently low to give

* That the hard and soft components consist of different kinds of particles, rather than particles all of the same kind but of different energies, was clearly put forward by Auger in 1935 (Nature, 135, 820; 1935). Auger's description of the soft component is almost identical with our present view, and for the hard component he suggested "heavy particles such as protons".

tracks with an ionization clearly distinguishable from that along tracks of the same curvature produced by electrons or protons.

In his opening address, Prof. Blackett set forth the 'birth, life and death' of the heavy electron as the main problems now awaiting solution. Prof. P. Auger described recent experiments which contribute to an understanding of the manner of their creation. In these experiments the frequency of coincident discharges of a number of counters of high resolving power (*c.* 10^{-6} sec.) is observed. The results obtained indicate the existence (in the open) of showers spread over at least 25 sq. m. and containing at least 1,000 particles. The observation of crucial interest, however, is that the particles in these showers have a range of about 15 cm. of lead. This means that the particles are of the penetrating type, that is, heavy electrons. It seems, therefore, that a whole shower of heavy electrons may be created in one act, and the experiments are consistent with the view that the heavy electrons are secondary in origin.

The heavy electrons are penetrating because, owing to their large mass, very little radiation is emitted in nuclear collisions, this emission of radiation being the process which stops high-energy electrons and gives rise to the ordinary 'cascade' showers. However, though the energy lost by the penetrating particles in traversing matter is very much less than that lost by electrons, it is yet appreciably greater than the theoretical energy loss by particles of 200 electron masses. The latter is mainly due to collisions with atomic electrons, with a small contribution from collisions with atomic nuclei. Prof. P. Auger reported measurements carried out in collaboration with P. Ehrenfrest according to which the actual loss is more than three times the theoretical value. The experiments of Blackett and Wilson require a still higher ratio. This discrepancy is of much interest and its further investigation may throw light on the properties of the new particle.

The ultimate fate of the heavy electrons is not yet clear. Comparatively few are observed with energies less than about 2×10^8 volts, suggesting their disappearance or transformation into electrons at this energy (Blackett). However, in this region the velocity of the heavy electron starts to fall appreciably below that of light, and the attendant rapid increase in ionization would in any case reduce the relative number of heavy electrons with energy much below 2×10^8 volts. No definite conclusion regarding this matter can be drawn from existing observations.

The heavy electron is not unwelcome to theoretical physicists. Such a particle was in fact envisaged by Yukawa so long ago as 1935 in order to explain the force between a proton and a neutron. Previous attempts to explain this force on the basis of electron exchange and Fermi's theory of β-decay gave results of a wrong order of magnitude. Yukawa assumed that the role of exchange was taken by a new type of particle and showed that to explain the observed force the new particle would have to be given a mass of about 200 electron masses—in remarkable agreement with the particle now found in cosmic radiation. Thus, in much the same way as the positive electron in cosmic rays bore out the predictions of Dirac's theory of negative energy states, the heavy electron bears out the crucial assumption in Yukawa's theory of nuclear forces. This theoretical aspect of the subject was dealt with by Dr. W. Heitler and Dr. H. J. Bhabha. Dr. Heitler showed how the original theory of Yukawa had to be modified to give the right dependence of the forces between a neutron and a proton on the orientation of their spins, and also showed that the mass attributed to the new particle to explain the forces also corresponds to the departures of the magnetic moments of a neutron and proton from the values required by Dirac's theory for elementary particles. Dr. Bhabha discussed the applications of the theory in the creation and behaviour of the heavy electrons in cosmic rays. In reply to a question, Sir Arthur Eddington stated that while the 'background' particle of his recent theory might be made to play the part in nuclear forces similar to that assumed in Yukawa's theory, he would not expect it to be able to exist in the free state as, for example, a cosmic ray particle.

Matters concerning the effect of the earth's magnetic field were discussed by Prof. J. Clay and Dr. E. G. Dymond. Prof. Clay finds that the line of minimum cosmic ray intensity, though always close to the magnetic equator, shows definite departures from it, and the significance of this was discussed. Another effect reported by Prof. Clay was a decrease in the intensity of the soft component of cosmic rays during a magnetic storm, indicating a disturbing current of about 10^7 amperes at two to four earth radii away. Dr. Dymond gave an account of his experiments made in collaboration with Dr. Carmichael on the variation of cosmic ray intensity with altitude in the region of the north magnetic pole (see also NATURE, **141**, 910; 1938). The agreement of the results with those of Regener in lower latitudes (49°) indicates a lower limit of about 3×10^9 volts to the energy of the cosmic ray particles in this region of the solar system. The suggestion that this cut-off is due to the sun's magnetic field is unacceptable if recent estimates of its magnetic moment are reliable. The cut-off would accordingly refer to the cosmic rays in outer space, and its cause is not yet understood.

Prof. Regener described experiments on the variation with time of the hard component. Periodic variations both with respect to solar and sidereal time are found. The former has an amplitude of 0·25 per cent, with maxima at 10^h and 22^h. The variation with sidereal time has a smaller amplitude with a maximum at about 18^h, and may be attributed to the effect of galactic motion suggested in this connexion by Compton.

While there is obviously much to be cleared up in the field of cosmic rays, the discussion left the impression that the subject is not as much in a state of confusion as it has often been in the past.

E. J. WILLIAMS.

Obituary Notices

Prof. W. Stroud

PROF. WILLIAM STROUD, chairman of the firm of Barr and Stroud, Ltd., died at the age of seventy-nine years on May 27, at Torquay.

At an unusually early age young William Stroud of Bristol entered Balliol College, Oxford. "I was confronted," he wrote, "with the problem whether I should study Latin Hexameters and Greek Iambics or devote myself to what was contemptuously called 'Stinks'." It was a lecture by Prof. Tyndall that determined his choice, and his association with the late Prof. Barr that diverted his physics to industry.

When in July, 1936, the University of Leeds bestowed upon Lord Rutherford and himself the honorary degree of D.Sc., he wrote: "There was Lord Rutherford, the most worthy representative of Pure and Sacred Physics, and here was I, the least worthy representative of Profane Physics," between which and engineering he found it difficult to discriminate, for he was both a physicist and an engineer. How to attain some superlative accuracy from available materials and machines was a question never absent from his mind. For judicious approximation—that characteristic of the skilled engineer—he had a natural gift, but he never acquired the facility in the use of the slide rule of his colleague who, he alleged, in order to multiply two by two, would set these figures on the appropriate scales and, after close scrutiny, declare the product to be 3·96 or 7.

From Balliol, Stroud proceeded to the Universities of Heidelberg and Würtzberg, where, incidentally, he acquired his habit of continuous smoking. Arthur Smithells in the Heidelberger Schloss dared him to smoke a five-pfennig cigar. The results of this unaccustomed experiment were unpleasant. "I determined," he said, "to conquer such squeamishness and eventually achieved such a triumph that up to date I must have smoked over 110,000 cigars—more than half a ton of tobacco—with much satisfaction, and three cigarettes smoked simultaneously in parallel with no satisfaction whatever."

Soon after Stroud's return to England, the Yorkshire College of Leeds in June 1885 lost, by resignation, two of its professors, Sir Edward Thorpe and Sir Arthur Rücker. His friend, Prof. Smithells, was appointed to the vacant chair of chemistry and he, at the early age of twenty-five years, succeeded Sir Arthur Rücker as Cavendish professor of physics. This chair he occupied with great distinction until 1909, when he retired in order to devote his whole attention to the rapidly expanding business he and his partner had established in Glasgow.

During his first session, Stroud thought it necessary to discourse with what he termed "the best Professional dignity he could summon to his assistance". From the results of the terminal examinations he was, however, dismayed to find "that most of the students had learned next to nothing from my lectures". "I resolved," he said, "that the Pontifical Pomposity to which I had been accustomed would be a thing of the past." How well he succeeded in teaching physics effectively with inspiring geniality will always be remembered by his many students, to whom he was affectionately known as 'Billy'.

It was at the Yorkshire College that he met the colleague of his lifetime, the late Archibald Barr, the occupant of the chair of engineering at Leeds and later at Glasgow. Their collaboration in the invention of the rangefinder and many other valuable appliances has already been recorded in the obituary of Prof. Barr (NATURE, 128, 294; 1931) and is well known. The power of assessing conditions and of rapid readjustment was an outstanding characteristic of Prof. Stroud in all his activities, whether physical, practical or financial, for in all these spheres he was eminently successful. For any problem his penetrating mind would produce not merely one but several solutions and each with its variations. His letters from Leeds abound with coloured sketches of diagrams and mechanisms and such expressions as "Undoubtedly this is the way to do it.—A still better way is this—". "Try turning the mechanism inside out." Gifted with eloquence, he was sparing of unnecessary words. Invariably his letters ended with "Y.v.t., W.S."

By his death, science and industry have lost a very great man. JAMES WEIR FRENCH.

Dr. C. C. Edgar

WE regret to record the sudden death of Dr. Campbell Cowan Edgar, distinguished as an authority in Egyptian archæology, which took place on May 10 at Berkhamsted.

Dr. Edgar, who was of Scottish extraction, entered Oriel College as a scholar in 1891, and later was attached to the Egyptian Department of Antiquities, where he became acting head of the Musée des Antiquités in Cairo. He contributed a large number of articles to the "Catalogue Général des Antiquités Egyptiennes du Musée du Caire", dealing with the development of various aspects of Greek art and culture, more especially under the influence of its Egyptian environment. By these studies he came to be recognized as one of the first authorities on the culture of Græco-Roman Egypt. His knowledge and reputation marked him out as well fitted, notwithstanding his lack of specialized training, to undertake the editing of the Zenon archive, an extensive collection of papyri found at Darb-el-Gerza (Philadelphia) in the Fayum, which had been acquired from time to time by the Cairo Museum. A selection published in the "Annales du Service" was speedily and widely accepted as authoritative, and fully justified his selection for the task. This verdict was confirmed by the four volumes afterwards published by him in the "Catalogue Général". Detailed knowledge of the second Ptolemy's scheme of land development in the Fayum is largely due to Edgar's commentary.

On his retirement, Edgar continued his papyrological work and was associated with the late Dr. A. S. Hunt in his work on the Tebtunis papyri. He had also undertaken the editing of the portions of the Zenon papyri in the possession of the University of Michigan and the Rylands Library, Manchester. He acted in an advisory capacity for Græco-Roman Egypt in the editing of the *Journal of Egyptian Archæology* and was a member of the committee of the Egypt Exploration Society. His services to papyrology and Egyptian archæology received the recognition of the honorary degree of Litt.D. from the University of Dublin.

WE regret to announce the following deaths:

Prof. W. A. Bone, F.R.S., formerly professor of chemical technology in the Imperial College of Science and Technology, on June 11, aged sixty-seven years.

Mr. B. D. Burtt, survey botanist in the Department of Tsetse Research, Tanganyika Territory, on June 8.

Mr. M. J. R. Dunstan, O.B.E., principal of the South-Eastern Agricultural College, Wye, in 1902–22, and of the Royal Agricultural College, Cirencester, in 1922–27, on May 28, aged seventy-four years.

Dr. W. W. Campbell, For. Mem. R.S., president of the University of California in 1923–30, director of the Lick Observatory in 1901–30, on June 14, aged seventy-six years.

Mr. A. W. Shorter, assistant keeper of the Department of Egyptian and Assyrian Antiquities in the British Museum, on May 31, aged thirty-two years.

Dr. Sinclair Smith, physicist at the Mount Wilson Observatory, on May 18, aged thirty-nine years.

Mr. C. F. M. Swynnerton, C.M.G., director of tsetse research in Tanganyika Territory, on June 8, aged sixty years.

News and Views

King's Birthday Honours List

THE list of Birthday Honours conferred by H.M. the King includes the names of the following men of science and others associated with scientific work: *Order of Merit:* Sir Arthur Eddington. *Baron:* Sir Josiah Stamp. *Baronets:* Major Sir William Prescott, chairman of the Metropolitan Water Board; Lieutenant-Colonel Sir Archibald Weigall, chairman of the Royal Empire Society. *G.C.M.G.:* Lord Harlech, lately Secretary of State for the Colonies. *K.C.B.:* Sir Cyril Hurcomb, chairman of the Electricity Commission. *K.B.E.:* Prof. T. H. Easterfield, formerly director of the Cawthron Institute of Scientific Research, New Zealand; Sir Samuel Hordern, president of the Royal Agricultural Society, New South Wales; Mr. A. W. Street, First Deputy Under-Secretary of State, Air Ministry, lately Second Secretary, Ministry of Agriculture and Fisheries. *Knights Bachelor:* Mr. W. G. Ball, surgeon and dean of the Medical College, St. Bartholomew's Hospital; Mr. W. A. Cosgrave, lately chief commissioner of the Andaman and Nicobar Islands; Dr. Cyril Norwood, president of St. John's College, Oxford; Mr. W. Roberts, manager of the British Cotton Growing Association Farm, Khanewal, Multan District, Punjab; Dr. R. B. Wade, president of the Medical Board, New South Wales.

C.B.: Dr. J. J. Fox, Government chemist. *C.M.G.:* Mr. G. A. Jones, commissioner of agriculture, Imperial College of Tropical Agriculture, Trinidad; Prof. A. E. V. Richardson, deputy chief executive officer, Council for Scientific and Industrial Research, Commonwealth of Australia; Mr. J. W. Spiller, chief engineer, Designs Branch, Crown Agents for the Colonies. *C.I.E.:* Lieutenant-Colonel E. H. V. Hodge, professor of medicine, Medical College, Calcutta, and first physician to the College Hospitals, Bengal; Mr. H. S. E. Stevens, secretary to the Government of Bengal in the Agriculture and Industries Department, Bengal; Mr. T. A. Whitehead, chief conservator of forests, Madras. *C.B.E.:* Mr. H. Bishop, assistant chief engineer, British Broadcasting Corporation; Mr. W. W. Henderson, director of veterinary services, Nigeria; Dr. Elizabeth Hurdon, lately director of medical services and research, Marie Curie Hospital, Hampstead; Prof. B. Melvill Jones, Francis Mond professor of aeronautical engineering, University of Cambridge; Mr. E. J.

Wayland, director of geological survey, Uganda; Mr. E. B. Wedmore, director and secretary, British Electrical and Allied Industries Research Association.

O.B.E.: Dr. N. Ahmad, director of the Technological Laboratory, Matunga, Bombay; Lieutenant-Colonel Ambuj Nath Bose, professor of pathology, Prince of Wales' Medical College, Patna, Bihar; Dr. G. Bryce, assistant director of agriculture, Nigeria; Mr. J. W. Cassels, director of agriculture, County Durham; Dr. S. E. Chandler, principal of the Plant and Animal Products Department, Imperial Institute; Mr. P. M. Cooper, chairman of Water Commission, Jamaica; Mr. H. M. Gardner, conservator of forests, Kenya; Prof. R. M. Gordon, director of Sir A. L. Jones Research Laboratory, Freetown, Sierra Leone; Mr. A. P. F. Hamilton, deputy conservator of forests, Hoshiarpur Siwaliks, Punjab; Dr. R. B. Jackson, malariologist, Medical Department, Hong-Kong; Mr. A. R. Lambert, inspector, Plant Observation Section, Gezira Agricultural Research Service, Sudan Government; Mr. H. G. Mundy, secretary, Department of Agriculture and Lands, Southern Rhodesia; Mr. R. O'F. Oakley, principal, Department of Scientific and Industrial Research; Mr. D. Robinson, superintending examiner, Patent Office, Board of Trade; Captain J. C. A. Roseveare, chief drainage engineer, Ministry of Agriculture and Fisheries; Mr. B. S. Smith, superintending scientist, Anti-Submarine Establishment, Portland; Dr. A. W. Turner, senior bacteriologist, Animal Health Division, Council for Scientific and Industrial Research, Commonwealth of Australia; Mr. A. E. White, principal of Shrewsbury Technical College; Mr. D. W. Young, deputy surveyor of the New Forest, Forestry Commission. *M.B.E.*: M. R. Ry. Krishnaswami Ayyar Ramayya Avargal, paddy specialist at the Agricultural College and Research Institute, Coimbatore, Madras; Mr. H. L. Dutta, deputy director of agriculture, Orissa; Mr. W. G. Leckie, senior agricultural officer, Kenya; Dr. S. K. Mitra, professor of physics, University of Calcutta; Mr. C. H. Norton, district commissioner, British Guiana; Mr. V. P. Sondhi, geologist, Geological Survey of India. *I.S.O.*: Mr. F. Jenner, district commissioner, Basutoland; Mr. A. Percival, surveyor-general and chief property officer, Department of the Interior, Commonwealth of Australia; Mr. A. H. D. le P. Trench, senior coffee officer, Kenya.

Sir Arthur Eddington, O.M., F.R.S.

THE appointment of Sir Arthur Eddington by His Majesty the King to the Order of Merit will be warmly acclaimed by scientific workers in every corner of the globe as a fitting reward for a series of remarkable achievements in the realms of astronomy and theoretical physics. Senior wrangler and fellow of Trinity College, Cambridge, Eddington entered the scientific world, as chief assistant at the Royal Observatory, Greenwich, at the beginning of a new epoch in astronomy; Kapteyn had made his discovery of star-streaming in 1904 and within a few months Eddington contributed his first important investigation on this subject, to be followed in 1910 by his classic treatment of the proper motions of the naked-eye stars. In 1913, Eddington succeeded Sir George Darwin in the Plumian chair of astronomy at Cambridge, and in 1914 he was appointed director of the Cambridge Observatory in succession to Sir Robert Ball. Between 1913 and 1915, Eddington published several outstanding papers on the dynamics of stellar systems, which are still unsurpassed as models of mathematical elegance and astronomical insight. Relativity and the internal constitution of the stars next, and almost simultaneously, claimed his attention. In the former subject he is recognized, next to Einstein himself, as the foremost authority and investigator. The latter subject is of his own creation and has attracted many of the most eminent astronomers to a fruitful field of research. Within recent years, Eddington's researches have been devoted to the theory of the expansion of the universe and to the interrelation of quantum mechanics and relativity. Eddington's scientific influence is world-wide; his mathematical books are standard works; his popular books have brought delight and understanding to innumerable readers, scientific workers and laymen alike, and have influenced in a remarkable way the currents of recent philosophical thought.

Prof. E. S. Goodrich, F.R.S.

ON June 21, Prof. E. S. Goodrich celebrates his seventieth birthday, in honour of which he is being presented with a volume of "Essays on Evolution" by his colleagues and pupils. Starting his career at University College, London, he followed Sir Ray Lankester to Oxford in 1891, where he has occupied the Linacre chair of zoology and comparative anatomy since 1921. His contributions to zoology, and especially to morphology, are too well known to require detailed enumeration here. Mention should, however, be made of his classical researches on the nephridia and genital ducts, the Stonesfield mammals, the auditory ossicles, the segmentation of the vertebrate head, his general work on the structure and development of vertebrates, and his interpretative studies of the problems of homology, heredity, development and evolution. It is to be noted further that by his work and his teaching he has preserved and encouraged interest in the problem of form, which, now that experimental methods are available for biological studies, is more essential than ever as a starting-point and an objective for research in the newest branches of biology. We offer Prof. Goodrich our most sincere congratulations.

Prof. Irvine Masson, M.B.E.

As announced elsewhere in this issue (p. 1112) Prof. Irvine Masson has been elected to the office of vice-chancellor of the University of Sheffield, which is about to become vacant owing to the retirement of Dr. A. W. Pickard-Cambridge. Prof. Masson was born in 1887, the son of the late Sir David Orme Masson, vice-chancellor of the University of Melbourne, and grandson of Prof. David Masson, the well-known professor of English at Edinburgh. He has been professor of chemistry and head of the Department of Pure Science in the University of Durham since 1924. He was educated at Melbourne

Grammar School, the University of Melbourne, the University of Edinburgh, and the University of London, and is a doctor of science of the University of Melbourne. He was lecturer and reader in chemistry at University College, London, before and after the Great War, while in 1915–19 he was at the Research Department, Royal Arsenal, Woolwich. From 1921 until 1924 Prof. Masson was secretary of the Chemical Society, and he was a member of the Senate of the University of Durham in 1930–36. He is a member of the Council of the Institute of Chemistry and of the Council of the Universities' Bureau. He gave the Alexander Pedler Lecture of the British Science Guild in 1931, when he spoke on "Problems in the National Teaching of Science". His published work includes "Three Centuries of Chemistry" (1925), papers on physical, inorganic and organic chemistry in the journals of the Royal Society, Chemical Society, etc., and occasional bibliographical studies in the *Transactions of the Bibliographical Society*.

Earthquake of June 11

AT 11.58 a.m. (G.M.T.) on June 11, an earthquake of unusual severity was felt all over Belgium and Holland, in the south-west of Germany, the north-east of France and the south-east of England. From the early accounts, the intensity of the shock seems to have been greatest in the west of Belgium, where buildings were slightly damaged, several persons were injured and one was killed. In France, it was most severe in the district around Lille, where many chimneys were thrown down, and at Roubaix, close to the Belgian frontier, where about twenty persons were injured. It was felt also at Boulogne and Paris and, it is said, at Strasbourg. It was observed all over Holland, though but slightly in the north and east of that country. In the south-east of England, especially in Kent, the earthquake was felt rather strongly and also at places so far from the origin as London, Ipswich and Brighton. The disturbed area must therefore have been at least 380 miles long from east to west and 330 miles wide, and have contained not less than 100,000 square miles. It is difficult at present to assign the position of the epicentre. It may have been under the North Sea near the coast of Belgium, or on land in the west of that country. The earthquake was clearly of less intensity than that of April 6, 1580, but, though many of the places disturbed by both shocks are the same, its epicentre must have lain some distance to the east of that of the earlier earthquake, which, as Mr. E. R. Ockenden has shown (NATURE, 138, 472; 1936) was probably submarine and near the east coast of Kent.

Commemorative Window at the Old Ashmolean, Oxford

ON June 11, in the Museum of the History of Science, Oxford, the new window commemorating the gifts of the Mercers', Grocers' and Merchant Taylors' Companies, the Royal College of Physicians and of the Friends of the Old Ashmolean, was unveiled by the Vice-Chancellor in presence of a large and representative audience. Before the unveiling, speeches were made in the Divinity School by Sir Cecil Clementi, Sir Henry Norbury, Dr. R. Hutchison and Dr. G. D. Parkes and also by the Vice-Chancellor. The new window is placed at the bottom of the staircase of the Museum next to a similar window unveiled by Lord Birkenhead about nine years ago. At the top is represented the arms of Dr. R. T. Gunther, the present keeper and virtual founder of the Museum as it has now become. Below this are represented the arms and crests of the City Companies mentioned and the arms of the Royal College of Physicians.

Meyerstein Institute of Radio-Therapy

THE Meyerstein Institute of Radio-Therapy at the Middlesex Hospital, London, was opened by Sir William Bragg on June 9, before a large audience with many representatives of medicine and science. Sir William Bragg referred in reminiscent terms to the early days of X-rays and radioactivity, pointing out the ever-growing interest in the quest of the invisible phenomena about us. The Institute which he declared open is at the north end of the original Cancer Wing of the Hospital, four floors of which have been reconstructed and adapted to radiological work. The main equipment consists of four X-ray installations having Metropolitan-Vickers tubes actuated at 250 kilovolts, four Newton and Wright sets of oil-cooled Siemens tubes to be run at 200 kilovolts, and a 4-gram radium unit, the radium being automatically transferred to a large radium safe surrounded by 10 inches of lead when not in actual use upon patients. The protection of the personnel has been carefully studied throughout the entire working arrangements. The layout of the Institute is of a very pleasing as well as efficient character, being well ventilated and lighted, with ample space and air for patient and operator alike. The whole policy has been to provide trustworthy apparatus with the best possible conditions under which a selected staff can pursue radiological investigation.

East Malling Research Station

THE purchase by East Malling Research Station of the adjoining property of Bradbourne will provide a background of more than ordinary interest for the future activities of the Station. Originally a moated Tudor house built around an open courtyard, Bradbourne was transformed in the early eighteenth century into a typical Queen Anne mansion. From the Station's point of view, the estate of 200 acres is an even more important acquisition than the house itself, providing opportunity for future development of field experiments under conditions which are typical of much of the fruit-growing land in Kent. The open ground in the district has already been largely built over, and had Bradbourne been allowed to suffer a similar fate, the expansion of research activities of the Station in future years might have been seriously hampered. The prompt action taken by the committee in securing the estate when it came into the market has met with encouragement and support from the Government and from several important public bodies including the National Trust, the Council for the Preservation of Rural England, the Pilgrim Trust, and the Society for the Protection of Ancient Buildings. An enterprise of this nature which will mean at one and the same time the safeguarding of land for the development of scientific research and the preservation of a green belt in an area rapidly becoming industrialized, should have a double appeal: to those who think well of East Malling as a research centre, and to those also who approve of keeping part at least of the 'Garden of England' unspoilt. Such a project as the purchase and maintenance of Bradbourne must necessarily entail a heavy strain on the Station, and it may be several years before it is free from financial anxiety. Hence any contributions towards paying off the debt for the purchase and restoration will be welcomed by the Director, East Malling Research Station, Near Maidstone, Kent.

B.M.A. Committee on Mental Health

THE ever-recurring problems of sickness both in industry and in the general population which cannot be satisfactorily diagnosed or relieved by reference to the bodily symptoms alone, has led to a slowly developing interest into the mental aspect of disease. More than ten years ago, a report of the Industrial Health Research Board gave experimental evidence that led to the view that telegraphists' cramp was a psycho-neurotic manifestation. Studies of industrial sickness-absence show that much inefficiency, lost time and unhappiness are related to disorders of the type vaguely labelled nervous breakdown. Also investigations into industrial failures show that a large proportion are people whose disabilities are of a mental or emotional nature. It is therefore opportune that a special committee of the British Medical Association should be appointed to study the problem of mental health in general. The committee is to make a thorough study of all the available statistics and will seek to compare the importance of mental illness with other conditions already recognized by the State as requiring action. It will consider the part which the general practitioner, hospitals, clinics under the Mental Treatment Act, child guidance and other clinics, can play in the prevention of such illness, and study the degree of success attainable by the present available methods of treatment. A very important part of the committee's work will be to consider the part allotted to psychological medicine in medical training. The members of the committee are as follows: Sir Robert Johnston (president), Sir Kaye le Fleming (chairman of council), Mr. H. Guy Dain (chairman of representative body), Mr. N. Bishop Harman (treasurer), Sir Henry Brackenbury, Dr. J. A. Brown, Dr. Millais Culpin, Dr. R. G. Gordon, Sir Walter Langdon-Brown, Dr. Mary C. Luff, Dr. E. Mapother, Dr. Doris M. Odlum, Dr. A. A. W. Petrie, Dr. J. R. Rees, Dr. Benjamin Reid, Dr. D. Stewart, and Dr. R. M. Stewart.

Bureau of Human Heredity

AN appeal for funds on behalf of the Bureau of Human Heredity, which appears in *The Times* of June 7, gives some slight indication of the value of the work which has been carried out by this organization with the limited resources at its disposal and in the brief period since its foundation. The function of the Bureau is to centralize in one organization as a world clearing-house the information already accurately ascertained on the inborn constitutional factors in man, and to distribute it freely wherever it is required. In less than eighteen months the Bureau has accumulated data on the inheritance of more than six hundred physical and mental differences. As a result of a financial appeal in May 1936, the Bureau secured sufficient support to enable it to carry on from day to day, while a grant for one year was made by a scientific worker. The present appeal is headed by Lord Dawson of Penn, with the support of Sir F. Gowland Hopkins, Sir E. Farquhar Buzzard, Sir Richard Gregory and others. In their view, the facts warrant an appeal to the public for a sum of £25,000, an amount which is not considered excessive in view of the importance of the work to be carried on. It would enable the activities of the Bureau to be placed on a permanent basis. In justification, the signatories to the appeal point out that attempts to improve the lot of the individual must remain largely ineffective so long as the data which reveal his inborn nature remain obscure. When the Bureau has been placed in a position to carry out its functions normally in accordance with the intentions of its promoters, it will be possible for any medical man to obtain in English the latest information from any country relating to, for example, the resistance or non-resistance of certain types to common infections, or occupational disease. Research workers themselves are well aware that the organization of knowledge, such as that upon which the Bureau is engaged, is little less important for scientific progress than research itself. Without it there is risk that much valuable work may suffer oblivion. The appeal is issued from the Bureau of Human Heredity, 115 Gower Street, London, W.C.1.

Haslemere Educational Museum

THE Haslemere Educational Museum will celebrate, on June 29, the fiftieth anniversary of its foundation. The speakers on the occasion will be Earl Winterton and Dr. John Ramsbottom. This museum was founded in 1888 by Sir Jonathan Hutchinson, F.R.S., at a time when the majority of the smaller museums were stagnant and uninspiring because they lacked teachers. Hutchinson was a great teacher, and through his teaching the museum at his country house at Inval, about a mile from Haslemere, quickly made its influence felt. There he arranged for the first time the space-for-time schedules of geology and human history which are still a special feature of the museum, and these schedules were largely used in his lectures to friends and to members of the Haslemere Natural History Society. In less than ten years the Museum had completely outgrown itself, and Hutchinson then built a much more commodious one in Haslemere on the hillside to the south-east of the town, and there continued to lecture at week-ends in the summer months.

In 1897, Mr. E. W. Swanton became curator of the Museum and still holds that office. The founder died in 1913; no provision had been made for its future, and it was taken over by a committee with Sir Archibald Geikie as chairman. From that time to the present, the necessary funds to allow the work to continue have been subscribed year by year chiefly by local residents. As its activities steadily increased, it became more and more desirable that the Museum should be moved to a central position. In 1925 the committee purchased an old house with beautiful grounds in Haslemere High Street; new galleries for the adequate display of the space-for-time schedules were added and the collections removed there in 1926. Afterwards a new gallery was added to contain a valuable gift of British birds. Through grants from the Carnegie United Kingdom Trust, the work has been extended to include a regional and ecological survey of the district. The value of the Museum as a teaching centre is widely known. Every autumn mycology students from the University of Oxford make it their headquarters. A course in field biology held at Whitsun attracted students from a wide area.

Hittites in Northern Syria

ONCE more Sir Leonard Woolley's archæological investigations in the East have produced unanticipated results. In his dispatch from Atchana in Northern Syria (*The Times*, June 13), which covers the work of his expedition during the first half of the current season, he records that two hundred inscribed tablets have been found, which reveal for the first time the existence of a strongly established and highly organized Hittite power in Northern Syria at about 1600 B.C., at least two centuries before the great expansion of the Hittite Empire, centring on Hattusas (Boghaz Keui) beyond the Taurus, in what is now Anatolia, with which scholars were previously familiar from excavation and inscribed records. These archives are part of the official documents removed from the Hittite palace, of which a preliminary examination was made at the close of last year's excavations, and now shown to have been destroyed by fire, presumably accidental, as the contents of the building had been removed. The most striking feature of the building, in the account given by Sir Leonard, is the skilled arrangement and the elaborate character of the accommodation. The ruins, still standing to more than a man's height, cover more than 22,000 square feet. Access to the building is from an open courtyard and through a great entry into an entrance hall, from which doorways right and left give admission to the business and residential quarters of the palace respectively. These were virtually separate buildings without intercommunication, and the difference in their character and arrangement indicate their entirely different purposes. In the residential quarter, intended, Sir Leonard thinks, for important members of the palace personnel—the royal family being accommodated above, and the domestic staff, equipment and stores being housed in the courtyard in front of the entry—the accommodation consisted of suites, each of which contained a good-sized bathroom and lavatory. The whole arrangement and content of the palace is, as Sir Leonard remarks, eloquent of a strong and stable government; while the pottery, ivory and gold work bear witness to relations with Cyprus, Crete, Phenicia and the Greek mainland, as well as with Egypt and Mesopotamia.

The Unity Schools

THE fifteenth Unity School was held at Jordans Hostel in Bucks, on May 20–23. The general subject was the need and the relation of philosophy to the social sciences, and an introductory address on that topic was given by Prof. Morris Ginsberg, on the evening of May 20. On May 21, Mr. F. S. Marvin introduced the central subject of "What we mean by Social Justice", and the liveliness of the discussion showed clearly how deeply the current thinking on these questions goes, and how much it needs clarification and, so far as possible, harmonization. Dr. C. H. Desch introduced the question of the comparison of our approach to truth in physical and social science, and Prof. Herbert Dingle gave a parallel statement. In particular the question was raised, and viewed from several angles, of whether it is possible in social science properly to speak of a scientific experiment. On May 22, Prof. J. H. Muirhead gave a carefully prepared and moving discourse on the place of the State in relation to right and justice, with the title, "State Law and Individual Morality". The programme, as originally drawn up, was concluded on the Sunday evening by a historical review by Dr. A. J. Carlyle of the various larger subjects which had occurred in the earlier debates—justice, law, sovereignty and the freedom and equality of men—mainly as they are treated in the codes and writings of Greeks, Roman jurists and medieval thinkers. In view of the great success and obvious usefulness of such gatherings, the possibility of extending them to a larger number of people, more frequent occasions and a still wider expanse of subjects is being considered. Further information on the Unity Schools can be obtained from Mr. F. S. Marvin, Pantiles, Coneydale, Welwyn Garden City, Herts.

Correct Street Lighting

THE General Electric Co. Ltd. has installed in its street-lighting showrooms at Magnet House, Kingsway, London, W.C.2, a model demonstrating many of the problems that arise in street lighting and how they have been effectively solved by the methods recommended in the final report on street lighting issued by the Ministry of Transport. The model measures 5 ft. long by 2 ft. wide, the lighting columns and roads being to a scale of 1 in 380. Running the whole length of the model is a main arterial road lighted by columns which in practice would provide a mounting height to light source of 25 ft. for a main road (Group *A*). The thoroughfare is lighted by a staggered arrangement of units not more than 150 ft. apart. In every third position an auxiliary unit is centrally suspended, so that there can be adequate lighting down and across what would otherwise be a dark central section of the road. After a roundabout, there is a dual carriage way and it is emphasized how necessary it is to treat dual carriage ways as if they were two separate roads. When the dual road bends away in the country from the 'roundabout', the lighting points become closer on the outside of the bend. Cross-road lighting treatment is also shown in several places. Lights here are arranged just beyond the crossing on the left-hand side as the traffic proceeds ; then traffic moving at right angles and pedestrians preparing to cross the road become clearly visible. In addition, photographs are shown to illustrate the more important features demonstrated by the model and suggested in the recommendations. A fuller description of this model is given in the *Osram G.E.C. Bulletin* of May 1938.

Short-Circuit Testing Stations

ABOUT ten years ago it was found necessary to build short-circuit testing stations in order to find out the true rating for a large switch or current-breaker. In order to find out how a switch will break a large electric current at a low voltage or a current at a very high voltage, different methods have to be used and special large and expensive devices are necessary. It is very unsatisfactory to assign nominal ratings based on theoretical design considerations and experience gained by similar apparatus. The International Electrotechnical Commission has now published a specification for the short-circuit testing of circuit-breakers, and manufacturers have to issue a certificate with the apparatus stating that it has passed the required proving tests. Eight years ago Messrs. Reyrolle and Co. built the first short-circuit testing station at Hebburn-on-Tyne and since then, two more have been erected in Great Britain and others are being constructed or are under contemplation. According to the *Electrical Power Engineer* of December last, the certification of switches is not exclusively confined to those manufacturers who own testing stations in whole or in part. The facilities of all the British proving stations are open to other manufacturers for making tests. This entails a definite assurance from the testing stations of privacy in testing and secrecy of results of experiments making so much noise and requiring so large a space. All work is carried out on apparatus under a reference number, the manufacturer's name being omitted and also the designation of the apparatus. During testing all entrances to the station are locked. A separate office is provided for the use of customers wishing to discuss reports. Sometimes cinematograph films of the tests are shown at these offices.

Paris Academy of Sciences

THE "Annuaire" of the Paris Academy of Sciences has for some years past included a biographical index of past and present members and *correspondants* of the Academy. In this year's volume (Paris : Gauthier Villars, 1938), this index is considerably enlarged ; notes have been added indicating the subject or subjects in which each individual was particularly interested, and the list of names has been augmented by including the members of the older body, the Royal Academy of Sciences (1666–1795). A paper read by Prof. Alfred Lacroix, one of the permanent secretaries of the Academy, at the meeting held on January 4 last (*C.R.*, **206**, 23), explains the changes that have been made and describes briefly the various previous attempts to provide a complete statement of past and present members of the Academy. The archives of the Academy now have a separate file for each individual who has been connected with it, and every effort is being made, by searching national, parish and other records, to ensure that biographical details are correct. Further, by dint of most painstaking research, the documents relating to the proceedings of every meeting of the Academy, apart from biographical material, have been classified and they are now also arranged in files, one to each meeting from that of "6 nivôse an IV" (December 27, 1795). As regards meetings of the Royal Academy of Sciences, there are in the archives 109 large folio volumes of *Procès verbaux* prepared by the five successive permanent secretaries, J.-B. du Hamel, Fontenelle, Dortous de Mairan, Grandjean de Fouchy and Condorcet, which go back to the first meeting on December 22, 1666. The total number of men of science who have belonged to the Academy since 1666 is 2,071 (members, 992 ; *correspondants*, 1,079) ; it possesses nearly sixteen hundred autographs and about the same number of portraits.

Curtis's Botanical Magazine

A COMPLETE volume of this beautifully illustrated botanical periodical has recently been published in one cover (*Curtis's Botanical Magazine*, **147**. London : Bernard Quaritch, Ltd. 63*s*. net). This is to fill a gap in the series created by the non-appearance of a volume in 1921. At the end of 1920, publication of the *Magazine* ceased, and it seemed possible that the copyright would pass to an owner in the United States ; but in 1921, the Royal Horticultural Society was presented with the copyright through the generosity of subscribers. The gap thus created in the series has now been filled through the generosity of Mr. Reginald Cory, and the volume is dedicated in accordance with his wish to Sir Isaac Bayley Balfour, Sir David Prain and Sir Frederick Moore in recognition of their services to botany and horticulture. Fifty-seven plants are described and beautifully illustrated, including eleven species of *Rhododendron*, fifteen of *Primula* and four of *Gentiana*. Plants from all parts of the world are described in the *Magazine*; but in this volume Chinese plants take pride of place—thirty-eight species ; five South African species are described and the rest come from countries so far apart as Peru, Siberia, Japan and Tibet. The method familiar to all readers of this periodical is adopted. The history of each species, so far as it is known, is briefly given, and this is followed by a detailed description of morphology (especially floral) and distribution. The beautifully coloured illustrations of each plant described are, of course, the main feature of the volume. The authoritative nature of the text cannot be questioned. Here one notices such familiar contributors as O. Stapf (seventeen species alone and ten in collaboration either with

C. V. B. Marquand or with F. Ballard), J. M. Cowan (thirteen species), A. B. Rendle (five species), and others including J. Anthony, G. Taylor, W. B. Turrill and T. A. Sprague. The volume is edited by Dr. J. Ramsbottom and does credit to editor and contributors. The price may appear to be high, but the illustrations alone make it good value and a real acquisition to any botanical library.

Biological Effects of Ultra-Sound Waves

A SECTION of Messrs. Hermann's "Actualités Scientifiques et Industrielles" series of publications is being devoted to investigations of the effects of radiation on living organisms; it is under the charge of Prof. N. Marinesco, director of research in the Institute of Physico-chemical Biology, Paris. Two parts dealing with ultra-sound waves and their properties have already appeared: (1) "Proprietes piézo-chimiques, physiques et biophysiques des Ultra-sons. Technique des ondes élastique de haute fréquence", and (2) "Propriétés des Ultra-sons. Destruction des micro-organismes. Préparation des colloides à basses températures. Réactions explosives. Réactions photochimiques". Both are written by Prof. Marinesco. The first 56 pages and 5 plates (15 francs) describes the electro-elastic properties of quartz, the production of stationary waves in liquids, the intensity of the radiation, the pressure it exerts and the absorption it undergoes. The second, of 68 pages and 7 plates (18 francs), describes the effects of ultra-sound waves in sterilizing water and milk, in producing emulsions, in detonating explosives and in accelerating chemical reactions with special reference to those in photography. Many of the plates are reproductions of photographs taken by the author. Bibliographies are provided.

International Union against Cancer

THE Third International Cancer Congress under the auspices of the International Union against Cancer will be held in Atlantic City, New Jersey, on September 11–16, 1939. The president of the Congress is Prof. Francis Carter Wood, director of the Institute of Cancer Research of Columbia University; Dr. Donald S. Childs of Syracuse, New York, is the secretary-treasurer; and Dr. A. L. Loomis Bell of Long Island College Hospital, Brooklyn, New York, is in charge of transportation and exhibits. The proposed sections are as follows: general research; biophysics; genetics; general pathology of cancer; surgery of cancer; radiological diagnosis of cancer; radiotherapy of cancer; statistics; and education. Details concerning section chairmen, committees and other data will be announced later. Further information can be obtained from the Institute of Cancer Research, 1145 Amsterdam Avenue, New York, N.Y.

A Regional Survey Field Service Pocket-book

THE Le Play Society's well-known "Discovery" chart has been revised and enlarged and its subject-matter has been put into pocket-book form with blank leaves for maps and notes. In this form it is published under the title "Exploration" at 4*d.*, postage 1*d.* It directs attention to some hundreds of possible fields of local exploration grouped under the major headings: geology, rivers and water-supply, weather and climate, vegetation and open spaces, agriculture, zoology, archæology, history, communications, occupations, folk-lore, place-names, modern and changing conditions, camping and rambling. It is calculated to stimulate youthful zest for exploration and arouse and develop scientific curiosity. An ethical aim is provided by the following passage, appearing on the front page, reminiscent of the teaching of Patrick Geddes and Victor Branford: "If you learn to know your own place well, and in so doing learn to love it more, it will help you to understand and appreciate other places, and to sympathise with their problems". It should prove serviceable to scoutmasters and girl-guides as well as to others engaged in the teaching of local history, local geography and civics and in training for citizenship.

Colonial Service Appointments

THE following appointments and promotions have recently been made in the Colonial Service: R. O. Roberts, field geologist, Uganda; W. L. Stapleton, inspector of mines, Malaya; F. G. Bridges, inspector of plants and produce, Nigeria; M. J. Douglass, agricultural officer, Sierra Leone; J. Ford, entomologist, Tsetse Research Department, Tanganyika Territory; K. S. Hocking, secretary, Tsetse Research Department, Tanganyika Territory; A. R. Jones, meteorological assistant, Sierra Leone; A. G. Robertson, field officer, Tsetse Research Department, Tanganyika Territory; F. L. Vanderplank, field officer, Tsetse Research Department, Tanganyika Territory; E. F. Whiteside, field assistant, Tsetse Research Department, Tanganyika Territory; T. W. Brown (agricultural officer), botanist, Research Branch, Department of Agriculture, Malaya; B. G. A. Low (botanist, Research Branch, Department of Agriculture), agricultural officer, Field Branch, Malaya; F. B. Higgins (senior inspector of mines, Nigeria), senior inspector of mines, Gold Coast; H. H. Cobon (assistant superintendent of surveys), superintendent of surveys, Malaya; F. W. Abbott (laboratory assistant, Medical Department), laboratory assistant, Grade I, Medical Department, Gold Coast; P. A. Clearkin (formerly deputy director of Laboratory Service, Tanganyika Territory), bacteriologist and pathologist, British Guiana (temporary appointment); C. K. Robinson (agricultural assistant), agricultural superintendent, Saint Vincent; G. C. Stevenson (assistant botanist, British West Indies Central Sugar Cane Breeding Station, Barbados), botanist, Sugar Cane Research Station, Mauritius.

Shower of Bright Meteors

A REMARKABLE shower of fireballs is reported to have been seen in southern Sweden on May 27 between $18^{h}\ 20^{m}$ and $20^{h}\ 12^{m}$ U.T. About $18^{h}\ 40^{m}$, two specially bright fireballs, visible in full sunshine, appeared over Bornholm Island. The general direction was from west to east. Further details of these and other fireballs are requested by A. Corlin, Lund Observatory. It is hoped that sufficient data will be available later to enable the paths to be computed.

Curious Fading of Comet Gale

As announced in NATURE recently, Comet Gale was found on May 1 by Mr. L. E. Cunningham at Harvard, its magnitude being 10. An orbit and ephemeris were computed, and, knowing the distances of the object from the earth and sun, its magnitude on various dates was estimated. The remarkable thing is that its magnitude is considerably less than that predicted, as the following figures will show :

Date	Predicted Magnitude	Observed Magnitude
May 9	9·5	11
28	8·5	11
31	8·4	13

It is probable that some rapid internal changes, on which one can only speculate at the moment, are taking place in the comet.

Announcements

THE Albert Medal for 1938 of the Royal Society of Arts has been awarded to H.M. Queen Mary "in recognition of her Majesty's unremitting interest in arts and manufactures to the great benefit of British industry and commerce". Queen Mary has intimated her acceptance of the medal.

DR. F. W. HAYWOOD has been appointed chief metallurgist to Wild-Barfield Electric Furnaces, Ltd., to take charge of the new research department nearing completion. Dr. Haywood, who is at present engaged with Messrs. I.C.I. (Fertilizer and Synthetic Products), Ltd., at Billingham, will be commencing his duties later in the year.

GEH. REG. RAT HEINRICH KAYSER, emeritus professor of physics at Bonn, and Dr. Hans Horst Meyer, emeritus professor of pharmacology, pathology and biology at Vienna, celebrated their eighty-fifth birthday on March 16 and 17 respectively.

PROF. PAUL FOURMARIER, professor of physical geography in the University of Liège, has been elected a foreign correspondent of the Geological Society of London.

PROF. M. T. BOGERT, professor of organic chemistry in Columbia University, has been awarded the Priestley Gold Medal of the American Chemical Society. The medal, the highest American honour in chemistry, is granted once in three years. It was established in honour of Joseph Priestley. Priestley lived most of his life in England but went to America late in life to escape hostility to his views as a nonconformist preacher. He lived in Philadelphia and Northumberland, Pa. Alone, and in collaboration with his many students, Prof. Bogert is the author of more than four hundred papers in synthetic organic chemistry.

MR. J. REID MOIR will give the next Huxley Lecture of the Imperial College of Science and Technology on May 4, 1939, at 5.30 p.m. The subject of his lecture will be "The Earliest Men".

THE tenth International Medical Congress for Psychiatry will be held at Oxford on July 29–August 2. A detailed programme will be published later. Further information can be obtained from Dr. E. B. Strauss, 81 Harley Street, London, W.1.

A NATIONAL conference on Maternity and Child Welfare will be held in the Great Hall, University of Bristol, on July 5–7, under the presidency of Mr. R. H. Bernays, M.P., Parliamentary Secretary of the Ministry of Health. Further information can be obtained from the Honorary Secretary, Dr. Minett, Carnegie House, 47 Piccadilly, W.1.

THE next meeting of the French Association for the Advancement of Science will be held at Arcachon on September 22–27 under the presidency of M. Guilliermond, member of the Institut de France and professor in the Paris Faculty of Sciences. The subjects for discussion are : (1) the oyster (palæontology, zoology, biology, hygiene, fishing and cultivation) ; (2) the marine pine and its derivatives ; (3) the pigments of living beings (chemical composition and psychological role) (4) biology and protection of fresh water. Further information can be obtained from the Secretary of the Association, 28 rue Serpente, Paris.

THE fifth International Locust Conference will be held in Brussels on August 25–September 1, under the patronage of His Majesty the King of the Belgians. The programme includes discussions on the standardization of studies on phase transformation in locusts ; on methods of studying locust migrations ; on general principles of anti-locust research, etc. The greater part of the programme is devoted to problems of organization of preventive control of locusts and grasshoppers in different natural regions of the world. Information on the Conference can be obtained from the Secretariat, 7 Place Royale, Brussels ; and from the Imperial Institute of Entomology, British Museum (Natural History), London, S.W.7.

WE have received the April issue of *Sands, Clays and Minerals*, a journal edited and produced by A. L. Curtis, Chatteris, which contains a number of interesting papers. One of these deals with the modern uses of tantalum and niobium, another with the reparation of historical buildings, and a third (by A. Barclay, of the Science Museum) is on early technical balances and is profusely illustrated. The journal is of a high standard and contains much information of scientific and economic interest.

ERRATUM. Prof. J. H. Orton writes that in his letter entitled "Life-History of the Salmon (*Salmo salar* L.)" in NATURE of June 4, p. 1017, the word "mature" in the bottom line of column 1 was inadvertently written for the word "immature".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1103.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Packing Fractions of Bromine, Chromium, Nickel and Titanium

I HAVE obtained a new determination of the packing fraction of ^{79}Br by measurements of the doublet given by its triply charged atom and the quintuply charged atom of ^{132}Xe, the value for which has been provisionally given[1]. As the difference in mass between ^{79}Br and ^{81}Br has also been measured[2], values for both isotopes can be calculated as given below. These are provisional only, but are certainly more reliable than those previously in use. I hope in the future to get more accurate results by means of the doublet ^{81}Br+++ — C_2H_3, but this cannot be used now owing to the presence of aluminium in the discharge tube.

Very satisfactory results were obtained with chromium. The volatile carbonyl was used, which when combined with suitable proportions of methyl chloride gave ^{52}Cr — $CH_3{}^{37}Cl$ the doublet required. As soon as the initial difficulties of admitting the vapours in the right proportions had been overcome, a great many well-matched doublets were photographed giving very consistent measurements.

Experiments with nickel were disappointing. Nickel carbonyl was used, but the line ^{58}Ni++ could not be obtained intense enough for comparison with C_2H^5. As the first order line ^{58}Ni was strong, it was considered worth while to compare the ratio of this to CO_2 by means of the fairly near ratio ^{16}O to ^{12}C, using artificial doublets. Four complete sets of comparisons were made, and the mean of these indicates a negative packing fraction considerably smaller than that previously estimated ten years ago by the same method.

The packing fraction of ^{48}Ti has recently been given by Dempster as $- 7{\cdot}22 \pm 0{\cdot}1$ by direct comparison of its triply charged atom with the standard oxygen atom[3]. His comparisons of ^{48}Ti++++ — C were, however, not satisfactory. I have been to great pains to obtain and measure the corresponding doublet ^{48}Ti++ — C_2, as this affords an entirely independent check on the controversial value of ^{12}C. Titanium tetrabromide was used, but is very troublesome in the discharge. The line ^{48}Ti++ was very feeble and the exposures consequently long, and as there was little possible control on the relative intensities of the lines, only very few of the plates taken were of any value. After many weeks of work, seven reasonably well-matched doublets had been obtained with the mean result given below. If my value 2·96 for the packing fraction of carbon is used, the value obtained is virtually identical with Dempster's; conversely, this agreement provides a further independent and welcome confirmation of my value $12{\cdot}00355 \pm 0{\cdot}00015$ for the mass of ^{12}C. This and H = 1·00812 have been used in calculating these results:

Doublet	Number of doublets measured	Difference in packing fraction	Difference of mass
^{79}Br++ — ^{132}Xe+++++	6	$28{\cdot}30 \pm 0{\cdot}3$	0·0745
^{52}Cr — $CH_3{}^{37}Cl$	18	$9{\cdot}22 \pm 0{\cdot}15$	0·0479
^{48}Ti++ — $^{12}C_2$	7	$10{\cdot}20 \pm 0{\cdot}15$	0·0490

Symbol	Packing fraction	Isotopic weight
^{48}Ti	−7·24	$47{\cdot}9652 \pm 0{\cdot}0008$
^{52}Cr	−8·18	$51{\cdot}9575 \pm 0{\cdot}0008$
^{58}Ni	(−8·35)	$(57{\cdot}9516 \pm 0{\cdot}0020)$
^{79}Br	(−7·4)	$(78{\cdot}9417 \pm 0{\cdot}0020)$
^{81}Br	(−7·4)	$(80{\cdot}9400 \pm 0{\cdot}0020)$

F. W. ASTON.

Cavendish Laboratory,
Cambridge.
June 1.

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[1] NATURE, 140, 149 (July 24, 1937).

[2] NATURE, 137, 357 (Feb. 29, 1936).

[3] *Phys. Rev.*, 53, 68 (1938).

Resonance in Nuclear Photo-Effects

IN connexion with the remarkable selectivity of nuclear photo-effects of heavy elements indicated by experiments, it was pointed out in a recent note in NATURE[1] that such photo-effects might provide a means of examining certain features of the mechanism of excitation of atomic nuclei not disclosed by ordinary experience about nuclear reactions by collisions. In fact, the probability of excitation of a nucleus by monochromatic radiation depends on the degree to which forced oscillations of given frequency of the nuclear matter can be produced, and experiments on the variation of the yield of the photo-effects with radiation frequency would therefore allow a direct estimate of the strength of coupling between the different modes of oscillation into which the collective motion of the nuclear particles may approximately be resolved.

In view of the very incomplete experimental evidence, I would like, however, to emphasize the preliminary character of any such estimates as attempted in the note referred to, and at the same time to direct attention to a possible misunderstanding of the argument regarding the separation of the course of the photo-effects into successive stages. Such a separation into the initial excitation of a certain mode of oscillation and its subsequent quenching due to the coupling cannot, of course, be carried out in the case of strictly monochromatic radiation. Nevertheless, a well-defined meaning can be attached to the argument as soon as we, instead, consider the effect of a time-limited irradiation with a corresponding frequency uncertainty.

In particular it follows from such a treatment that, so far as we are concerned only with mean values of the yield of the photo-effects over energy regions wide compared with the distance of the nuclear levels, all typical resonances will be essentially the same whether the level distribution is discrete or continuous. It follows also that, contrary to an assertion in the note, the selectivity is completely independent of the ratio between the chances of the re-emission of the whole energy as a single radiation quantum in the initial and in the subsequent stage of the excitation process. All such conclusions are in fact in complete harmony with a treatment on the lines of the ordinary theory of dispersion of monochromatic radiation, according to which the selective phenomena would be attributed to an abnormally large radiative transition probability to the normal state from certain energy regions.

For the clarification of these points I am indebted to discussions with Prof. Peierls and Prof. Placzek, in collaboration with whom a paper about nuclear resonance phenomena with special regard to the above-mentioned arguments is being prepared for publication in the communications of the Copenhagen Academy of Sciences.

N. Bohr.

Institute of Theoretical Physics,
Copenhagen.
May 28.

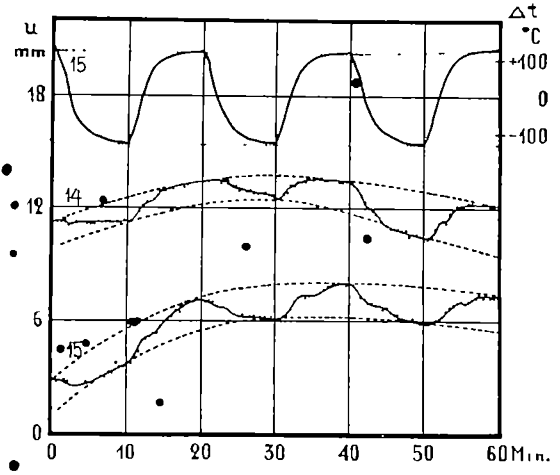
[1] Cf Bohr, N., Nature, 141, 326 (1938).

Effects of Gas Ions on the Benedicks Effects in Mercury

It has been proved by one of us[1] that a thermoelectric force of the first kind—now, with W. Meissner, called the first Benedicks effect—appears in asymmetrically heated homogeneous liquid mercury, with a *negative* sign. (A negative sign indicates that in the external circuit the electron current flows from the hot side of the temperature gradient to the cold one.) As for the reverse effect—the second Benedicks effect (or heat transport caused by an electric current)—it was found by us[2] that this effect likewise was 'negative' in pure mercury containing gas, but *positive* in degassed pure mercury—evidently due to a lowered content of gas ions, already known to influence the sign of this effect in the case of platinum[3]. The conclusion was drawn that likewise a change of the sign of the first Benedicks effect may be caused by a lowered gas content.

In order to test the accuracy of this conclusion, a 'strangulation vessel' of Normal-glass—giving locally a high temperature gradient—filled with carefully degassed mercury, was used. Possible sources of error were carefully considered. From eight series obtained in varying circumstances—all of them in good agreement—two are reproduced in the accompanying figure. The upper curve gives the temperature differences producing the gradient, the lower ones (two series) the corresponding galvanometer deflections (1 mm. = $1{\cdot}16 \times 10^{-9}$ volts). The reproducibility is seen to be fairly good. Most of the periods show an inflection point, due to the fact that the E.M.F. is proportional to the third degree of the temperature difference—this was separately proved.

The main result is, that *the first Benedicks effect in mercury of highest purity is actually a positive one.* The *negative* sign found earlier, consequently, *must be due to the action of gas ions*, as in the case of the second Benedicks effect.



This causes an earlier discrepancy of the periodic table to disappear: while, in its second column, zinc and cadmium have a positive Thomson effect, the following metal, mercury, has always been found to give a negative sign for the Thomson effect. For theoretical reasons, we may now conclude that the Thomson effect of pure mercury quite free from gas will be positive, causing this discrepancy to disappear.

C. Benedicks.
P. Sederholm.

Metallografiska Institutet,
Stockholm.
May 18.

[1] Benedicks, C., *Ann. Phys.*, iv, 62, 185 (1920).

[2] Benedicks, C., and Sederholm, P., *Arkiv. f. Mat. Astr. and Fysik* (*Stockholm*), A, 25, No. 22, 1–20 (1936).

[3] Benedicks, C., and Borgmann, C. W., *Arkiv f. Mat. Astr. and Fysik* (*Stockholm*), B, 24, No. 10, 1–5 (1934); Benedicks, C., Borgmann, C. W., and Sederholm, P., *Arkiv f. Mat. Astr. and Fysik* (*Stockholm*), A, 25, No. 9, 1–28 (1935).

Molecular 'Rejuvenation' of Muscle Tissue

The decomposition of creatine phosphoric acid during muscular action, and its rebuilding during rest, has been the subject of numerous detailed investigations. We were interested in the problem, if, and to what extent, creatine phosphoric acid molecules are decomposed and afterwards rebuilt, or 'rejuvenated', in the resting muscle. This problem can be easily solved by injecting labelled sodium phosphate, for example, into frogs, and determining if, and to what extent, creatine phosphoric acid extracted from the muscle of the frog becomes labelled (radioactive). Phosphorus atoms present in creatine phosphoric acid and other organic compounds do not exchange spontaneously with other phosphorus atoms present, and thus the fact that labelled creatine phosphoric acid can be isolated from the muscle is a proof that this was synthesized after the administration of labelled sodium phosphate.

The muscle was placed at once after removal in liquid air, the acid soluble components extracted with trichloracetic acid kept at − 9°, and the inorganic phosphate present in the solution precipitated as ammonium magnesium salt. The next step was the decomposition of creatine phosphoric acid remaining in the filtrate from the last-mentioned precipitate. The decomposition was carried out by adding[1] sulphuric acid (1*n*) and ammonium molybdate (1 per cent) to the solution. The phosphate ions were then precipitated as ammonium magnesium salt. The phosphorus content of the latter was determined by the colorimetric method of Fiske and Subbarow, and its radioactivity by making use of a Geiger counter. The results obtained for this and some other fractions are seen in the accompanying table.

PHOSPHORUS ISOLATED FROM FROG KILLED 3 HOURS AFTER SUBCUTANEOUS INJECTION OF LABELLED SODIUM PHOSPHATE.

	Relative specific activity (activity per mgm. P)	
	Frog kept at 2°	Frog kept at 21°
Inorganic P	100	100
Creatine P	49	78
Adenosin P (7 min. hydrolysed at 100°)	50	—
"Hexose" P (30 min. hydrolysed at 100°)	52	78
Product of 100 min. hydrolysis at 100°	45	—
Non-acid soluble residual fraction	9	38

A specific activity of the creatine phosphoric acid phosphorus amounting to 49 per cent of that of the inorganic phosphorus indicates that 49 per cent of the creatine phosphoric acid molecules present in the resting muscle were split and newly synthesized through enzymatic action in the course of the last 3 hours before the frog was killed. As the total number of creatine phosphoric acid molecules present in the muscle can be assumed not to have changed during that time, in the resting muscle we are faced with a molecular rejuvenation of the creatine phosphoric acid to the above extent. The adenosin and the hexosephosphate molecules are rejuvenated to about the same extent as those of the creatine phosphoric acid. With increasing temperature, as is to be expected, the rate of molecular rejuvenation increases, and in the course of less than a day practically all creatine phosphoric acid molecules are renewed.

The new formation of some of the 'acid soluble' phosphorus compounds present in the blood also takes place to a very appreciable extent. In human blood 2 hours after intravenous injection of labelled sodium phosphate, the specific activity of the total acid soluble organic phosphorus, kindly extracted by Mr. A. H. W. Aten from the blood corpuscles, amounted to 20 per cent of that of the plasma inorganic phosphorus.

In experiments *in vitro*[2] in which dog's blood was shaken for 2·5 hours with labelled sodium phosphate, 1/25 of the total acid soluble molecules was found to be labelled and thus split and resynthesized under the action of enzymes. In the same *in vitro* experiments the formation of only very minute amounts of labelled phosphatides (less than 0·1 per cent) could be ascertained. Also in experiments *in vivo* labelled phosphatides were found to be present to an appreciable extent in the blood only after a very long time. The specific activity of phosphatide P extracted from human blood corpuscles 24 hours after administration of labelled sodium phosphate was found to be 40 times less than that of plasma inorganic P, showing the very low rate of rejuvenation of the phosphatide molecules present in the blood.

There is thus a conspicuous difference in the rate of rejuvenation of some low molecular water soluble compounds, as for example, creatine phosphoric acid, adenosin phosphoric acid, hexosephosphate, and non-water soluble products like phosphatides, nucleoproteins and similar compounds, present in the blood. This difference is closely connected with the fact that the first-mentioned compounds are at least partly rejuvenated through enzymatic action in the blood itself, while the latter are principally rejuvenated in the organs and carried from these in the blood stream. The measurement of the rate at which, for example, adenosintriphosphoric acid molecules are renewed can be conveniently used to determine the amount of enzymes the presence of which enables the exchange reaction to take place.

We wish to express our most hearty thanks to Prof. Krogh for all the biological material used, and to him and to Prof. Niels Bohr for their kind interest taken in this work. We wish also to thank Miss Hilde Levi and Mr. Ussing for their assistance.

G. HEVESY.
O. REBBE.

Institute of Theoretical Physics
and
Zoophysiological Laboratory,
Copenhagen.
May 17.

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[1] Lohmann, K., *Biochem. Z.*, 194, 306 (1928).

[2] Hahn, L., and Hevesy, G., *Bull. Lab. Carlsberg*, 22, 188 (1938)

Adsorption Potentials

Ehrensvärd and Sillén[1] have recently considered the interfacial potential difference between two immiscible or slightly miscible liquid phases containing electrolytes; they conclude that the E.M.F.'s across cells of the type

Calomel electrode	Electrolyte BA in water C_1	Non-aqueous phase	Electrolyte BA in water C_2	Calomel electrode

are not derived from true partition equilibria of the electrolyte between the aqueous phases and the adjoining regions of the oil phase, but from an "*ion adsorption equilibrium* between the aqueous phases and the interfacial layer".

The E.M.F. of a cell is not necessarily affected by the adsorption of ions or neutral molecules at one or more of the interphases. In the system

$$\text{metal } M \mid \text{solution of salt } M^+X^-$$

for example, in thermodynamic equilibrium, changes in the potential difference across the metal - solution interphase are controlled by changes in the chemical potential of the ion M^+ in the solution. If any substance is introduced into the system which is insoluble in the bulk phases and adsorbed at the interphase, no change of potential difference will occur. The added substance is insoluble and can therefore be shown not to alter the chemical potentials of the bulk phase components. If this substance has strongly polar molecules, and forms an oriented layer at the interphase, the distribution of electrical potential and of charged particles in the interphase will be altered by its presence, but no change in potential difference across the interphase will be observed.

There are two conditions in which adsorption potentials can affect the E.M.F. of a cell:

(1) When the interphase contains a boundary across which no charged particle can pass.

(2) When diffusion of ions as well as of non-ionized molecular species takes place across an interphase which is not in a state of equilibrium.

Type 1 maintains a constant charge on its double layer when left on open circuit. For solutions of a given composition, it takes up any potential which is initially imposed. It has no definite potential of its own; but changes in the composition of the solution at constant surface charge produce definite changes of potential which depend on the actual charge on the double layer. These changes of potential arise from the adsorption at the interphase of substances from the solution. The theory of adsorption at interphases of this type has been worked out by Stern[2], who assumes the validity of Langmuir's adsorption isotherm for such cases. An examination of the partition function for an interphase shows that this assumption is not valid for charged particles[3], but the general basis of Stern's theory is supported by work on dropping mercury electrodes and electrocapillary data[4].

Adsorption at interphases of Type 2 will result in general in altered diffusion rates, and may alter these rates differently in the case of different ions. Since the diffusion of neutral electrolytes, interchange of cations and interchange of anions all involve the superposition of electric currents flowing in opposite directions, a selective change in the rates of ionic diffusion may lead to a modified distribution of electric charge. Thus the interfacial potential difference will alter.

The formula for a diffusion potential may be written approximately as:

$$\Psi_\beta - \Psi_\alpha = -\sum_{i=1}^{i=s}\int_\alpha^\beta \frac{t_i}{z_i F}\cdot d\mu_i \quad \ldots\ldots \quad (1).$$

The integration is from homogeneous solution α to homogeneous solution β on the other side of the diffusion boundary, and all the terms have their usual thermodynamic significance. As $\mu_i = \mu_{oi} + RT \ln c_i f_i$ and μ_{oi} is a constant depending on the temperature, pressure and nature of the solvent, attempts to relate equation 1 to ionic concentrations when water and oil are diffusing into each other involve a consideration not only of the diffusion of each ion but also of the solvent; diffusion of the latter causes the partition coefficients to vary both in space and in time.

As the cells examined by Ehrensvard and Sillén take up definite potentials, their aqueous - oil interphases cannot be of Type 1. They claim that their observations are consistent with the theory of such an interphase. The early stages of the setting up of a diffusion gradient in oil-water interphases seem therefore to confine the diffusion to the first one or two molecular layers of the oil phase. For these layers, interchange equilibrium is rapidly set up. The subsequent extension of the region of diffusion into the non-aqueous phase is very slow. Kinetically, therefore, a continuous transition can take place from an adsorbed monolayer to a diffusion gradient. Mathematically, Equation 1 is formally valid for a completely polarizable interphase.

S. R. CRAXFORD.
O. GATTY.
ROTHSCHILD.

Cambridge.
May 17.

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[1] Ehrensvard, G., and Sillén, L. G., NATURE, 141, 788 (1938).

[2] Stern, O., *Z. Elektrochem.*, 30, 508 (1924).

[3] Levine, S., personal communication.

[4] Philpot, J. St. L., *Phil. Mag.*, 13, 775 (1932); Craxford, S. R., Dissertation, Oxford, 1936.

An Anomalous Case of Emulsification

IT is commonly supposed that an emulsion of two immiscible liquids is stabilized by the formation of an interfacial film of emulsifying agent molecules which, by their constitution and orientation, condition the emulsion type. Thus, according to the Gibbs' equation, those materials which reduce surface or interfacial tension should facilitate emulsification. Indeed the term surface tension depressor has become synonymous with emulsifying agent.

It has recently come to our notice that simple inorganic salts such as the alkali halides enable relatively stable emulsions of water in amyl alcohol to be produced. These salts are not surface active but tend rather to *increase* the interfacial tension of the system.

The stability of emulsions thus prepared bears no simple relationship to the concentration of salt in solution. In the case of emulsions stabilized by potassium iodide, the maximum stability appears to be attained at an electrolyte concentration of 0·05 *N*, while concentrations greater than normal inhibit emulsification completely. On the other hand, concentrations of potassium iodide so low as 0·001 *N* have considerable stabilizing action.

D. F. CHEESMAN.
A. KING.
J. N. SUGDEN.

Department of Chemistry,
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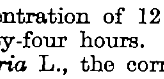
May 20.

Control of Insects by Methallyl Chloride

IT is difficult to control insects in stored products, where they cause millions of pounds worth of damage annually. The most efficacious method is by fumigating them with poisonous gases or vapours. Many chemical compounds have already been tried, for example, by the United States Department of Agriculture[1].

I carried out some investigations upon methallyl chloride, and found that this material possesses good insecticidal qualities. It is a product manufactured from petroleum hydrocarbons and has the following formula:



$$CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_2Cl$$

Its specific gravity at 20° C. is 0·925 and its boiling point 72° C. It is a colourless liquid which evaporates easily at normal temperature. Mixtures of its vapour with air are not explosive in concentrations of 105–339 gm. per cub. m. It was H. F. Zimmermann at Prague who directed my attention to this product. It was found in the laboratory that species of *Ephestia* such as *E. kuhniella* Zeller and *E. elutella* Hb. were killed by a concentration of 12·5 gm. per cub. m. applied for twenty-four hours.

Calandra granaria L., the corn weevil, was killed by a concentration of 18·75 gm. per cub. m. applied for twenty-four hours at 18° C. The insects are not dead immediately after fumigation, but methallyl chloride proved to have a strong after-effect, so that within a few days all the insects are killed. Eggs, larvæ and pupæ are also killed. Imagines of *Calandra*, placed in the centre of a bag of wheat, were easily reached and killed by the gas.

It is surprising that if the fumigation time is reduced to one eighth (from twenty-four hours to three hours) only a four times higher dose is required, which is not in keeping with Haber's law ($c \times t = K$).

Five kgm. of methallyl chloride was evaporated, by pouring it on to flat dishes, in a gas chamber of 70 cub. m. capacity, containing bags of wheat and maize with *Calandra* species, bags of peas with *Endrosis lactella* Schiff., cases of currants and apricot stones with *Ephestia elutella* Hb. and *Paralispa gularis* Z., and also bags of cow hair with *Lermestes* species. At the end of twenty-four hours the gas was drawn off by suction. All the insects were killed. The temperature was 20° C.

A cocoa storage loft of about 150 cub. m., infested by tens of thousands of larvæ of *Ephestia elutella*, the cocoa moth, was treated in the same way at a temperature of 14° C. All the larvæ were exterminated.

In these tests, special attention was paid both to the influence of the gas upon the smell and taste of the gassed products and its toxicity to mammals.

As a soil insecticide, methallyl chloride was also used. Larvæ of the cockchafer were killed by a dose of 25 gm. per sq. m. distributed in four holes.

The great majority of plants are not damaged by methallyl chloride.

A detailed publication on methallyl chloride is being prepared and will be issued shortly.

C. J. Briejèr.

Laboratory,
N. V. De Bataafsche
Petroleum Maatschappij,
Amsterdam.
May 17.

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[1] U S. Dept. Agric. Bull. No. 1313.

Pterinopecten papyraceus and "*Strophomena*" *pecten*

Linnæus, in the tenth edition of "Systema Naturæ" 1758, p. 702, described a species *Anomia pecten* in these words: "A. testa semi-orbiculata depressa multistriata; valvula altera plana (List. angl. 243, t. 9, f. 49). Testa inferne ʃ. margine cardinis linea recta ʃ. transversa". No locality was given, but a specimen is contained in his cabinet at the Linnean Society, London.

Lister's figure, cited by Linnæus, is of a specimen "ex fodinis carbonum Fossilium juxta Hallifax", and is quite recognizable as *Pterinopecten papyraceus* (J. Sowerby, 1822) known to occur in the Halifax Hard marine band of the Coal Measures. The above description could be held to apply to this shell. By a strict application of the rules of nomenclature, J. Sowerby's specific name would appear to be invalidated by Linnæus's previously erected species.

On the other hand, there is no doubt that Linnæus had before him Swedish Silurian brachiopod shells long known as "*Strophomena*" *pecten* Linn. Knowledge of the typical form was spread by personal contact among the Swedish palæontologists, and the first figured specimen of '*S.*' *pecten*[1] is probably conspecific with the specimen still preserved in the Linnean cabinet.

This confusion seems to arise from a difference of method. Linnæus presumably only intended to show the general appearance of his shell to other workers, not to establish a type specimen.

Since *Pterinopecten papyraceus* is a common shell, cited in European literature for more than a hundred years, strict interpretation of the rules would lead to confusion. Therefore I am applying to the International Committee for Zoological Nomenclature for a suspension of the rules in this case, so that the specific name *pecten* Linn. can be retained for the Silurian brachiopod.

Other of the Linnean species are similarly referred to figures which do not represent the species in the modern interpretation, for example, such a common fossil as *Atrypa reticularis*, and if the rules are suspended in this case, a precedent will have been set up for the retention of those Linnean species at present doubtful.

If the rules are suspended, and '*S*'. *pecten* Linn. is retained, I propose to figure and describe the specimen of '*Anomia*' *pecten* in the Linnean cabinet as the neotype.

Alan Wood.

Geology Department,
Imperial College of Science and Technology,
London, S.W.7.
May 13.

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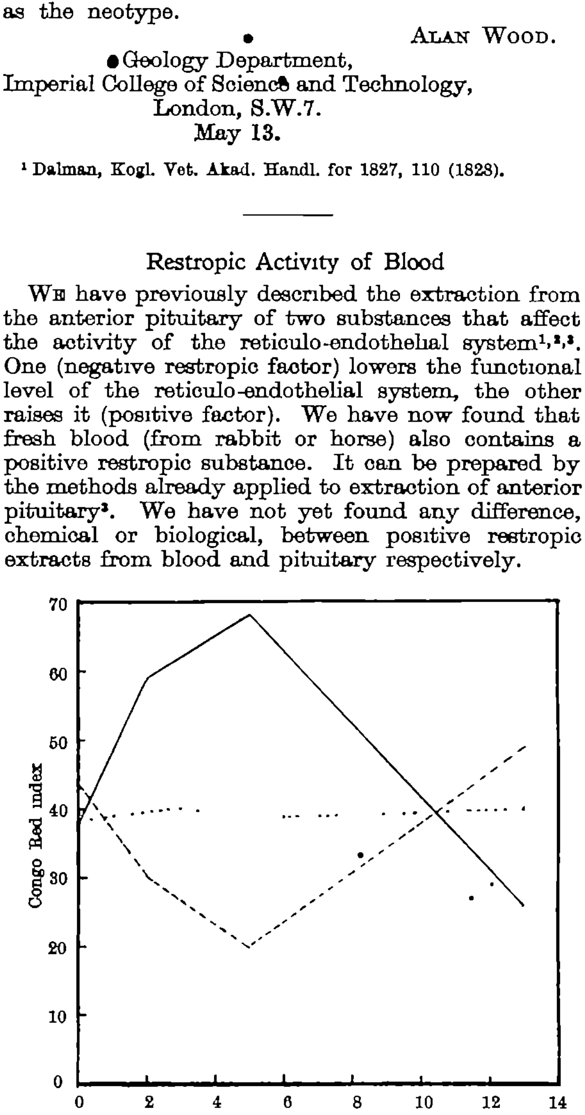
[1] Dalman, Kogl. Vet. Akad. Handl. for 1827, 110 (1828).

Restropic Activity of Blood

We have previously described the extraction from the anterior pituitary of two substances that affect the activity of the reticulo-endothelial system[1,2,3]. One (negative restropic factor) lowers the functional level of the reticulo-endothelial system, the other raises it (positive factor). We have now found that fresh blood (from rabbit or horse) also contains a positive restropic substance. It can be prepared by the methods already applied to extraction of anterior pituitary[3]. We have not yet found any difference, chemical or biological, between positive restropic extracts from blood and pituitary respectively.



Activity of the reticulo-endothelial system. Blood extracts from normal subject (full line), case of malignant disease (broken line), and case of cholelithiasis (dotted line).

The experiments have been extended to human blood. Samples of venous blood were obtained from healthy subjects and from various clinical cases. Each sample (5·0 ml.) was immediately extracted by a method previously described[3], deproteinization followed by aqueous extraction of the precipitate. The extract, made up to a volume of 5·0 ml., was injected into a rabbit in daily doses of 1·0 ml. The Congo Red index was again taken as measure of the activity of the reticulo-endothelial system[4]. This index was determined before, and 24 or 48 hours after, the first injection; further determinations were made one day and about ten days after the last injection.

The resulting curves of the activity of the reticulo-endothelial system varied greatly (see accompanying graph). All healthy subjects yielded extracts that rapidly increased the rate at which the dye disappeared from the blood. This rise in the Congo Red index was followed, on cessation of the injections, by a return to the initial level. Normal human blood thus contains a positive restropic factor.

The blood of patients exhibiting various clinical conditions (other than malignant disease) yielded either positive or inactive extracts. Entirely different results were obtained with extracts of blood from cases of malignant disease. Such extracts rapidly lowered the index. This negative restropic effect is usually noticeable 24 hours after the first injection, but may take several days for its full development. Exceptions were noticed in two cases, one showing a tumour of the parotis, the other diagnosed as carcinoma of the ear; these extracts were inactive. No case of malignant disease so far examined has yielded positive extracts; no case of non-malignant disease so far examined has yielded negative extracts.

It would thus appear that human blood contains substances affecting the active mesenchyme in the manner previously described for pituitary extracts. The concentration and the nature of the restropic substances seem to be related to the condition of the subject. The positive restropic activity of the blood of healthy subjects may be absent in some clinical conditions, as yet undefined; in malignant disease it tends to be reversed. There is as yet no evidence to show whether the absence of positive restropic, and the presence of negative restropic, factors in cases of malignant disease have a causative or merely a symptomatic significance.

The samples examined were obtained, together with the clinical diagnosis, through the courtesy of Dr. P. O. Ellison, pathologist to the Royal Northern Hospital, the staff of the Royal Cancer Hospital (Free), Dr. J. Patterson, pathologist to the Charing Cross Hospital and Dr. Rouillard of the Waterloo Hospital.

C. WETZLER-LIGETI.
B. P. WIESNER.

The Laboratory,
37 Great Cumberland Place,
London, W.1.

[1] Wetzler-Ligeti, C., and Wiesner, B P., NATURE, **140**, 892 (1937).

[2] Wetzler-Ligeti, C., and Wiesner, B. P., *Chem. and Ind., Proc. Biochem. Soc.*, **57**, 85 (Jan. 22, 1938).

[3] Wetzler-Ligeti, C., and Wiesner, B. P., *Endocrinology*, **22**, 698 (1938)

[4] Stern, K., and Wilhelm, R., *Z. Exper. Med.*, **97**, 354 (1935).

Cytochrome Oxidase

IN a recent paper on the indophenol oxidase, now known as the cytochrome oxidase, Keilin and Hartree[1] repeat the statement which they made in an earlier paper[2] that "According to Harrison[3], it is hardly necessary even to postulate the existence of an enzyme such as indophenol oxidase. The oxidation of *p*-phenylenediamine in muscle preparation he explains as a secondary or coupled oxidation by means of a peroxidase or a hæmatin compound acting in conjunction with H_2O_2 formed in a primary oxidation of substances such as glutathione or hypoxanthine". They then proceed to give arguments against this secondary oxidation theory, but the facts they quote merely show that the indophenol reaction of tissues is not *solely* due to secondary oxidation.

I was well aware of these considerations, but showed in a number of ways that the indophenol oxidase theory alone does not explain all the experimental facts relating to the indophenol reaction; for example, the production of a positive reaction on adding hypoxanthine to liver suspension, even in presence of cyanide, which is known to inhibit the activity of the indophenol oxidase. What I actually said in concluding my paper was: "I feel that the explanation of the indophenol reaction and its significance in cell oxidations is best accounted for by assuming a combined action of an indophenol oxidase, as suggested by Keilin, and the secondary oxidation mechanism suggested in this paper. These together afford a satisfactory explanation of the observed facts."

So far from not believing in the existence of an indophenol or cytochrome oxidase, I carried out experiments shortly afterwards to show the interaction of a dehydrogenase system (glucose dehydrogenase) with the cytochrome-oxidase system as postulated by Keilin. These experiments gave a positive result[4] and have recently been confirmed in this laboratory.

The amount of secondary oxidation by hydrogen peroxide occurring in the intact tissues is at present unknown, but there is no reason to believe that it is negligible; indeed Keilin and Hartree[2] have themselves recently extended the number of systems which are known to be capable of bringing about secondary oxidations.

D. C. HARRISON.

Department of Biochemistry,
Queen's University,
Belfast.
May 25.

[1] Keilin, D., and Hartree, E. F, *Proc. Roy. Soc.*, B, **125**, 171 (1938).

[2] Keilin, D, and Hartree, E. F., *Proc. Roy. Soc*, B, **119**, 114 (1936).

[3] Harrison, D C., *Biochem. J.*, **23**, 982 (1929).

[4] Harrison, D. C, *Biochem J*, **25**, 1016 (1931).

Dismissals of Scientists in Austria

BRITISH and other scientists will be interested to know the position of some of their colleagues in Austria since the recent annexation of that country. It is difficult to get reliable information, as the dismissals, arrests and other measures of repression are not officially published, and the state of affairs in the Austrian universities and technical schools changes from day to day. Nevertheless, it is possible to give a preliminary and incomplete account of what has been happening in the field of the natural sciences. It should be borne in mind that the state of affairs in other fields is likely to be worse, since the natural sciences do not touch on political questions, while philosophy, history, sociology, etc., do.

The following is a list of professors of the natural sciences who have been dismissed (lecturers and assistant professors are not included):

Prof. Emil Abel, physico-chemist, Technical High School of Vienna.

Prof. Benndorf, physicist, University of Graz.

Prof. Felix Ehrenhaft, physicist, University of Graz.

Prof. Fritz Feigl, analytical chemist, University of Vienna.

Prof. Fuerth, physiological chemist, University of Vienna.

Prof. Philipp Gross, physico-chemist, University of Vienna.

Prof. Victor Hess, physicist, University of Graz (Nobel Prize winner).

Prof. Mark, physico-chemist, University of Vienna.

Prof. Stephan Meyer, director of the Radium Institute of the Academy of Sciences, Vienna.

Prof. Pauli, colloidal chemist, University of Vienna.

Prof. Karl Przibram, physicist, University of Vienna.

Prof. Hans Thirring, theoretical physicist, University of Vienna.

Prof. Otto Redlich, physico-chemist, Technical High School of Vienna.

Among the arrested are:

Prof. Baule, mathematician, University of Graz.

Prof. Karl Buehler, psychologist, University of Vienna (since released).

Prof. Dobretsberger, rector of the University of Graz.

Prof. Loewi, physiological chemist and pharmacologist, University of Graz (Nobel prize winner).

The following professors have been dismissed from the famous medical school of Vienna:

Drs. Julius Bauer, Richard Bauer, Bustin, Elias, Erlacher, Leopold Freund, Froschels, Glaessner, Glas, Gottlieb, Julius Hass, Walter Hausmann, Hammerschlag, Leo Hess, Oskar Hirsch, Hecht, Lieben, Ernst Lowenstein, Marburg, Henrich Neumann, Moriz Oppenheim, Pappenheim, Paschkis, Ernst Pick, Pollak, Porges, Ranzi, August Reuss, Sauser, Schilder, Schueller, Schur, Gottwald Schwarz, Max Sgalitzer, Scheminzky, Sicher, Silberstein, Stern, Stransky, Robert Stein, Weninger, Willheim, Emil Zak, Walter Zweig. Dr. Bruecke, of Innsbruck, has also been dismissed.

Among the physicians:

Prof. Ferdinand Blumenthal, the German authority on cancer, who was living in Vienna, is in prison; Prof. Oskar Frankel, the gynæcologist and histologist, and Prof. Knoepfelmacher, the well-known specialist in children's diseases, have committed suicide.

It must be pointed out that these measures have been directed against men of varying political convictions, and have hit those who were active in the Christian movement and those who were simply opposed to official Nazi principles, as well as democrats, socialists and Jews.

Margaret Gardiner.
(Hon. Secretary.)

For Intellectual Liberty,
23 Haymarket,
London, S.W.1.
June 3.

Darwin Misunderstood

To argue fully Sir Edward Poulton's two main points[1] against my biography—the "fragmentary" nature of Darwin and his "fear" of his father—would take more space than I can ask for. I will only remark on the first point that the term "fragmentary" was intended by me to refer primarily to categories of imaginative and intellectual activity, and that my case is not even touched by the fact that Darwin was, as everyone knows, the best of neighbours and friends; and on the second point that no more is Darwin's alleged "fear" of Robert Darwin disproved by citing his "boundless and most touching reverence," since—as any psychologist might testify—it is the very "boundlessness" of that reverence which suggests some hidden and contradictory motivation, lying in all probability, I would hazard, below the threshold even of Charles Darwin's own consciousness.

I stand by both these points (though admitting that the second can be of its nature only speculative), but I will readily confess that in relation to the first some of my statements were either too bold or too bald—sometimes both—and have been amended in the American edition published last month by the Yale University Press, where the sub-title "The Fragmentary Man" has been retired from the title-page to its proper place—the final chapter which I myself would prefer to regard as a personal comment upon, rather than integral part of, my biography. To make my point of view—which is one of the highest admiration for Darwin as man *and* as scientist—rather clearer, I should like to quote a few lines which appear in my American but not English preface to the book: "If I would attack anything, it is neither Darwin nor even Darwinism but dogmatism, above all that dogmatism which regards its own particular truth—whether scientific, artistic, or religious—as final. Like Emerson, I do not believe in final truths, nor do I regard it as a derogation of a great man to indicate that he, like every other natural creature, had his limitations. On the contrary, I would contend that greatness only yields its full harvest when its limitation is completely understood."

I should also like to stress the fact that my book is primarily a biography—in nineteen, indeed, out of twenty chapters—and not only of Charles Darwin but also of his grandfather Erasmus, and of the immediate Darwin and Wedgwood families from 1730 to 1896.

Geoffrey West.

22 Lathbury Road,
Oxford.

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[1] Nature, 141, 807 (May 7, 1938)

Those who have read the words quoted from Mr. Geoffrey West's book will have formed their own opinions upon the fairness of my comments. I feel sure that they will be glad to learn the intentions of the author and also to know that the word "fragmentary" is not prominent in the American edition.

Edward B. Poulton.

Wykeham House,
Oxford.

Convergent Sunbeams

I can add to the correspondence on the above subject in Nature of February 19 and March 26 by reporting that I have observed the phenomenon on numerous occasions at Diyatalawa, a village at an altitude of 4,000 ft. on the eastern side of the central hills of Ceylon. The western horizon about eight miles away is the edge of a block of rough mountainous country with many peaks of about 7,000 ft. altitude (including the well-known Adam's Peak). During the clear weather of spring and summer, I frequently observed the shadows converging on the eastern horizon at sunset, and I used to wonder if they could be produced by prominent peaks as well as by clouds.

J. E. Jackson.

Survey Office,
Badulla, Ceylon.
April 24.

Preparation of Radio-Element $^{32}_{15}P$ by Means of an Electric Field

I WISH to correct slightly my recent letter in NATURE[1] on this subject. The number of neutrons emitted by a radium plus beryllium neutron source has been accurately measured (C. J. Bakker[2] and other observers) and found to be $(2 \cdot 1 \pm 0 \cdot 2) \times 10^4$ neutrons per sec. per mC. radium. The source of 120 mgm. used in our experiments emitted during nine days about $1 \cdot 96 \times 10^{12}$ neutrons. If each neutron transformed an atom of sulphur into radio-phosphorus (ideal case certainly not realized) we should obtain $1 \cdot 96 \times 10^{12}$ atoms of $^{32}_{15}P$ weighing about 10^{-10} gm. Hence the coloration and the increase in weight of 3·7 mgm. of the electrode in our experiment cannot be due to the radio-phosphorus.

Nevertheless, as is shown by our experiments on the photographic action of the electrodes[3] and the measurements with the Geiger-Müller counter, practically all the activity is collected on the electrodes. Spectroscopic and chemical experiments are proceeding in order to determine the cause of the coloration and increase of weight of the electrodes.

Note added in Proof. After sending the above correcting letter, Prof. F. A. Paneth (London), M. Goldsmith (Paris) and Dr. J. Tandberg (Stockholm) wrote pointing out that, in connexion with the number of kicks per minute observed, we obtain a quantity of radio-phosphorus weighing less than 10^{-11} gm. I had myself made a similar calculation, but have not mentioned it above in order not to occupy further space needlessly.

J. GOVAERTS.

Laboratory of Radioactivity,
Institute of Physical Chemistry,
University of Liège.
May 20.

[1] Govaerts, J., NATURE, 141, 871 (1938).

[2] Bakker, C. J., *Physica*, 4, 723 (1937).

[3] Groven, Ch., Govaerts, J., Guében, G., NATURE, 141, 916 (1938)

Points from Foregoing Letters

New values for the 'packing fraction' of atoms of titanium (mass 48), chromium (mass 52), nickel (mass 58) and bromine (mass 79 and 81) are given by Dr. F. W. Aston, as calculated from mass spectrographic measurements on doublets (electrically charged atoms and groups of atoms having the same mass/charge ratio). A knowledge of the packing fraction is necessary in calculating energy changes involved in atomic transmutations.

Clarifying and commenting on some of the statements on resonance and nuclear photo-effects, dealt with in a previous note, Prof. N. Bohr points out that in the case of strictly monochromatic radiation one cannot separate the initial excitation of a certain mode of oscillation from its subsequent quenching due to coupling; also the selectivity is independent of the ratio between the chances of the re-emission of the whole energy as a single radiation quantum in the initial and in the subsequent stage of the excitation process.

A temperature gradient in liquid mercury has been shown to give an electromotive force, the current flowing in the external circuit from the hot to the cold side (first "Benedicks effect"). Further experiments by Prof. C. Benedicks and P. Sederholm show that when the mercury is purified and freed from gas the E.M.F. changes sign. The author suggests that the known anomalous behaviour of mercury, which gives a negative sign for the Thomson effect, might also disappear if suitably purified mercury were used.

By injecting labelled radioactive sodium phosphate into frogs and afterwards determining how much of the labelled phosphorus is combined as creatine phosphoric acid, Prof. G. Hevesy and O. Rebbe find that, in the course of a day, practically all molecules of creatine phosphoric acid in the muscle are broken up and 'rejuvenated'. The phosphatide molecules in the blood of the dog, on the other hand, were found to take up only a small amount of labelled phosphorus during 24 hours, indicating a low rate of rejuvenation.

Messrs. Craxford and Gatty and Lord Rothschild discuss the theory of adsorption potentials and some recent work of Ehrensvärd and Sillén on this subject. From the results obtained by the latter, the authors conclude that the early stages of a diffusion gradient in oil-water interphases may confine the diffusion to the first one or two molecular layers of the oil phase.

D. F. Cheesman, A. King and Dr. J. N. Sugden report that certain inorganic salts, such as potassium iodide, while increasing the interfacial tension, have the property of stabilizing the emulsion of water in amyl alcohol.

Tests have been carried out by C. J. Briejèr to determine the insecticidal effect of methallyl chloride in a gaseous condition. This material proved to be efficacious for combating insects both in stores and in the soil.

Dr. A. Wood is applying to the International Committee for Zoological Nomenclature for a suspension of the priority rules, which would enable the specific name *pecten* Linn. to be retained for the Silurian brachiopod which Linnæus probably had before him, rather than it should be applied to *Pterinopecten papyraceus* from the coal measures, which was figured by Lister and cited by Linnæus.

The blood of the rabbit, horse, and also of normal human beings, is found by C. Wetzler-Ligeti and Dr. B. P. Wiesner to contain a positive 'restropic' substance, that is, to increase the activity of the reticulo-endothelial system, as measured by the 'Congo-red index'. The blood of human patients suffering from cancer was found to be either inactive or more generally to have a lower Congo-red index.

Prof. D. C. Harrison states that while he does not doubt the existence of the enzyme 'indophenol oxidase' (also known as cytochrome oxidase), as postulated by Keilin and Hartree, this alone does not explain all the experimental facts observed; for example, the production of a positive indophenol reaction on adding hypoxanthine to liver suspension in the presence of cyanide, which inhibits the activity of the indophenol oxidase. To explain satisfactorily the indophenol reaction of the cell oxidations Harrison postulates an additional secondary oxidation by hydrogen peroxide, of a similar mechanism.

Research Items

Ancient Pottery from Peru

A SERIES of ancient Peruvian vases presented to the Department of Ethnography of the British Museum (Bloomsbury) by the Christy Trustees has been described and figured by Mr. H. J. Braunholtz (*British Museum Quarterly*, 12, 2, 1938). Some examples are without parallel in any other collection. Of the thirty-seven vases, thirty-one unmistakably belong to the Nasca region of the southern Peruvian coast. The remaining six are of Early Chimu and Chimu types from northern Peru. It is still impossible to assign any more precise dating to the Nasca or proto-Nasca ware than the first half of the first millennium A.D.; but as a result of a detailed analysis by Kroeber, this ware has been divided into three groups, forming a chronological sequence, A and B with an intervening X. By this definition the figure vases with modelled heads in the British Museum series fall into group B, while the flaring bowls, though having A shapes, are also to be assigned to group B on account of their painted designs. The 'jagged staff demon', a mythological figure, is characteristic of the B group, and a progressive subordination of realism to decorative purposes is shown in the suppression of the body and the disconnected treatment of the legs. Figure vases representing women have variations of the 'jagged staff demon' painted on their cloaks at the back. Modelled figures, especially animals and birds, from Nasca are rare. Some interesting points are raised by those in this series. The style and colour justify their inclusion in Early Nasca, but a double-bodied figure representing an owl is typical rather of northern Peru, where such figures belong to the Late Chimu period, considerably later than Early Nasca. This specimen has a further affinity with Chimu in being a whistling vase. Another vase in the form of a snake or eel-like creature is also of the whistling type.

Decorative Art of the Australian Aborigines

DR. DANIEL SUTHERLAND DAVIDSON, assistant professor of anthropology in the University of Pennsylvania, under a fellowship grant of the Science Research Council of New York, has made a study of the decorative art of the aborigines of Australia, based upon an examination of material in the Australian museums, and on field work in north Australia (*Mem. Am. Phil. Soc.*, 9; 1937). This study is to be regarded as preliminary, in view of the absence of information from certain specific localities and the difficulty of securing painted, as opposed to incised, objects. Aboriginal paint is impermanent, and certain classes of painted objects are always burnt at the close of the ceremonies in which they are used. Only objects of major regional or continental significance have been considered. The aborigines gave considerable attention to the decoration of their possessions, utilitarian and sacred. Much Australian art is primarily æsthetic, but much also of profound religious significance. Designs are usually applied by incising or painting. Other techniques are employed, but little is known of this subject, or of symbolism and design analysis. Many of the designs are of local distribution. Others are scattered all over the continent. Although the psychological incentives are more or less constant, the expression in design and technique varies according to historic influences. The continent basically seems to be an art unit, historically considered. Available evidence in respect of contemporary art indicates that Australia can be divided into five roughly determined and overlapping design areas, each divisible into sub-areas. These areas have permanent characters; but changes in design and styles of portrayal are currently taking place as the result of diffusion and local elaborations.

Cerebro-spinal Fluid

THE content of a series of lectures on the meninges and the cerebro-spinal fluid delivered at University College, London, has recently been given by Prof. L. H. Weed (*J. Anat.*, January 1938). The article furnishes an interesting account of the history of the discoveries and theories relating to this subject from as far back as Alexander Monro, 1783, up to the present day, when a considerable amount of research on it is being carried out in the author's laboratories. It is now established fairly satisfactorily that the cerebro-spinal fluid is secreted by the choroid plexuses and thence passed into the neural cavities. The excess passes from the 4th ventricle into the subarachnoid space and thence, via the arachnoid papillæ, directly into the venous system. The cerebro-spinal cavity is regarded as a closed system which protects its contents from changes in atmospheric pressure. When man's precursors adopted an upright posture, it naturally affected the pressures in the column of fluid in the cerebro-spinal cavity, and apparently no protective mechanism has been developed to meet this. It is not so serious a problem as might be expected since, as the author shows, the closed cerebro-spinal system has a morphological and physiological mechanism whereby the volume of the brain can vary, the volume of the blood can vary, the volume of the cerebro-spinal fluid can vary, but the total volume of the whole contents of the system can remain relatively constant.

Genotypic Selection for Weight in Mice

AN interesting experiment in selection for increased size in the albino mouse is described by Dr. H. D. Goodale (*J. Heredity*, 29, No. 3). He used the method of genotypic rather than phenotypic selection, that is, selection by progeny test. The experiment began in 1930 with 4 males and 8 females, a similar number being added the following year. The thousandth male was born three years later, and all descendants since that date, January 1934, are derived from 16 mice. The males at first averaged 26 grams and the females 21·3 grams. Matings were made only on the basis of weight at two months after birth and without regard to relationship or age; so the generations overlap, ranging from 12 to 16 for the whole experiment to date. The mean weight shows a steady increase, the last 500 males averaging 36·4 grams, an increase of 40 per cent. The present average weight exceeds by several grams the maximum weight of mice in the early generations. It is suggested that the present results indicate the presence of at least 32 pairs of genes affecting weight. The results can be explained in terms of the multiple factor hypothesis ; but there is no indication that the limits of size are being approached, or of the number of genes affecting size which may be present. The results are not attributed to the occurrence of size mutations during the experiment, but to the method of selection adopted.

Metabolism in Lepidoptera

MR. I. W. KOZHAUTSHIKOV, of the Zoological Institute, Academy of Sciences, Leningrad, has recently published an article on the above subject (*Bull. Entomol. Res.*, March 1938). It is concerned with carbohydrate and fat metabolism in certain moths, namely, the common species *Agrotis segetum*, *Pyrausta nubilialis* and *Loxostege sticticalis*. Moths reared from caterpillars, bred under optimal conditions, were used in these experiments just after they had emerged. It appears that fat synthesis is of great importance in the metabolism for the maintenance of the body weight with the same supply of energy and for egg-yolk production. Moths increase their live weight by the consumption of sugar solution often by 40–50 per cent, but the fat synthesis out of sugar, and the water output, rapidly reduce the live weight to normal. Changes in the respiratory quotient show a peculiar metabolic phase after carbohydrate nutrition due to fat synthesis. The fat synthesis of carbohydrates results in a decrease in oxygen consumption for the reason that the oxygen liberated by the fat synthesis reaction is utilized. The author recognizes two types of specialization of carbohydrate metabolism as being present in adult insects. He quotes Beutler (1936) as showing that in bees, sugar is used directly without transformation into fat, and no reserves of fat have been observed in these insects. The reserves of sugar are found in the stomach, and the activity of the insect is only possible so long as these reserves are not used up, feeding being necessary many times a day. In Lepidoptera, on the other hand, a large quantity of sugar can be taken during a short period and utilized after its transformation into fat. Feeding is not necessary every day for some species, and they can live for their normal period, even if food is taken only once during the first few days of adult life.

Agaricaceæ of Hokkaido, Japan

AN extensive, detailed survey of the agaricaceous fungi which occur in Hokkaido, Japan, has recently been published by Sanshi Imai (*J. Fac. Agric. Hokkaido Imp. Univ.*, 43, Pt. 1, 1–178, with 3 plates, March 1938). Studies were commenced in 1924, and now twenty new varieties are described, many of them for the first time. A modified classification is used, which accommodates the Japanese species without rupturing well-established groups. New tribes and subgenera are established with Latin diagnoses, whilst the descriptions of species are detailed, and in English. The volume is critical and contains adequate references ; it provides a fitting superstructure to the modest mycological foundations first laid in Japan in 1860 by two British investigators, M. J. Berkeley and M. A. Curtis. Thirty-two excellent halftone illustrations, combined into the three plates, include many of the new species, and also show a few kinds which are common in England. The general impression of the present volume, however, is that of a special flora, typical of Japan, and having but little in common with other fungus floras of regions in the same latitude.

Crystalline Preparations of Potato Virus *X*

THE virus of tobacco mosaic has been isolated as a crystalline nucleo-protein of high molecular weight. This particular virus has, however, many properties different from other viruses, and it did not appear safe to assume that the others would have similar composition. Messrs. F. C. Bawden and N. W. Pirie have recently shown (*Brit. J. Exp. Path.*, 19, 66–82, 1938) that the *S* and *G* strains of potato virus *X*, isolated from infected tomato, tobacco or *Nicotiana glutinosa* plants, do indeed yield nucleo-proteins, which can be prepared as liquid crystalline extracts. No such preparations could be isolated from healthy plants, and all available evidence suggests that they are the viruses themselves. Concentrated solutions were spontaneously birefringent, and dilute solutions exhibited anisotropy of flow, as was established for tobacco mosaic virus. Filterability and various types of inactivation were described for both viruses. Potato virus *X* is perhaps more typical of viruses in general than tobacco mosaic, so it seems more probable that all viruses may be specialized nucleo-proteins.

Desiccation in West Africa

THE problem of progressive desiccation in the western Sudan between the Sahara and the humid belt has received much attention in recent years. Prof. E. P. Stebbing recently developed a theory of the steady encroachment of the Sahara on Nigeria and the replacement of the natural vegetation by drier types. The problem has lately been investigated by an Anglo-French Forestry Commission in northern Nigeria and the French Niger colony. In an article in the *Geographical Journal* of May, Mr. Brynmor Jones reviews the evidence especially as regards northern Nigeria and reaches somewhat different conclusions from those of Prof. Stebbing. Silting up of streams and river capture have reduced the amount of surface water on the fringe of the Sahara, but this process is very slow and does not contribute an immediate threat to the prosperity of the West African colonies. It can, moreover, be delayed by protection of head waters and by flood control. Protection of forests in certain places in order to check erosion is advisable, and the practice of shifting agriculture is certainly harmful in the drier parts in accelerating erosion. But Mr. Jones finds little evidence that depopulation is due to desiccation. He attributes it rather to political and economic factors, inter-tribal wars, slave raiding and pestilence. He is guarded on the problem of climatic changes. These have no doubt occurred since the Quaternary period, but changes are too slow to be noticeable in the space of a few hundred years. Minor oscillations are characterized by cycles of years of relatively high or relatively low rainfall. The last major change appears to have been one towards more humid conditions.

Volcanic History of Montserrat

EARLY in 1936 the Royal Society, in collaboration with the Colonial Office, organized an expedition to Montserrat, with the object of studying the geology of the island and of investigating earthquakes and soufrière activity that had caused considerable damage and alarm in the two previous years. A. G. MacGregor, the geologist of the expedition, has now published the results of his investigations (*Phil. Trans. Roy. Soc.*, B, 229, 1–90 ; 1938). An outline of the geological history and structure of the island and an account of the active soufrières is followed by a detailed petrological study of the rocks. The latter are mainly labradorite-dacites and olivine-basalts, but nevertheless they represent almost the full range of types known in the Caribbean volcanic arc. The chemical characters are brought out with the aid of seven new analyses, and it is shown that there are many analogies with the Lassen Peak district of California. Special attention is devoted to cognate xenoliths and dome formation; magmatic corrosion of feldspar phenocrysts; oxidation and resorption of hornblende; origin of breadcrust bombs of the peléan type; and the occurrence of tridymite and cristobalite. It is pointed out that prediction in regard to future events in the Lesser Antilles is made difficult by the lack of continuous scientific records of past soufrière activity and earthquakes. Since 1692, the longest period that has elapsed without volcanic disturbance somewhere in the arc is 47 years, but on seven occasions the interval of tranquillity has been seven years or less. There is thus every reason to believe that eruptions or earthquakes will be renewed in the arc at no very distant date, and probably more than once in the lifetime of the present generation.

Methylene

THE methylene radical, CH_2, has often been invoked as an intermediate in combustion reactions, the thermal decomposition of hydrocarbons, and other processes. The first direct evidence of its existence was obtained in photochemical investigations on the decomposition of keten: $CH_2:CO = CH_2 + CO$. T. G. Pearson, R. H. Purcell and G. S. Saigh (*J. Chem. Soc.*, 409; 1938) now describe the formation of methylene from keten and diazomethane ($CH_2{:}N_2 = CH_2 + N_2$) by thermal and photochemical decomposition. Keten is not easily decomposed thermally to give methylene but readily does so when exposed to light of 2580–3130 A. Diazomethane is thermally decomposed to produce methylene. The apparent life of the methylene was different when produced from keten and diazomethane, being very long in the first case and similar to that of an alkyl radical in the second. The methylene was detected by reaction with selenium and tellurium. The authors describe a large amount of experimental work and they consider that their results show that free methylene should be regarded as a highly reactive molecule rather than a free radical in the sense that methyl is. Its persistence is therefore a function of its environment, as indicated by the varying life when obtained from different materials. A consequence of this point of view is that the carbon atom in methylene is essentially bivalent, or in a ^3P state, as postulated by Nef and others and recently emphasized by Norrish and collaborators.

The *p*H Scale

IT is customary to determine pH values by means of the equation (1): $pH = (E-E_0)/2{\cdot}3026(RT/F)$, where E is the potential of the cell: (Pt), H_2: solution X: KCl sat.: reference electrode (A), and where E_0 is a constant at a given temperature, depending on the nature of the reference electrode. It is also customary to interpret pH according to the equation: $pH = -\log a_{H^+}$, where a_{H^+} is the hydrogen ion activity. This procedure is based on the belief that the liquid junction potential at the boundary between solution and saturated KCl solution is very small or constant. D. A. MacInnes, D. Belcher and T. Shedlovsky (*J. Amer. Chem. Soc.*, 60, 1094; 1938) direct attention to certain difficulties in this procedure, and propose another method of calculation in which the equation (1) is retained, but they adjust the thermodynamic quantities as closely as possible by means of a shift of E_0 from the value commonly used. For this purpose, buffer solutions were used as solution X. If C_{HA} and $C_{A'}$ are the concentrations of weak acid and its anion in the buffer solution, they find that $pK' = pH - \log (C_{A'}/C_{HA})$ has, up to an ionic strength $\mu = 0{\cdot}01$ mol./lit., an empirical value $pK' = pK_0 - B\sqrt{\mu}$, where pK_0 and B are constants. The value of E_0 is then adjusted so that the equations yield a value of pK_0 equal to the thermodynamic constant pK. The pH values of commonly used acetate and phthalate buffers were so redetermined at three temperatures. The authors point out that the uncertainties in the liquid contact potentials and the theoretical impossibility of finding single ion activities lie at the root of the present difficulties in setting up a pH scale.

Visible Radiation of Electrons in Pure Liquids

P. A. CHERENKOV (*Bull. Acad. Sci. U.R.S.S.*, 491; 1937) finds that when fast electrons (β-rays or Compton electrons) pass through pure liquids they cause a faint visible radiation showing unusual properties. The spectrum is continuous and extends into the far ultra-violet; the energy distribution shows an increase to shorter wave-lengths. The most characteristic feature of the radiation is its asymmetrical distribution in angle around the path of the electron. According to a theory developed by I. M. Frank and I. F. Tamm, the radiation is due to the velocity of the electrons in the medium being greater than the phase velocity of light in the medium.

Markings on a Satellite of Jupiter

UNDER the title "Markings of the Third Satellite of Jupiter in Transit across the Planet", a paper by Dr. E. M. Antoniadi has recently appeared (*J. Brit. Astro. Assoc.*, 48, 7; May 1938). At the end there are several notes by Mr. B. M. Peek, director of the Jupiter section, in which he refers to the work of other noted observers, more especially members of the British Astronomical Association. Dr. Antoniadi has produced some very beautiful drawings showing the appearances presented by satellite iii in transit in 1927, and beside these he has placed drawings made by W. R. Dawes during transits in 1849, 1860 and 1867. The evidence that the satellite rotates in the same period that it requires to revolve around Jupiter can now be considered established. The author of the paper points out that although satellite iii is frequently represented as larger than satellite iv, this is not correct. Satellite iv is actually the largest of all such bodies in the solar system. Another interesting matter is referred to. Although the mass of the satellite is more than twice that of the moon, yet the velocity of escape is almost comparable from the gravitational point of view. But as the satellite receives considerably less heat than our moon, the velocity of the gaseous molecules is thereby lessened, and it is possible that the satellite may have a highly rarefied atmosphere of heavy gases. The apparent distortion of satellite iii, which has been noticed by many observers, presented a difficulty until 1921, when the Rev. T. E. R. Phillips showed that it was due to the spots of the satellite.

Hydrobiology and Fisheries Laboratory, Alexandria

IN a review that appeared in NATURE[1] of some publications of the Directorate of Hydrobiology and Fisheries, Egypt, F. S. Russell concludes thus: "Now that research is on so sound a footing, the Egyptian Government should see grounds for fostering and furthering investigations in this most interesting region". Dr. C. Crossland has already described in NATURE[2] the Marine Station of the Egyptian University at Hurghada on the Red Sea, and a short description of the Egyptian Government Laboratory on the Mediterranean at Alexandria may be of interest.

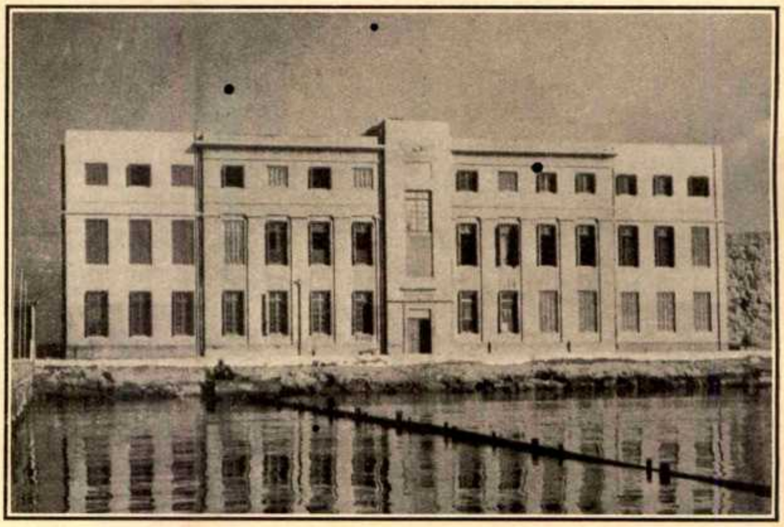
The favoured position of Egypt overlooking two seas, the incomplete knowledge we possess of the Eastern Mediterranean basin, and the existence of two main factors influencing that basin, namely, the opening of the Red Sea on the Mediterranean through the Suez Canal, and the Nile flood arriving at the coast by the end of summer, and throwing great quantities of freshwater into the Mediterranean—all these facts present problems of exceptional interest for research workers in aquatic biology.

The Cambridge Expedition to the Suez Canal[3] has already proposed to repeat its exploration after a lapse of only ten years. Workers at the Hydrobiology and Fisheries Laboratory have carried out some research round Alexandria, in which the effect of the Nile flood on the area is incidentally touched upon. In the Suez Canal, the regime of currents has been studied by monthly observations of salinity, oxygen content and temperature at nine stations on the Canal; and the movements of the phytoplankton have been examined at six stations. These studies must be continued in order to observe any changes produced by the Red Sea waters reaching the Mediterranean for at least nine months every year, and the Nile flood water breaking, between September and August, through the earth barrages artificially raised at the mouth of the delta every year in February.

The Laboratory at Alexandria offers facilities for visiting scientific workers to proceed with research on these lines, or in any other direction. A launch is attached to the Laboratory, for short coastal trips, and the research steamer *Mabahiss* can be used for more important cruising.

The laboratory is a three-storied building, situated on the tongue of land supposed to be the promontory of Pharos Island, on which stood the famous lighthouse of the Ptolemies. It overlooks, from the south-eastern side, the bay now known as the Eastern Harbour, and from the north-western side, the open sea. This situation unites the advantages of being right near the sea, and of being twenty minutes journey by bus or tramway from the centre of the town of Alexandria. Accommodation for living on the premises of the laboratory is thus rendered unnecessary.

The ground floor contains the show-aquarium, with twenty-four tanks, and sea or fresh-water *ad libitum*. There are four research cubicles, with sea and fresh-water laid on to taps, and possibility of establishing research aquaria when needed. The chemical store, a dark-room, bath-room, lavatories, and store-room for gear, etc., complete the ground-floor.



THE ALEXANDRIA MARINE LABORATORY.

There are seven research laboratories on the first floor; there are incubators, fume cupboard, electric centrifuge, accurate balance and refrigerator. The offices and the Director's laboratory complete this floor.

The library and the museum occupy the second floor.

On the roof is a cement tank for sea water, with pipes to the aquaria and the laboratories. Sea water is brought in to another cement tank at the basement of the laboratory by an 'eternite' (asbestos and cement combined) pipe laid for sixty metres in the water of the Eastern Harbour; water is drawn from this tank by electric pumps which either send the water to tanks under the ground floor, where it can be filtered, or directly to the roof-tank.

Applications for work and for more ample information, should be sent to the Director, Marine Laboratory, Kayed Bey, Alexandria.

HUSSEIN FAOUZI.

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[1] NATURE, **137**, 1080 (June 27, 1936).

[2] NATURE, **134**, 743 (Nov. 10, 1934).

[3] *Trans. Zool. Soc.*, **22** (1924).

The London Television Service

A MEETING of the Institution of Electrical Engineers held on April 21 was devoted to a series of papers describing the development of the television broadcasting service which has been operated by the British Broadcasting Corporation at the Alexandra Palace station since August 1936. The first paper, by Messrs. T. C. Macnamara and D. C. Birkinshaw entitled "The London Television Service", recalled certain early electrical discoveries which laid the foundations of modern television. The Nipkow scanning disk was invented in 1884 and is still in use in certain systems to-day; while in 1908, A. A. Campbell Swinton described the forerunner of the present-day cathode ray tubes used both for scanning and for reproduction purposes.

In 1929, arrangements were made between the B.B.C. and Baird Television, Ltd., for the first regular transmissions from a London station of television programmes of the low-definition type, using 30-line scanning and 12½ pictures per second. Some five years later, His Majesty's Postmaster-General appointed a committee under the chairmanship of Lord Selsdon to review the development of television and to advise on the conditions under which a public service should be conducted. The recommendations of this committee were put into effect in August 1936, by the inauguration of the London Television Station at Alexandra Palace. After a trial period, in which the technical merits of two systems of high-definition television were compared, the same committee announced in February 1937 that the London station would in future use the Marconi–E.M.I. system with its interlaced scanning with 405 lines and 25 frames per second. The use of interlaced scanning is advantageous in that it has the apparent effect of increasing the picture-repetition frequency to 50 per second, at which no flicker is perceptible to the eye, without increasing the band of modulation frequencies required.

A detailed discussion of the development of this standard of scanning with a specification of the radiated wave-form employed is given in the second of the series of papers, entitled "The Transmitted Wave-form", by A. D. Blumlein. The transmission is of the so-called direct-current type in that there is no fixed average value of the carrier wave amplitude. Under normal running conditions, with no transmitted picture, the 'all-black' condition is represented by the carrier wave amplitude being at 30 per cent of its peak value, the line and frame synchronizing impulses reducing this to zero amplitude at the appropriate intervals. This arrangement of the conditions is claimed to minimize the effect of interference on the synchronism of the received picture. The 'all-white' condition is represented by full modulation at the peak amplitude, so that the vision signals occupy values between 30 per cent and 100 per cent of the radiated carrier. Details of the equipment which has been developed to handle the modulation which arises from this method of transmitting the picture signals are given in the third paper, entitled "Vision Input Equipment", by C. O. Browne. This paper includes a cursory description of the technical features of the equipment, and contains a list of references to more detailed information.

The fourth and last paper of the series was presented by Messrs. N. E. Davis and E. Green under the title "The Radio Transmitter". The vision transmitter at the London station was designed to give a peak output power of 17 kw. when a steady condition is maintained corresponding to the transmission of a full white picture. The general design of the transmitter was based on the fundamental principles which have now been in use for some years in commercial short-wave communication transmitters, but certain new problems were met in adapting this design to the ultra-short wave-length of 6·7 m. (frequency 45 Mc./sec.) required and also to enable it to handle the unusually great modulation bandwidth of ± 2·5 Mc./sec. The paper gives some details of the circuit, valves and assembly employed at the Alexandra Palace station.

Reverting to the first paper by Macnamara and Birkinshaw, considerable space is devoted to a general description of the London Television Station, with plans of the accommodation and details of the studios and equipment employed for the staging and production of the vision programmes radiated. For outside broadcasts, a fleet of special motor vans has been developed, these carrying respectively a mobile studio, an ultra-short wave transmitter for providing a radio link with Alexandra Palace, and a mobile power supply for the above two vehicles. In addition, a fourth vehicle is used to carry an extensible self-supporting wooden ladder of the fireman's type, to provide an aerial mast for the local mobile transmitter. Reception from this transmitter is carried out with a radio link receiver installed at Alexandra Palace, but precautions have had to be taken to secure freedom from interference from the main vision transmitter.

To avoid difficulties involved in the operation of such an ultra-short wave radio link, a balanced low-capacitance cable, primarily designed for television, has been installed between Alexandra Palace and central London, tapping points being provided at frequent intervals along the cable route at what may be considered to be the main points of interest from a television programme point of view. In addition, experiments have been conducted into the use of short lengths of ordinary telephone line whereby extensions may be made from the main television cable.

The latter portion of the paper gives the results of a field strength survey of the radiation from Alexandra Palace, and a contour map illustrates the distribution of the field at distances up to 25 miles from the station. This was the range originally estimated for, but it is now safe to say that good reception can be obtained up to about 35 miles, except in cases where unusually bad interference is encountered. Under exceptionally favourable conditions, good reception has been reported at distances of 40 to 60 miles, and while reception is still possible at much greater distances up to a few hundred miles, this usually does not come up to the standard of reliability which it is desirable to attain in a public broadcasting service.

Altogether these four papers form a useful and interesting record of the successful development and operation of what still remains the first public television service in the world. R. L. S.-R.

Association of Teachers in Technical Institutions

ANNUAL CONFERENCE AT LEEDS

THE twenty-ninth annual conference of the Association of Teachers in Technical Institutions was held in Leeds on June 4–7. A civic welcome was accorded to the delegates by the Deputy Lord Mayor of Leeds, who was supported by the Director of Education. The president for 1938–39, Mr. A. C. R. Ritchie (Gravesend), was inducted by the retiring president, Mr. W. E. Park (Luton). In his presidential address, Mr. Ritchie reiterated the Association's belief in the principle of collective security and said that in spite of the rapid deterioration in standards of international integrity, "we believe that it is not too late for the nations to get together in a sane and orderly atmosphere, so that they may work together for the common good of their people, and that the wonders of scientific discovery and inventive genius may at last be directed towards increasing human happiness instead of being prostituted to the destruction of modern civilization. After all," he asked, "what has civilization done for us if we cannot live peaceably one with another ?"

In this connexion, Mr. Ritchie referred to a remark by the Chinese Ambassador during a recent address to an international conference of teachers convened by the League of Nations Union. Arguing that "We will have to scuttle back to the humanities to save our lives, let alone ourselves," the Ambassador said, "Technical Education is now ripening to make us cave-men as its final fruit." Mr. Ritchie hoped he would not be misunderstood if he reminded the Ambassador that such a statement is scarcely fair to technical education. No one more than he sympathized with the desperate sorrows of peoples torn by war. But technical education is not necessarily responsible for those sorrows. On the contrary, it gives us possibilities of life-standards hitherto unknown. Could the Conference which His Excellency addressed have been held without the aid of technical education ? Here were representatives of many countries brought to London by all the modern forms of transport. Their words and thoughts were transmitted across space by means of inventions just as modern. Because social ideas move slowly, because a minority prostitutes the work of scientific workers and technologists, science and technology should not be blamed. If there are those who use it mischievously, it is their *ideas* which must be attacked and not the blessings of technology which must be delayed.

At the closing meeting of the Conference, Prof. H. Levy, of the Imperial College of Science and Technology, gave an address in which he sought to evaluate the part played by men of science and technologists in the present international situation. Since they have made possible the latest and most deadly means of war, he insisted that it is their duty to see where the application of their work is leading the world. They cannot, for example, shut their eyes to the experiments now being conducted in Spain and China. They have been brought up, he said, to believe that any contributions they make to scientific knowledge are to be regarded as a service to humanity. That is not true. The results of their work are at present being used to destroy humanity, and it is their duty to face up to that fact. They must learn, however, to watch such experiments as those in Spain and China unemotionally and with the same detachment as they regard an experiment in a laboratory. They must understand causes and effects, and to do that they must realize that, from man's first appearance, forces have been at work which have, at various stages in history, altered the economy under which society has been conducted. A feudal economy, for example, could not cope with new knowledge and it had to break up. The main forces which have driven man on through successive stages have been the discovery of new kinds of tools and the knowledge of new raw materials. These forces are more than ever at work. Technical men are producing a new technique. The new processes which are being discovered to control Nature are causing the stresses and strains, the wars and the revolutions which have been manifest since the end of the war in 1918. The man of science and the technologist, as individuals, can do little. But, if they see clearly what is happening and understand the significance of events and the part which their work is playing, they will discover the necessity for them to work through their groups and associations in order to save the world from disaster.

Pontifical Academy of Sciences

THE formal inaugural meeting of the second academic year of the newly reconstituted Pontifical Academy of Sciences (see NATURE, 140, 965; 1937) was held on January 30, 1938, in the presence of His Holiness Pius XI. The meeting, an account of which is contained in the Academy's *Acta* (2, Part 1, 1938), was held in the new hall which has been added to the Casina Pio IV, the Academy's headquarters in the Vatican gardens, through the generosity of the Pope. Besides a large proportion of the seventy academicians, there were present Church dignitaries and lay members of the Vatican Government, representatives of the Royal Italian Academy and of the Academy of the Lincei, and members of other Roman cultural and scientific bodies.

In his presidential address Father Gemelli, after paying tribute to the Pope's active and generous interest in the progress of science, surveyed the Academy's first year of existence. In addition to the publication of two large volumes of the

Commentationes and of the *Acta*, the Academy has instituted an inquiry among its members to determine what shall be its most useful function. The president emphasized that the Papal Academy differs from other national bodies of a similar nature in being truly international, since it contains members of many nationalities all of whom have equal rights and privileges. From the large number of replies to the president's inquiry, which are reproduced in the *Acta*, it would appear that there is a general desire that the Academy should not restrict its activities to the publication of individual scientific communications, but should take advantage of the freedom of action guaranteed by its scientific independence of race or creed to strengthen the bonds between the various sciences. The rules of the Academy have been the subject of further discussion by its council and members, and steps have been taken to ensure that in the election to vacancies in the membership the international character and the representation of the different sciences shall be maintained.

An annual prize, of the value of 25,000 lire, to be known as the Pius XI Prize, has been instituted. It may be awarded for any distinguished contribution to the progress of science made in the preceding ten years, either by a single important discovery or as a result of a series of systematic researches, or by a publication of great scientific interest. The president announced that the members of the Academy would shortly be called on to propose names for the 1938 award, which will be made for a distinguished contribution to the progress of biological science.

During the first year of its existence, the new Papal Academy has suffered the loss by death of three of its members, namely, Lord Rutherford, Paolo Luigioni, and the Marchese Marconi, and the main purpose of the inaugural meeting was to honour the memory of the last-named of these distinguished men of science. The Marchesa Marconi was present as an honoured guest at the ceremony. Guglielmo Marconi's immense contributions to physical science and to the development of wireless communication through space formed the subject of addresses by Prof. G. C. Vallauri of Turin, and Prof. W. F. Bjerknes of Oslo, both members of the Papal Academy. The latter, who is probably the sole surviving personal pupil of Heinrich Hertz, exhibited during his discourse the original 19-page manuscript entitled "Über elektrodynamische Wellen im Luftraume und deren Reflexion" in which Hertz described the first results of his experiments on electric waves. At the close of Prof. Bjerknes' address, Hertz's manuscript was examined by His Holiness with considerable interest. As was reported in *The Times* of March 26, 1938, the Pope's interest in this document (which was not, as reported there, presented by Prof. Bjerknes to the Papal Academy) found a practical expression in the personal gift of a sum of £250 to Hertz's widow, Mrs. Elizabeth Hertz, who is living in exile at Cambridge with her two daughters. The presentation of the gift was entrusted to Canon Marshall, of Cambridge, by Cardinal Hinsley, Archbishop of Westminster.

Pius XI, in his own address to the Academy, paid a personal tribute to the benefits conferred on mankind by the labours of Hertz and of Marconi, whose work, undoubtedly accompanied by Divine blessing, recalled the words of Schiller: "Soll das Werk den Meister loben, doch der Segen kommt von oben". The Pope also referred to his own deep-rooted interest in science and the search after truth—an interest which had in his own private life found an outlet in the love of Nature and a passion for the reading of books.

Oil from Coal

In the December 1937 issue of the *New Zealand Journal of Science and Technology* (19, No. 7), there is an interesting article, initialed "W. G. H.," on the production of oil from coal as seen from an Australian point of view.

The process of low-temperature carbonization is dependent for commercial success largely upon the acquisition of a market for the semi-coke produced. Such a market is readily found in Great Britain, where the smoke nuisance from raw coal burned in the domestic grate is acute. In Australia, however, very little raw coal is burned in the cities and there is consequently no market for semi-coke in this direction. Low-temperature carbonization might be considered as a subsidiary method of providing coke for the Fischer Tropsch process of synthesis of hydrocarbons or to provide coke for hydrogenation.

Economically, hydrogenation is unsound from the Australian point of view. The estimated cost of a plant capable of producing 45,000,000 gallons of petrol per annum from bituminous coal is approximately £11,000,000 (Australian currency) and for one working on lignite it is nearly £12,000,000. Allowing for a return on capital of 6 per cent and for amortization in ten years, the cost would be 17*s*. 3*d*. per gallon from bituminous coal and 18*s*. 2*d*. per gallon from lignite. The Fischer Tropsch process is no more attractive economically than hydrogenation in Australia. It has been estimated that to produce petrol at 8*d*. per gallon from a plant with an output of 9,000,000 gallons per annum, a subsidy of £300,000 or £1,000 per man per annum would be required.

The above facts admittedly do not commend any of these processes in Australia, but there are other important factors which would have to be carefully considered before deciding whether or not to erect a coal conversion plant in the Commonwealth. The chief of these are future supplies and cost of flow oil; payment in Australian goods for foreign supplies; possible interruption of supplies in the event of war; storage problems; the likelihood of finding flow oil in the Commonwealth; and the value of a new industry as an employer of both direct and indirect labour.

All these contingencies must be assessed before any decision is taken to erect a plant which at best can only produce a local product to compete with an imported article at one third to one quarter of the cost.

Science News a Century Ago

Philip Kelland appointed to Edinburgh

ON June 20, 1838, *The Times* announced that Mr. Kelland had been appointed to the chair of mathematics in the University of Edinburgh. The vacancy had been caused through the resignation on account of ill-health of Prof. William Wallace (1768–1843), who had held the chair since 1819. Kelland was the son of a clergyman and was born at Dunster, Somerset, in 1808. Entering Queens' College, Cambridge, he graduated in 1834 as senior wrangler and Smith's Prizeman, and for three years was a tutor. He held the professorship at Edinburgh until his death on May 7, 1879. Among his writings were a "Theory of Heat", papers on the motion of waves, the article on algebra in the ninth edition of the "Encyclopædia Britannica" and an introduction to quaternions. At the time of his death he was president of the Royal Society of Edinburgh. As a teacher he was unequalled.

Wheatstone and the Stereoscope

THE meeting of the Royal Society held on June 21, 1838, was the last before the long vacation. One of the papers was by Whewell on tides, and another was by Wheatstone entitled "Contributions to the Physiology of Vision. Part I. On some remarkable and hitherto unobserved Phenomena of Binocular Vision". In his paper, Wheatstone showed that the perspective projections of an object upon the two retinæ differ according to the distance at which the object is placed before the eyes; if it be placed so distant that to view it the optic axes must be parallel, the two projections are precisely similar, but if it be placed so near that to regard it the optic axes must converge, a different perspective projection is presented to each eye, and these perspectives become more dissimilar as the convergence of the optic axes becomes greater. Notwithstanding this dissimilarity between the two pictures, which is in some cases very great, the object is still seen single, contrary to the very prevalent metaphysical opinion that the single appearance of objects seen by both eyes is owing to their features falling on corresponding points of the two retinæ. To illustrate some of his views, Wheatstone used an apparatus called by him a stereoscope.

The Newcastle and Carlisle Railway

AMONG the British railways opened in 1838 was that from Newcastle to Carlisle, a distance of sixty-one miles, which was inaugurated with much ceremony on June 18. Describing the event, the *Tyne Mercury* said: "The anniversary of the battle of Waterloo, which crowned the British arms with success and restored peace to Europe, was selected as the day on which to celebrate the event, and one of the engines is named *Wellington*. Different portions of the railway have been opened from time to time, and made available for the commerce of the north; but on Monday the whole line was passed over for the first time. The engines started in the following order:—First the *Rapid*, as an advanced guard and without any train, displaying the Union Jack, next the *Meteor* with four carriages and a flag on which was inscribed 'England expects every man to do his duty'. In this train we observed the mayor of Newcastle and his friends with the Allenheads band; then followed the *Victoria* with nine carriages, the *Wellington* with nine, the *Nelson* with seven, the *Lightning* with ten and the Carlisle band; next the *Tyne* with its steam organ and nine carriages; after these came the *Carlisle* with eight, the *Eden* with ten, the *Goliath* with nineteen and about 600 passengers, then the *Atlas* with seventeen, next the *Samson* with eleven. . . . The *Newcastle* with nine . . . followed by the *Hercules*, the last of the list, with eight carriages." The *Tyne Mercury* estimated that the trains carried more than 3,500 passengers, and the procession when in motion extended over one and a half miles.

Disease Among Troops in West Indies

IN a paper read before the Statistical Society on June 18, 1838, and published in the *Athenæum* of June 30, on the sickness and mortality among the troops in the West Indies, Mr. Henry Marshall, deputy inspector-general of hospitals, and Captain Tulloch came to the conclusion that many of the opinions hitherto entertained of the nature and influence of the causes of diseases in the West Indies must have been adopted on inadequate evidence, since it appeared that no uniform effects were produced by exposure to a high temperature, by excess of moisture, by the combined effects of high temperature and great moisture, by the absence of trade winds during the sickly season, by the supposed influence of miasma from the South American continent, or by the physical and geographical character of the soil. In the absence of all tenable and consistent theories to account for the high mortality of the white troops in the West Indies, the suggestion was made that experiments should be undertaken on the electrical condition of the atmosphere during epidemic periods, the development of electrical phenomena being known to be intimately connected with heat and moisture, and to exercise an influence on vegetation.

Electric and Crystalline Polarity

FARADAY's first entry in his Diary for June 21, 1838, is: "Experimented on the effect of Polar arrangement of the particles of crystals on their specific inductive capacity, i.e., on their inductive capacity in different directions." The work thus begun evidently occupied him for the greater part of the summer, for the entries continue until August 14. The apparatus used was simple. Cubes of various crystalline materials, for example, Iceland spar and rock crystal, were cut with their faces parallel and perpendicular to the crystal axes. The cube under experiment was placed on a stand, and a brass ball, connected to a Leyden battery by which it was kept uniformly electrified, brought up to one face. The induction through the crystal was measured by means of a Coulomb torsion electrometer, the carrier ball of which was brought up to the opposite face.

A large number of measurements of the inductive capacity of the materials was made in directions parallel to and transverse to the crystalline axis, in the hope of detecting some difference. The experiments were afterwards described in the Fourteenth Series of the "Experimental Researches in Electricity", and although Faraday says that he "sought with great anxiety for a relation between electric polarity and that of crystallization", he came reluctantly to the conclusion that his results had "not established any connection of the kind sought for".

Retirement of Olinthus Gregory

In its issue of June 23, 1838, the *Mechanics' Magazine* said: "We understand that Dr. Olinthus Gregory, who has for the long period of thirty-five years presided over the Royal Military Academy, Woolwich, with so much credit to himself and advantage to the public service, and whose numerous scientific works have contributed so much to the promotion of practical science, has been permitted to retire from the Professorship of Mathematics at Woolwich. He is succeeded in the professorship by Mr. S. H. Christie, Secretary to the Royal Society who took a high degree at Cambridge many years ago, and who has been connected with the Royal Military Academy, we believe, about 32 years."

Olinthus Gilbert Gregory (1774–1841), who was born in Huntingdonshire of humble parentage, owed his early training in mathematics to the Leicestershire botanist, Richard Weston (1733–1806). He was in turn sub-editor of a newspaper, a bookseller and a private teacher. Becoming known to Charles Hutton, the professor of mathematics at Woolwich, and the editor of the *Ladies' Diary*, in 1802 he was made a master in the Royal Military Academy and in 1807 succeeded to Hutton's chair. Among his contributions to science were his experiments on the velocity of sound. He was one of the projectors of University College, London, and his name was inscribed on the stone laid in Gower Street on April 30, 1827.

University Events

BIRMINGHAM.—The new Hospital Centre and Medical School are to be opened by the King and Queen on July 14, and to mark the occasion, at the degree congregation on July 2, the honorary degree of LL.D. is to be conferred on the following: Viscount Nuffield, who has contributed nearly £200,000 to the Hospital Centre; Mr. Harry Vincent, who besides being a generous supporter has given much time and energy to the working out of the scheme; Colonel Sir Bertram Ford, chairman of the Board of Management of the Birmingham Hospitals Contributory Association; Dr. Robert Hutchison, president of the Royal College of Physicians; Sir Cuthbert Wallace, president of the Royal College of Surgeons; and Sir Edward Mellanby, secretary to the Medical Research Council.

CAMBRIDGE.—Prof. Eileen Power, professor of economic history in the University of London, has been elected to an honorary fellowship at Girton College.

OXFORD.—In Convocation on June 14, it was agreed to confer the honorary degree of D.Sc. on Prof. C. G. Jung, professor of psychology at the Federal Technical University, Zurich, on July 30.

C. G. T. Morison, Christ Church, has been elected a member of the Hebdomadal Council.

H. B. Butler, All Souls College, has been appointed the first warden of Nuffield College.

SHEFFIELD.—Prof. Irvine Masson, professor of chemistry and head of the Department of Pure Science in the University of Durham, has been appointed vice-chancellor in succession to Dr. A. W. Pickard-Cambridge, who is retiring.

Dr. E. Leighton Yates has been appointed assistant lecturer in physics.

Societies and Academies

Dublin

Royal Irish Academy, May 23.

J. K. CHARLESWORTH: Some observations on the glacial geology of north-east Ireland. The chief theses of this paper are (1) the drumlins of north-east Ireland were fashioned by ice of the last main glaciation; (2) a Carlingford re-advance against the Mourne and Carlingford Mountains and along Carlingford Lough; (3) the southward retreat of the ice along the Main and Lower Bann and its stagnation along its front and in the Lough Neagh area; (4) an Antrim coastal re-advance that blocked the Bann and Lagan and ponded the drainage of the glens of Antrim in a suite of glacier-lakes.

H. S. W. MASSEY and R. A. BUCKINGHAM: Long-range forces between hydrogen molecules. The van der Waals' force between two hydrogen molecules in any fixed orientation is calculated.

Paris

Academy of Sciences, April 20 (*C.R.*, 206, 1209–1228).

LUCIEN DANIEL: Sudden or retarded ripening in the bean.

ANDRÉ HAARBLEICHER: The triangles of Poncelet.

MLLE. MARGUERITE QUINTIN: The hydrolysis of solutions of cadmium benzenesulphonate.

ANDRÉ MERCIER and TORSTEN GUSTAFSON: The true energy of the electron.

SERGE NIKITINE: Contribution to the theory of photodichroism.

HÉLIOS SCAETTA: The notion of a cycle in the evolution of tropical soil based on researches in central and in western Africa.

MME. RITA DUBERTRET, LOUIS DONCIEUX and LOUIS DUBERTRET: The Nummulitic of Koseir, to the south of Antioch (Syria).

VLADIMIR FROLOW: The annual component of the rains in Morocco.

April 25 (*C.R.*, 206, 1229–1272).

LUCIEN CAYEUX: The migration of phosphoric acid, following on the decalcification of the phosphatic chalks with *Belemnitella quadrata* in the north of France. The genesis of the phosphatic chalks and of the sands arising from their decalcification results from two totally different phenomena, an incomplete calcification causing an enrichment of the product and an addition of phosphate to the limestone which escaped solution.

ANDRÉ BLONDEL: An apparatus for comparing the luminous flux of sources of light.

GEORGES GIRAUD: Problems of the Dirichlet type.

JULES HAAG: Asymptotic formulæ concerning the oscillations of relaxation.

HENRI LAGATU and LOUIS MAUME: Measurements of agricultural biochemistry on the branches of the vine.

PAUL LÉVY: The definition of the laws of probability by their projections.

CHRISTIAN PAUC: Unification of the generator processes of various contingents and paratingents.

AYZYK GORNY: The maxima of the moduli of a function and of its derivatives.

JEAN MARIANI: A possible interpretation of the solar and terrestrial magnetic fields.

RAYMOND CHEVALLIER and MLLE. SUZANNE MATHIEU: Adsorption in the precipitation of hydroxide starting with ferric sulphate.

ANDRÉ MICHEL and MLLE. MARGUERITE GALLISSOT: The relation between the state of crystallization and the amplitude of the thermomagnetic anomaly of lepidocrocite.

MAURICE BAYEN: The measurement of the ultra-violet dispersion of water at temperatures between 6° and 35° C.

FRÉDÉRIC JOLIOT and IGNACE ZLOTOWSKI: The formation of an isotope ^{5}He during collisions between helions and deuterons. Description of experiments demonstrating the formation of the helium nucleus of mass 5·0106, stable towards the emission of a neutron.

ALBERT KIRRMANN and JEAN LICHTENBERGER: The structure of some halogen substituted aldehydes and of a methoxyl derivative.

V. M. MITCHOVITCH: The constitution of the quinaldinic acids.

MARTIN BATTEGAY and ROBERT KREBS: The thiolcarbamic esters (alkyl-S-thiourethanes) and their transformations into halides of alkylsulphonic acids.

EDOUARD LEGÉ: The transformation of oleaginous materials into mixtures of hydrocarbons.

ANDRÉ EICHHORN: Chromosomic enumeration and nuclear evolution in two *Tetrastigma* (Ampelidaceæ).

ANDRÉ KLING, NICOLAS SAMSSONOW and MME. MARGUERITE HEROS: Primitive cancers of the lung produced in mice by light oils from coal tar.

Vienna

Academy of Sciences, February 17.

H. LICHTBLAU: Anomalies occurring in mass spectroscopy. On plates taken with the mass spectrograph of Mattauch and Herzog certain lines and bands are found which do not correspond with any ions. The origin of these 'ghost' lines is investigated.

K. PRZIBRAM: Coloration and excitation of fluorite and a new fluorescent material containing divalent europium. Europium oxalate fused with calcium chloride yields a fluorescent material with the colour of Weardale fluorite. A study of this suggests that all fluorites contain traces of divalent europium. Various degrees of partial reduction of the calcium ions by the europium correspond with the various colours found in Nature.

H. GÜNTERT: New Clariide from the Cameroons.

H. PRZIBRAM: Biochemistry of the antipathic substances in the anterior and posterior lobes of the hypophysis. The anterior lobe is found to contain adrenalin and the posterior lobe choline. Various commercial preparations of extracts of the hypophysis are also examined.

R. SCHUMANN: Latitude variations in 1936 and 1937. It is necessary to establish latitude measuring stations in high latitudes if reliable measurements of movements of the poles are to be made.

F. KERNER-MARILAUN: Influence of melted snow on the temperature of mountain springs. Measurements of the difference in temperature between spring waters and the ground, when correlated with the amount of snowfall in the neighbourhood, enable the course of the water from the melting snow to be traced through the rocks to the springs.

V. F. HESS, A. DEMMELMAIR and R. STEINMAURER: Relation between the intensity of the earth's magnetic field and cosmic rays.

O. AMPFERER: Tectonic conception of dead folds. Elimination of dead folds and formation of folds from unfolded layers.

February 24.

M. TOPERCZER: (1) Secular variation of the magnetic declination in Austria in the period 1930–1935. (2) The great magnetic storm on the occasion of the aurora of January 25, 1938.

March 3.

J. HOFFMANN: Permanganate ions in violet and reddish apatites. The colours of certain apatites are due to MnO_4 ions. The colour changes which occur on heating, irradiation, etc., are analogous to those which occur in 'chameleon mineral'.

A. KAILAN: Chemical action of radium radiation (21). Action on piperidine and quinoline.

H. HABERLANDT: Luminescence, absorption and arc spectra of fluorites and apatites.

F. E. SUESS: Formation of the Caledonians and Wegener's hypothesis.

E. SPÄTH and P. H. LÖWY: Cumarine-α-pyrone.

K. M. KREMANN and E. GASTINGER: Degree of depolarization of the scattered radiation of binary liquid mixtures.

M. PESTEMER, A. J. K. SCHMIDT, LOTTE SCHMIDT-WILIGUT and F. MANCHEN: Halochromism of perylene, its quinones and some of its substitution products.

H. TOLLNER: Aurora of January 25, 1938. The Zentralanstalt fur Meteorologie und Geodynamik in Vienna has received 672 reports of observations of the aurora in Austria and neighbouring States. These are available for any men of science who may wish to study them.

March 10.

O. AMPFERER: Conception of tectonic leading lines.

D. V. KRIPP: Method for the measurement and graphical representation of organic systems.

Tokyo

Imperial Academy (*Proc.*, 14, No. 3, 87–124, March 1938).

SHIN-ICHI TAKAHASHI: An application of the Fourier transform to almost periodic functions.

KINJIRO KUNUGUI: On the projection of an ensemble plane *G* 8.

TOSIO KITAGAWA: Multiplication theorems of the Cauchy series.

HISASHI KIMURA: New observing programme for the International Latitude Service.

SHIGEO NAKAGAWA and INOSUKE SUMOTO: γ-Ray activity induced in cadmium by slow neutron bombardment.

AKITUNE IMAMURA: Crustal deformations as revealed through revisions of levels linking Hirosima with Sindi.

YASUHIKO ASAHINA and TUTOMU MOMOSE: A santonin derivative with immediate vermifugal action.

SHINKICHI YOSHIMURA and TOSIO WADA: Hydrogen sulphide and ferrous sulphide in the bottom deposits of the brackish water lake, Hamanako, Sizuoka Prefecture. The hydrogen sulphide in the black shale deposits determines the absence or poverty in population of fossils.

TEÜCHI KOBAYASHI: A tectonic view on the Öga Decke in the inner zone of western Japan.

Forthcoming Events

Wednesday, June 22

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY (at King's College, Strand, London, W.C.2), at 7.30.—Dorothea W. Singer: "The Name of Plato in Chemistry".

INTERNATIONAL ENGINEERING CONGRESS, June 21–22, to be held at the Empire Exhibition, Glasgow.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES, June 21–25.—Annual Congress to be held at Worthing.

June 21, at 8.—Dr. Julian Huxley, F.R.S.: "Natural History—Taxonomy and General Biology" (Presidential Address).

Friday, June 24

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. John Beattie: Recent Work in Experimental Surgery" (Arris and Gale Lectures. Succeeding lectures on June 27 and 29.)

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

DISTRICT FOREST OFFICERS and DISTRICT ESTATE OFFICERS to H.M. Forestry Commissioners—The Secretary, Forestry Commission, 9 Savile Row, London, W.1 (June 20).

ASSISTANT LECTURER IN ORGANIC CHEMISTRY and ASSISTANT LECTURER IN GEOLOGY in the University of Bristol—The Registrar (June 21).

PRINCIPAL of the Smithfield Meat Trades Institute, E.C.1—The Education Officer (T.1), County Hall, London, S E.1 (June 25)

LECTURER IN ELECTRICAL ENGINEERING in the Denbighshire Technical Institute, Wrexham—The Director of Education, Education Offices, Ruthin (June 25).

LECTURER IN MATHEMATICS in the Bedford College for Women, Regent's Park, London, N.W.1—The Secretary (June 30).

LECTURER IN ENGINEERING (Strength of Materials) and TWO LECTURERS IN ELECTRICAL ENGINEERING in the Technical College, Derby—The Clerk to the Governors (June 30).

SENIOR LECTURER IN ELECTRICAL ENGINEERING in the County Technical College, Mansfield—The Principal.

BOTANIST in the Plant and Animal Products Department of the Imperial Institute—The Establishment Officer, Imperial Institute, London, S.W.7.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation submitted to the Seventeenth Annual General Meeting on May 25th, 1938. Pp. ii+60. (London: Empire Cotton Growing Corporation.) [305

S C.R. Report on the 17th International Geological Congress, Moscow, 1937. By Dr. G. W. Tyrrell. Pp. 14. (London: Society for Cultural Relations with the U.S.S R.) *2d.* [315

Proceedings of the Royal Irish Academy. Vol. 44, Section A, No. 9: The Precession of the Inertial Frame of a Rotating Body. By W. J. van Stockum. Pp 109–122. *1s.* Vol. 44, Section B, No. 7. The Physiological Basis of the Sensation of Cold. 6: Excitability and the Oxygen Consumption of the Skin. By J. M. O'Connor. Pp. 129–140. *1s.* Vol. 44, Section B, No. 8: The Dalradian Rocks of the Sperrin Mountains and Adjacent Areas in Northern Ireland. By J. J. Hartley Pp 141–172+3 plates. *2s.* Vol. 44, Section B, No. 9: On the Irish Species of the Dipterous Family Phoridae. By Dr. H Schmitz Pp 173–205+1 plate. *2s.* (Dublin Hodges, Figgis and Co, London. Williams and Norgate, Ltd) [315

Department of Scientific and Industrial Research. Report of Test by the Director of Fuel Research on the Morgan Rotary Retort installed at Rodridge Hall, near Wingate, County Durham. Pp. iv+22+1 plate. (London: H.M. Stationery Office.) *9d* net. [16

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S), No. 1: Dissemination of Potato Viruses X and F by Leaf Contact. By J. B. Loughnane and Paul A. Murphy. Pp 16. *1s. 6d.* Vol. 22 (N.S.), No. 2: A Study of the Infiltration of Viruses into Seed Potato Stocks in the Field. By Phyllis Clinch, J. B. Loughnane and Paul A. Murphy. Pp. 17–31. [illegible]*s. 6d.* (Dublin: Hodges, Figgis and Co., London: Williams and Norgate, Ltd.) [16

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 2, No. 9: The Structure and Function of the Alimentary Canal of Æolid Molluscs, with a Discussion on their Nematocysts. By Alastair Graham. Pp. 267–308. *5s.* Vol. 59, Part 2, No. 10. On some undescribed Species from the Lower Carboniferous Flora of Berwickshire; together with a Note on the Genus *Stenomyelon* Kidston. By Dr. Mary G. Calder. Pp. 309–331+2 plates. *3s 6d.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [16

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Prehistory in South Africa

IN a letter appearing in a recent issue of NATURE (June 4, p. 1010) Sir Arthur Keith, commenting on the significance of the Florisbad skull for the study of the origins and distribution of early racial types and its place in the African series of primitive forms of man, drew a remarkable, and at first sight startling, conclusion from a recent examination of a cast of the skull. Pointing, in full agreement, to the anatomical analysis by Dr. Alex. Galloway of the characters of the Florisbad find, from which it appears that Neanderthaloid characteristics are here found accompanying features such as occur in the Boskop skull—a 'modern' type, which Sir Arthur regards as proto-Bushman—he goes on to suggest that not only is Florisbad man a transitional form from Rhodesian man to Boskop man, as Dr. Galloway maintains, but also that he heralds the modern Hottentot and Bushman races of South Africa. The skull is, he says, "a mosaic of Rhodesian, Boskop and Bush characters".

Hence it would appear that Sir Arthur finds in the Florisbad skull a link in the chain of evidence for the theory of the continental evolution of modern racial types, which he put forward some two years ago (see NATURE, 138, 194; Aug. 1, 1936), and for which he then sought support in the Mongoloid appearances which Prof. F. Weidenreich had detected in the teeth and jaws (and later found in the form of the nose) of Peking man.

It may not be out of place to note in this connexion that even Rhodesian man in certain characters shows an approach to the modern type, in contrast with the primitive facial skeleton—a contrast which moved the late Sir Grafton Elliot Smith to say at first sight that apparently the face was the latest feature to be affected by the evolutionary process. It will be remarked, however, that in the Florisbad skull it is the face, and more especially the forehead, in which the approach to the 'modern' is most marked.

Sir Arthur Keith's letter in NATURE, to which reference is made above, should be read in conjunction with the reference to the Florisbad find made by Mr. A. J. H. Goodwin in the course of a survey of recent advances in South African prehistory, which appears in the current issue of *Scientia* (iii), 32, 1–6; 1938). Mr. Goodwin there points out that the Florisbad skull, which was found in association with extinct animal forms and stone implements by Dr. T. F. Dreyer in 1935 and has been studied by Prof. M. R. Drennan and others, after reconstruction, is the first specimen of a human skull from Africa which may be said to show true Neanderthal characteristics, if *H. Rhodesiensis* be excluded. A further point of importance and great interest, in view of Sir Arthur Keith's conclusions, to which he also refers, is the possibility of a relationship with Prof. Broom's Korana type and the Cape Flats skull. The significance of this will be appreciated if reference be made to the account of the physical characters and culture of the inhabitants of the Oakhurst rock-shelter (see p. 1146 and p. 1151), in which Prof. Drennan finds Hottentot characteristics in the skeletal remains of a people definitely not, or perhaps it should be said not yet, Hottentot in culture. We appear here to be getting very near a chain of positive evidence, with collateral support, for Sir Arthur Keith's independent suggestion that the Florisbad skull, as a transition from the Rhodesian skull to the Boskop type, heralds the modern Hottentot and Bushman races of South Africa.

A further link in the chain of argument is supplied by an account by Sir Arthur Smith Woodward of a fossil skull of an ancestral Bushman, found on the foreshore of the Blue Nile at Singa, about two hundred miles south of Khartoum (*Antiquity*, June 1938). He points out that this find is of great interest in view of the fact that it is now recognized that during the Pleistocene, and even during a later prehistoric period, there were in northern Africa human races related to the existing Bushman and the Hottentots of the south; while the shape of the skull in some of the early Egyptians suggests relationship to the Bushman.

This specimen was found in February 1924, by Mr. W. G. R. Bond, then governor of the Fung Province of the Anglo-Egyptian Sudan. It was embedded in a limestone concretion, a few feet above low-river level. It is still partly embedded in the hard matrix, but it has been cleaned enough to exhibit its principal characteristics.

Without entering into the detailed description of the skull given by Sir Arthur, his main conclusions may be mentioned. The skull, it is said, is shorter and wider than the ordinary skulls of Bushmen, but its proportions are not very different from those of a few exceptional examples. It resembles the Bushman, first in the fullness of the frontal region and the slight longitudinal keel in its upper part; secondly, in the flattening of the middle part of the cranial roof; and thirdly, in the prominence of the large parietal bosses and the medium longitudinal depression between them. Other resemblances need not detain us; but the differences are no less important from the point of view with which we are here concerned. For this Singa skull differs from the Bushman in the greater prominence of the supraorbital ridges and in the forward curve of the nasal bones, which indicate a less shortened facial region. It may indeed, Sir Arthur concludes, be regarded as belonging to an ancestral Bushman type, in which the face has not yet shrunken. It is, therefore, especially significant that although Sir Arthur considers that this skull differs from all human skulls hitherto described as found fossil in North Africa, it presents certain resemblances with the skulls found at Afalou-bou-Rhummel in Algeria by Dr. C. Arambourg; but, it is added, in its most important features it agrees still more closely with the Boskop skull, of which it appears to be a brachycephalic variant. The modern Bushman, says Sir Arthur, summing up, may be regarded as a degenerate localized type, with shortened face and protuberant brain-case, of a normal-sized vigorous race, once distributed widely in Africa.

To return to the Florisbad skull. Its special interest for the prehistorian lies in the precision with which it can be assigned to a cultural setting. The stone implements, which were found with the skull, of indurated shale, belong to the Middle Stone Age of South Africa. There is present in them, Mr. Goodwin points out, a very clear Mousterian tradition. The most typical form is a flat long, triangular point, showing convergent flaking and a faceted butt. With this are later types, backed blades, parallel flakes and so on. Burins also occur. The culture is, in fact, a typical variant of the South African Middle Stone Age.

The special significance of the find in this relation is, as Mr. Goodwin goes on to indicate, that the discovery of Neanderthaloid characteristics in the skull in association with implements bearing Mousterian stigmata in South Africa is new. Hitherto, the skulls which have been found in certain association with implements of this general group have all belonged to the type of *H. sapiens*; but, he adds, until the chronological relationship between the Florisbad site and other Middle Stone Age deposits has been the subject of more detailed work, it is unfair to draw further conclusions. It may, however, be added that in the survey of the Vaal River gravels, which has been carried out by Dr. R. van Riet Lowe, as summarized by Mr. Goodwin, the Middle Stone Age is associated with the Third Wet Phase after the deposition of the youngest gravels, this being the third and latest of the three series of deposits which have been described. It is, however, significant that in South Africa the Middle Stone Age, though it has its origins in the Mousterian, would appear to have lasted considerably longer than in its European variant, and as it develops shows increasing influence of Upper Palæolithic type. The Later Stone Age diverges still further from any European cultures, and may best be related to the Capsian and later cultures of North Africa.

Lastly, to complete the picture, it may be mentioned that the Oakhurst Rock Shelter (see p. 1151) presents a full history of the local facies of the Later Stone Age, ranging, after the temporary use of the shelter, from Smithfield *B* cultures to the latest forms in a developed Wilton, the closing phase of Old Stone Age.

Life Work of Elliot Smith

Sir Grafton Elliot Smith: a Biographical Record by his Colleagues. Edited by Warren R. Dawson. Pp. 272 + 3 plates. (London: Jonathan Cape, Ltd., 1938.) 12*s.* 6*d.* net.

To Grafton Elliot Smith the pious hands of friends and colleagues have erected in this book "a monument more lasting than brass". A biographical sketch by Mr. Warren Dawson—based largely on letters written by Elliot Smith himself (for he preserved few or none addressed to him), two autobiographical fragments, of which the writing was interrupted by his death, and an account of his Cambridge days, also unfinished owing to the death of its author, Lord Rutherford, are followed by chapters, each contributed by someone most intimately in touch with him in a particular phase of his life or work.

After the period of formal education and training in Australia and at Cambridge, which closed with the acceptance of a professorial chair at Cairo in 1900, Elliot Smith's career, broadly speaking, was marked off into three phases: his work in Egypt from 1900 until 1909, of which an account supplementary to that of the main narrative, and dealing more particularly with his work in the Archæological Survey of Nubia, is given by Prof. F. Wood-Jones; secondly, his tenure of the chair of anatomy at Manchester from 1909 until 1919, which is recorded by Prof. J. S. B. Stopford; while Prof. H. A. Harris tells the story of the third period and the great work he carried out in the reorganization of his department at University College as professor of anatomy in the University of London from 1919 until the end. Prof. J. T. Wilson, formerly of Sydney, tells us of his early work as student and research worker, Dr. A. J. E. Cave surveys his contribution to knowledge in anatomy and neurology, and Dr. W. J. Perry, who was perhaps closest to him in the later part of his life, reviews his contribution to ethnological theory in the doctrine of the diffusion of culture and the origin of civilization in ancient Egypt.

The account of Elliot Smith's life and work given here is expository and descriptive rather than critical. The opposition with which his views on the diffusion of culture were greeted receives frequent mention; but no attempt is made to estimate how far, if at all, it was valid. It is treated throughout as negligible—a mere fluttering in academic dovecotes.

Apart from this weakness—and it is undoubtedly a weakness—this biography is a worthy tribute to a great man; and for once the eulogy of friends has drawn no distorted portrait. His loyalty to his friends was never failing and was repaid by a like devotion and understanding. Elliot Smith's one great failing, however, was an extreme sensitiveness to criticism, which reacted in a trenchant retort, too little apprehensive of a like sensitiveness in others. It veiled from many the essential kindliness, generosity and honesty that lay behind it all. It helped to obscure in the eyes of opponents the fact that Elliot Smith's work on both the physical and the cultural side of the study of man was essentially a logical and philosophic unity. His excursions into the cultural field, whatever their failings, were not merely the eccentric aberrations of genius, as many regarded them. It was this synthetic quality of his mind which led him, when at the close of the Great War he was deeply impressed by the significance of psychology, to formulate his conception of the study of man as a scheme of 'human biology'.

When Elliot Smith went from Australia to Cambridge, he was already well on the way to establishing a reputation as research worker and original thinker; but his appointment to the chair at Cairo was to exercise a decisive influence on his career. Within a very short time after this appointment his comparative studies of the mammalian brain had secured him a position of widely recognized authority. This he would have achieved in any environment which made research at all possible; but Egypt gave him something which he could have attained nowhere else. His examination of the technique of mummification and of the skeletal material brought to light in the archæological survey of Nubia, material extending over a prolonged period of time, gave him a new perspective in the investigation of the problems of human physical and cultural development. He was led in two directions: on one side are his contributions to palæopathology based upon the study of the evidence of disease, etc., in the skeletal remains of the ancient Egyptians, work continued by Prof. Wood-Jones; and on the other his analysis of the physical characters of the early population of Egypt, in which he detected the infiltration of a new race, the 'Armenoids', to whom he attributed the introduction of copper, with consequences in cultural development, upon which he enlarged in "The Ancient Egyptians" (1911).

This book many have considered contained some of his most original work in an all-round sense. W. H. R. Rivers, a few weeks after he himself had put before the anthropologists from the presidential chair of Section H at the Portsmouth meeting of the British Association analogous views on cultural development in the Pacific, wrote in a private letter that he had just read this book and was "wildly excited about it". Subsequent developments have perhaps tended to obscure the essential merits of a brilliant piece of research in racial analysis and history.

While these ideas concerning the racial history of the Mediterranean peoples and the cultures with which they were associated were incubating, Elliot Smith was no less busily engaged on his study of the development of the human brain, of which he gave the result to the world in his presidential address to the anthropological section at the Dundee meeting of the British Association in 1912. Possibly it would be no unfair judgment to say that it was at this point that Elliot Smith's work began to come to its full fruition. His correlation of the development of the brain and the acquisition of stereoscopic vision with the bodily modification and functional expansion, which made possible man's development in culture, are fundamental in all later studies of the course of human evolution; while his contributions to discussion of the specimens of early man which were discovered from time to time—Piltdown man, Rhodesian man, the London skull, *Australopithecus*, and above all Peking man, gave his views unquestioned authority. He was universally accepted as joint arbiter with Sir Arthur Keith on any and every skeletal fragment of early man in whatsoever quarter of the globe it might be found.

Such, in brief outline, are the salient features in a career in which Elliot Smith raised himself to an outstanding position among men of science of our time—a position in which his intellectual influence made itself felt far outside academic circles. It was in a measure the triumph of a personality, which impressed in one sense or another all who came into contact with him, and of which the essential qualities and their effect on his immediate circle may be gauged from the revealing volume for which we are indebted to Mr. Dawson and his collaborators.

Genetics of Developmental Processes

Physiological Genetics
By Prof. Richard Goldschmidt. (McGraw-Hill Publications in the Zoological Sciences.) Pp. ix + 375. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 24*s*.

PROF. GOLDSCHMIDT'S "Physiologische Theorie der Vererbung" was familiar to all serious students of genetics, and they will welcome the present book, in which the same ideas are developed in view of the last ten years' work of the author and others. The University of Berkeley, California, is fortunate in having been able to add Prof. Goldschmidt to its already world-famous school of genetics, and English students of genetics will be grateful for this book in their own language.

As an account of the genetics of developmental processes, it will prove indispensable. Among the most fascinating topics dealt with are the author's own work on the development of the wings in the 'vestigial' and 'truncate' series of allelomorphs in *Drosophila*, where the wing is normal in its early development, and lysis sets in later on, sometimes only after pupation. Sueffert found that the 'tails' on the wings of *Papilio podalirius* were produced by a similar process, which in some related species is gene-controlled. Equally interesting is Kühn's analysis, by genetical and physiological methods, of the determination of the wing pattern in *Ephestia kühniella*, and those of Zeleny, Hersh, Harnly, Plunkett and others on the temperature co-efficients of growth-rates in mutant forms.

While this book covers such topics as these very fully, it is somewhat deficient on the purely physiological side. It is startling that the name of Garrod is not even mentioned, although he was the first to show the importance of genetics for human physiology by his classical studies on alcaptonuria. Also the work of Beadle and Ephrussi on the precursors of the eye pigments in *Drosophila* is perhaps given less complete treatment than it deserves. This may be a matter of temperament. It is good, with Goldschmidt and Henke, to trace the path in the organism of an unidentified gene-controlled substance. It is better, with Beadle and Ephrussi, to be able to transfer it from one organism to another. But it is still better, perhaps, to obtain it in pure crystalline form, and to say, with Scott-Moncrieff or Penrose, that a particular gene is responsible for inserting a hydroxyl group at a particular point on the molecule. That at least is the reviewer's point of view. But it may well be that had Goldschmidt adopted it he would never have arrived at his extremely fruitful theory of the genic control of growth-rates.

Yet a more physiological outlook might have restrained the author from the rather revolutionary conclusions of the last chapter. Until recently he supported the view that different allelomorphs in the same locus merely differed quantitatively in the amount of gene substance which they contained. He has now reacted violently from this over-simple theory, and holds that there is no such thing as a normal, or wild type, gene. The chromosome is a physiological whole, and genes are merely steric re-arrangements of parts of it, altering its functions in various ways.

This is a natural reaction from the theory that the genes could be legitimately represented as points without parts of magnitude on a line. This was obviously a crude approximation to the truth. But it may still be very useful. It is just such work as Garrod's which, to the reviewer, seems to lead up to a truly physiological theory of the gene as an elementary organ with a definite function, and located in a definite region of a chromosome. The functions of the normal genes are concerned with those phases of intermediary metabolism which are upset in the mutants. On this view there is nothing strange in the possibility that two genes may overlap spatially, as for example the digestive and endocrine functions of the pancreas do. Nor is it surprising that a gene transplanted by a translocation may alter its function, as, for example, a pancreas discharging its juice to the outside through a fistula loses its digestive but not its endocrine function, or an ovary transplanted to a rabbit's ear secretes hormones of a male type. It may be that Goldschmidt has gone a little too far in his reaction from a crudely mechanistic gene theory. Mechanistic theories are not wholly true, but they are partly so; and the statement that an organism or a chromosome is a whole is no compensation for a lack of knowledge of its parts. Nevertheless, it is valuable that the case against the existence of wild type genes should be put so strongly as Goldschmidt has put it, if only to stimulate discussion.

I have only noticed one error in the book, where on p. 24, the fluid in the blebs of abnormal mouse embryos is said to be an extravasate. On the other hand, there are a number of passages in which the author does not use the normal English idiom, and where a revision would have been desirable. But these minor defects will not prevent geneticists from buying a book which is unique as a guide to the literature and stimulating even where it is perverse.

J. B. S. Haldane.

Sound Waves

Sound Waves, their Shape and Speed:
a Description of the Phonodeik and its Applications and a Report on a Series of Investigations made at Sandy Hook Proving Ground. By Prof. Dayton Clarence Miller. Pp. xi + 164. (New York: The Macmillan Co., 1937.) 12*s*. net.

In "The Science of Musical Sounds", published in 1916, Prof. Dayton C. Miller made available the substance of a series of eight lectures he had given at the Lowell Institute in 1914. The treatment and presentation of his subject were dictated by those circumstances. Though the results of his own investigations rightly received a due share of attention, their description appeared in a setting of "elementary and well known material". Thus the phonodeik, with which the account of those investigations began, was not mentioned until page 78 was reached in a book which, excluding the appendix, contained 270 pages. Moreover, as was natural in a record of lectures in which the audience had a phonodeik before their eyes, the description of the instrument was somewhat brief.

In his new book "Sound Waves, their Shape and Speed", Prof. Miller has produced a story of his investigations which is the complement of his earlier work. Its pages give a straightforward description of his objectives, the methods of attack, the experimental difficulties to be overcome, the means adopted to that end, and a brief outline of the results. The word "story" is used advisedly; for it is this simplification of aim which lends to the book its very real interest. Prof. Miller is not describing a new field of knowledge; Georg S. Ohm and Hermann von Helmholtz had made its general characteristics known more than seventy-five years ago. He is giving a narrative of many years work which has filled in, by the most careful experiment, the details of a large part of the country traversed. That is why few instructed readers who begin the book will be able to lay it aside until they have reached the last page.

As its title implies, the book falls into two parts, dealing in turn with the shape of sound waves and with their speed. The first part sets out much that is of direct interest to musical men of science, particularly in these days when electronic organs are making us acquainted with the synthesis of musical sounds. The six plates have been selected from the musician's point of view. Once the reader has realized, as he cannot fail to do from the description of the technique employed, that the photograph is that of a transverse vibration depicting, as it were diagrammatically, a longitudinal vibration of the most minute character in the air, the curves selected tell their own story. They are all capable of interpretation by the eye, and they cover in a representative manner results of a wide range of interest. Little knowledge of physics other than that which can be picked up by a careful reader is required for their interpretation.

The author gives a much fuller description of the phonodeik than appeared in his earlier book; and this will be useful to anyone interested in the details of his apparatus. In Prof. Miller's own words: "For the investigation of the tone quality of musical instruments, a permanent graphical record of the wave form of the sound seemed necessary; none of the methods for recording sound was sufficiently sensitive and free from influences producing distortion of the wave form." Dimensions and diagrams are given for the constructional details, but it may perhaps be suggested that, in a future edition, a couple of pages at the end of the book might record, for convenience of future reference, actual working drawings for the complete instrument in its final form.

A chapter is devoted to electric-spark photography of sound waves. While it contains little that is novel, it is useful for the excellent photographs it shows. Prof. Miller assumes in his readers a knowledge of the refractive effects, on light, of local variations in the density of air. Perhaps had he begun with a few sentences explaining this to help those who are not physicists, and even a preliminary diagram to show, as in modern textbooks on sound, the wave from the nose of a bullet as the envelope of a series of circles with their centres in its wake, the non-expert would have been encouraged to pursue Part 2, the general outline of which, so clearly described, should have interest for him, despite its technicalities and mathematical equations (which he can skip).

Part 2 deals with a number of experiments on the pressures from gun-fire and on the velocity of sound, which were made possible by exceptional opportunities available during, and just after, the Great War, at the Sandy Hook Proving Ground. Perhaps the most interesting section here is that describing the propagation of explosive sounds through air. Starting with Riemann's formula for the velocity of explosive sound, Prof. Miller describes the experimental precautions by which he was able to take account of the variables affecting his results. He found that "Simple approximate calculations led to the surprising and disturbing result that on a line at right angles to the axis [of fire of the gun], the apparent velocity was sometimes less than normal". The observations he then made led to the view "that the virtual source of the sound, and the centre of the developing wave front in its beginnings, are in effect shot out of the gun, with a speed which may be in excess of that of the projectile itself". The value of these observations is enhanced by the descriptions of the apparatus used and the mathematical analysis of the results. The final pages of the book are devoted to various determinations of the velocity of sound, to which Prof. Miller's own work makes a useful contribution.

The volume will find a place, for future reference, on the book-shelves of all who are interested in the several aspects of the subjects of which it treats.

LL. S. L.

Towards a World Encyclopædia

Encyclopædia Britannica—Book of the Year 1938:
being a Survey of the Principal Persons, Events, and Developments in various Spheres of Knowledge and Affairs during the Year 1937. Pp. xviii+742. (London: Encyclopaedia Britannica Co., Ltd., 1938.) 45*s*.

THE "Encyclopædia Britannica", in common with other institutions of world-wide fame, changes its methods to suit the demands of a changing era. Time was, when a batch of supplementary volumes might be added to the old to make a new edition. So the ninth edition of 1875–1889, reinforced by a massive group of supplements, appeared as the tenth edition of 1902, and this, which was destined to endure until 1911, was replaced in that year by an entirely recast edition, the eleventh—an edition still held in high esteem by those who love the detailed and technical scholarship of the older editions. The twelfth and thirteenth editions were made by adding supplementary volumes to this eleventh edition, and the fourteenth edition of 1931 was almost entirely new, giving expression to a policy which departed from that of the older editions in favour of a rather more popular though not necessarily less scholarly outlook.

But the hurrying years of our generation do not permit of seven- or ten-year intervals between successive editions, and the publishers of the "Encyclopædia", recognizing this, have produced what is to be the first of a series of year-books. The volume under review deals with the movements and events of the year 1937, and it may perhaps be regarded as a step towards the realization of the World Encyclopædia of Mr. H. G. Wells. We say this advisedly, for the volume does certainly fulfil some of the objects of that vastly greater scheme. It does not shirk the discussion of contemporary political and social questions of the highest import; it treats them, in general, in an objective and rational fashion; it gives up-to-date and quantitative political and social statistics; and in many instances, though not in so many as one could wish, it provides pointers to fuller sources of information.

In this volume, the first of an annual series, it is legitimate to expect that many of the articles should deal, not only with developments in 1937, but also with the happenings of the last half-dozen years. Indeed, in some articles, one might reasonably look for a brief, but complete in outline, exposition of the topic in hand. This expectation is, on occasion, realized. Thus the article "Communism" over the initials "E. B." is, as one might have expected it to be, a perfect thumb-nail sketch of the subject. The events of the civil war in Spain are outlined from the Spanish elections of February 1936. On the other hand, the story of the Abyssinian tragedy would seem to be completely inadequate, the events of 1937 being summed up in sixteen lines of text, and no attempt being made, under any obvious heading, to give even in bare outline, the course of the events that led up to the surrenders of the early months of 1937.

It is not easy to devise a fair test for the usefulness of a volume which covers such an immense range of topics, which deals with such vast masses of factual detail. It would be easy (and completely misleading) to put on record occasional instances where the information desired was not forthcoming. The most trustworthy test is to use the volume constantly over a period of some weeks and to note how frequently one is let down. This method has been tried with surprisingly good results. On matters of general interest such as the variation in income tax during the post War period, the criminal statistics of the year 1937, the acreage under root crops, the statistics of rearmament, the Budget, broadcasting, progress in art, music and philosophy, in international trade and international law, detailed and clear information was at once forthcoming. This is also true of more obscure and detailed matters. Thus, to chronicle one example from a score or more of such samplings, information was sought concerning the membership of the communist parties in England and in France. The numbers were listed and easily run down (c. 10,000 and 280,000 respectively). Again, a remarkable change, of recent months, has occurred in the attitude of this party to the policy of a 'United Front', and the year-book, consulted on the matter, points to the reason for this change in a manifesto emanating from the Comintern (the Third, or Communist International) in which the masses in democratic and fascist countries are urged "to work for the establishment of a United Front of anti-fascist forces"! This is but one sample of the minute detail to which the articles condescend, and it speaks volumes for the high standard of the writing and the skill of the editing that so much detail may be filled in without blurring the larger outlines.

The scientific and educational articles do not call for detailed treatment. They are, in the main, written in simple language. No important recent developments are omitted, and advances in the applications of science are fully recorded and explained. Atomic physics; the latest discoveries in biochemistry and in cancer research; developments in power supply: improvements in public and private illumination and its measurement; the design of the latest giant telescope; it would be easy to draw up a list of articles dealing with advances in science, pure and applied, which should exceed this review in length, and would still form but a sample of the part of the volume devoted to matters of scientific interest.

It is an almost impossible task to sum up, in a few phrases which shall not be misleading, the contribution made to the welfare of our society by a massive year-book such as this. Its articles are full, critical and written in clear and non-technical language; they miss little of importance and chronicle many obscure and trivial events—trivial, that is, purely by comparison with some of the happenings of world importance which receive full consideration. War clouds may be gathering; the structure of civilized society may show ominous cracks and fissures; but these are no reasons why we should not interest ourselves in the latest developments in ballet music, the doings of the National Baseball Association, or the whereabouts of Inaccessible Island. Political events are treated in a liberal and objective spirit, though here and there, *rari nantes in gurgite vasto*, articles may be found written in such a spirit of caution as to result in a presentation of meagre, though accurate, detail; the index is a work of art which immensely reduces the labour of search; the production leaves nothing to be desired.

The book may fairly be classed among the indispensables, and one can heartily wish to it and to its successors a complete and unqualified success. Allan Ferguson.

Vergleichende Morphologie der höheren Pflanzen

Von Prof. Dr. Wilhelm Troll. Band 1: Vegetationsorgane. Teil 1, Lieferung 2. Pp. 173–508. (Berlin: Gebrüder Borntraeger, 1937.) 27 gold marks.

ON the first page of this second "Lieferung" of Part I of the first volume, in continuation of the introduction to the main heading, "The Construction of the Shoot and Shoot-systems", the author discusses the 'phyton-theory' of Schultz, Gaudichaud and Celakovsky, but rejects it as not taking account of the structure prevailing at the stem-apex.

Section I of the main thesis on shoot-construction deals with nodes and internodes. Section II treats of the shoot-axis and leaf. Genuine cases of *terminal* foliar organs exist, but they are regarded as derivative. A chapter is devoted to the cortication and alation of the stem by leaf-bases. Leafless shoots form the topic of another chapter, and the rhizophore of *Selaginella* is described and its morphological nature discussed. The author concludes that a comparative and experimental study of the problem shows that the rhizophore is decidedly a modified *stem*. The leafless shoots of Psilotales are described.

In Section III many pages are devoted to the "Phenomena of Lateral Symmetry in the Structure and Leaf-formation of Shoots". 'Flattened shoots' are described in detail. The phylloclades of *Asparagus*, *Ruscus*, etc., are regarded as of shoot nature.

The final section of this "Lieferung" is concerned with the large subject of branching. That of the Pteridophytes and Lycopsidæ is discussed. Considerable space is devoted to the Lepidophytes from the Coal-period. In particular, the *Stigmaria*-problem is fully dealt with. After a special comparison of *Stigmaria* with the mature and seedling structures of *Selaginella spinulosa* and its rhizophores, the author concludes that *Stigmaria* and the rhizophores of *Selaginella* may be regarded, not as a mere "parallel modification" as Scott stated, but as strictly homologous structures.

As in the first "Lieferung", so in this one, the subject-matter is illustrated throughout by very numerous and excellent figures and photographs.

W. C. W.

The Metabolism of the Frog's Heart

By A. J. Clark, M. G. Eggleton, P. Eggleton, R. Gaddie, C. P. Stewart. (Edinburgh Medical Monographs.) Pp. xii+308. (Edinburgh and London: Oliver and Boyd, 1938.) 15*s*. net.

THIS useful monograph contains a full and critical summary of recent work on the chemical processes in the frog's heart and their relation to muscular activity. So much of our knowledge of muscle physiology is based upon those peculiar and highly specialized organs, the muscles of the hind legs of the frog, that information from other sources is needed as a corrective to one-sided views.

On the whole, heart muscle seems to be a more generalized type of tissue than skeletal. As the authors point out, the frog's heart (and perhaps any heart) is not well adapted to correlating energy exchanges, expressed as heat, tension or work, with chemical processes. For this purpose a muscle with straight parallel fibres capable of developing high tensions is necessary. To compensate for these defects, the frog's heart is well suited to measuring the chemical processes themselves, though on account of its small size a very refined technique is needed. The development of this technique has been almost entirely the work of Prof. A. J. Clark and his colleagues at Edinburgh during the past ten years. They are also responsible for most of the results.

The subjects dealt with are as follow: the structure and chemical composition of the heart; oxygen usage and its relation to carbohydrate and non-carbohydrate metabolism; anærobic processes; phosphorus metabolism; the effects of asphyxia and certain depressants on the heart's activity. There follows a discussion of the way the heart's metabolism varies with changes in the electrical and mechanical responses, and of the light these processes throw on the fundamental nature of muscular activity. The last chapter gives a useful comparison of the frog's heart with other types of muscle. There is an appendix on methods.

Through the Great Arid Filter (Man's Drift to Europe)

By A. J. McInerny. Pp. 46. (Otley, Yorks: The Author, c/o Printerdom, 1938.) 2*s*.

MR. McINERNY here elaborates further and in some considerable detail his theory of the part played by the desert in the development of the more advanced races. It is a special adaptation of the more general theory of the influence of geographical environment in moulding man and his culture; but whereas it is most generally held that arable land is an essential condition of progress, the initial stages of cultivation being regarded as the first step towards the higher forms of civilization, the author on the contrary holds to 'thermal aridity' as the efficient cause. The stimulating effect of the solar energy and wide range of variation in temperature of the desert, it is maintained, has transformed non-progressive jungle man into the progressive white races of Europe. On this view, the long-headed races are a product of the desert belt extending from Africa to India, of which the Sahara is the most important section, and the broad- or round-heads emerge from the area of the Caspian. The 'Brown Race', cutting across this desert belt, represents an intermediate stage in the development. In the Far East the Chinese are regarded as the equivalent of the Egyptians, their further development having been arrested for reasons which are stated, while the Japanese represent the Europeans, the efficient cause here being the Gobi Desert.

Mr. McInerny has applied his theory to racial distributions, past and present, with no little ingenuity, and makes it something more than plausible; but until the mental processes underlying progress are more fully understood, as well as the effect of the reactions to 'thermal aridity', it cannot be accepted hastily as proved. In the cultural context, the hypothesis seems to postulate a stimulus which at times is rather remote.

A Short History of Naval and Marine Engineering

By Eng.-Capt. Edgar C. Smith. Pp. xix + 376 + 16 plates. (Cambridge: At the University Press, 1938.) 18*s.* net.

AS the editor of *Engineering* points out in his foreword, most of the material in this work has appeared in the pages of that journal, but its re-issue in book form is more than justified. The author, who is now president of the Newcomen Society, has traced the development of marine engineering from the early reciprocating engine to the turbine and diesel, and from the rectangular flue boiler working at less than 5 lb./in.^{2} to the forced-circulation boiler of to-day. So much of the corresponding development in the field of naval architecture as is required to make a complete picture is also described.

While not in any way a text-book in the conventional sense, a perusal of this book should be as inspiring to the student as it should be attractive to the non-technical reader, to whom more especially the accounts of early voyages of steam vessels will appeal. As a work of reference, it will have lasting value; the index is excellent, and an extensive bibliography is scattered through the text.

In a chapter on the turbine, an intensely interesting light is thrown on the genius of Watt. The author tells us that in a letter full of calculations to Boulton in 1784, after hearing of the re-invention by Kempelen of what was in effect Hero's reaction turbine, Watt wrote with uncanny vision: "So that you see the whole success of the machine depends on the possibility of prodigous velocities . . . in short without god makes it possible for things to move 1000 feet pr″ [i.e., per second] it can not do much harm".

A plea must be made to the author to apply in the next edition the correct epithet to ship-model testing tanks. That of Froude the elder may well have been experimental, but to-day, in an experiment tank, it is only the models which are experimental.

G. V. B.

Elektrotechnische Berichte

unter Mitwirkung des Verbandes Deutscher Elektrotechniker e.V., herausgegeben von Franz Moeller VDE, Berlin. Band 4, Heft 6, 15 Januar, 1938. 6 Bde. yearly. (Berlin: J. Springer.) 48 gold marks each.

THE advent of a major abstracting journal is an event of considerable importance in the scientific world. The subject of this one is electrical engineering. Existing periodicals devoted to abstracting, or indexing, electrotechnical literature are thirteen in number. If we except the *Deutches Rundfunkschriftum* and the *Wireless Engineer*, which include a number of articles of less importance, hitherto no journal has included so many abstracts on electrical engineering as *Science Abstracts* B, and this contains only some three thousand five hundred in a year.

The new journal appears in fortnightly parts, forming six complete volumes annually, and comprising altogether a total of seven thousand abstracts, of which from four thousand to four thousand five hundred are taken from purely electrotechnical periodicals, while the remainder come from journals dealing with general science or cognate subjects, or represent notices of books. The length of the abstracts varies considerably, apparently being adjusted according to the values at which the articles are appraised.

The titles of the articles are quoted, as they should be, in the language of the original, and are also translated into German. The fact that the abstracts are in German is a drawback to English readers. But this difficulty is overcome to a large extent by classifying each abstract minutely by means of the decimal classification, several numbers being added to an abstract if the subject requires. This enables the abstracts of papers on any particular subject to be picked out with the greatest of ease, irrespective of language.

In spite of its high price, this new periodical is likely to become a standard abstracting journal in its subject.

Solvents

By Dr. Thos. H. Durrans. (Monographs on Applied Chemistry, under the Editorship of Dr. E. Howard Tripp, vol. 4.) Fourth Revised and Enlarged Edition. Pp. xvii + 238. (London: Chapman and Hall, Ltd., 1938.) 15*s.* net.

THERE is a plethora of books to-day dealing with one aspect or another of the use of organic solvents in industrial operations. Almost the earliest of these was that of Dr. Durrans; its utility is made clear by the fact that a fourth edition is now required. The preface speaks of a complete revision and amplification and an attempt to make it of use to a somewhat wider industrial field.

In particular, progress has been made in the field of plasticizing solvents. The appendix giving the probable composition corresponding to the numerous trade names for solvents has been enlarged, also the useful table indicating the solubility of sundry resins and varnishes in the solvents.

The book retains its former general character and will be as heretofore indispensable to anyone who has to do with solvents: it is most thorough in every detail.

Die Fermente und ihre Wirkungen

Von Prof. Dr. Carl Oppenheimer. Supplement, Lief. 7 (Band 2, Specieller Teil, Haupt-Teil 16, 17). Pp. 943–1102. 10 fl. Supplement, Lief. 8 (Band 2, Specieller Teil, Haupt-Teil 17). Pp. 1103–1262. 10 fl. (Den Haag: Dr. W. Junk, 1937.)

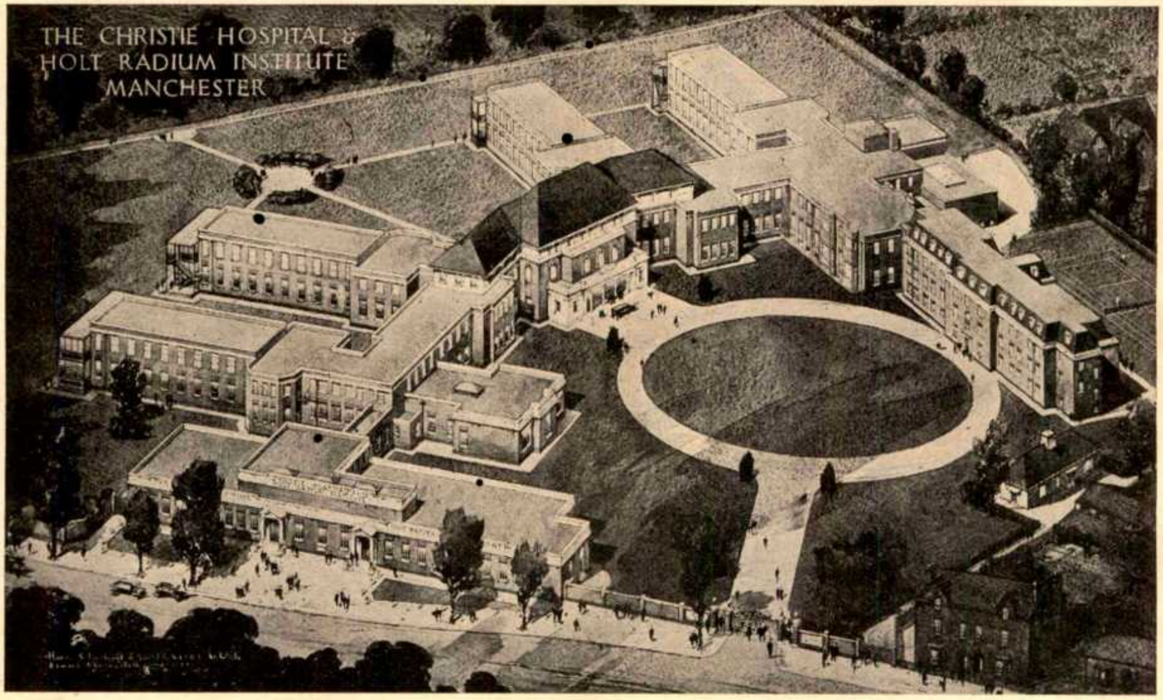
THIS supplement progresses towards its completion which, at the time of writing Part 8, is put down as requiring another six months. The two parts now received deal with thrombase, the fibrin ferment of the blood, and begin the fourth main section entitled "Desmolases". The theories of the oxidation-reduction chain of reactions and the well-known catalysts, including cellular fermentation, are described.

As these matters are in the forefront of interest at the present time, workers will appreciate having the literature summary brought up to date. The treatment follows familiar lines.

The Christie Hospital and Holt Radium Institute, Manchester

SITUATED in the outskirts of Manchester, the Christie Hospital and Holt Radium Institute, which was opened in 1933, presents certain features interesting not only from the medical aspect, but also from the point of view of organization of radio-therapy for malignant disease.

The present institution (Fig. 1.) is the result of the fusion of two much older hospitals; it is one of the largest units of its kind in Europe, and is only exceeded in size by a few American institutions of similar type. Although the main purpose of the unit is the treatment of patients suffering from malignant disease, much experimental work is done concomitantly to advance the scientific practice of radio-therapy, and to study the action of radiation on living tissue.



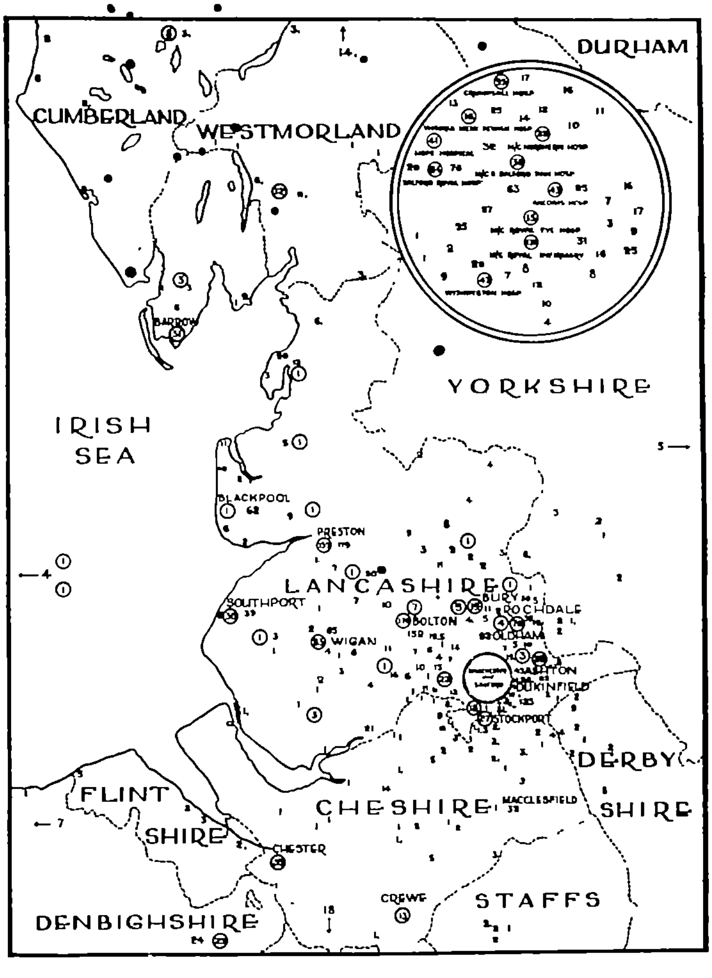
Little need be said about the history of the Institute. The old Manchester Radium Institute founded in 1915 within the confines of the Manchester Royal Infirmary took independent existence in 1921, owing to the generosity and foresight of Sir Edward Holt, at one time lord mayor and a freeman of Manchester. From the beginning, this Institute, under the guidance of the first director, Dr. A. H. Burrows, maintained the principle that radiation therapy should be centralized as an independent specialty. In consequence, Manchester had a long start over many other centres where organization was at first more haphazard. The Christie Cancer Hospital had a longer history. It developed gradually from a cancer home for incurables to an active unit concerned with the surgical treatment of malignant diseases. It then became apparent that expansion was essential, and in 1933, under the chairmanship of F. P. Nathan, deputy-lieutenant of the County of Lancashire, the scope of the work of both units was vastly increased by fusion and removal to the present spacious buildings.

More than six grams of radium are held at present; part of this is owned, and part is loaned from the National Radium Commission. The bulk of the radium is in the form of needles and tubes, with in addition just over one gram in solution for the preparation of radon. With this amount of radium in use, extensive protective devices for the health of workers have had to be developed. From the time the radium leaves the safe, which has protecting walls of 6 in. of lead, until the moment of insertion into the patient, the radium needles remain encased in lead, although in the interval they have been threaded, prepared, sterilized and transported from room to room.

Speaking generally, present-day radium methods consist either of implantation of radium contained in hollow platinum needles into and around malignant growths, or of the application of radium, suitably mounted, superficially to such growths. The former method, implantation technique, is analogous to surgical procedures and requires asepsis and anaesthetics. On the other hand, for radium used superficially, a special laboratory has been developed which combines to some extent the features of a dental workshop with those of a sculptor's studio. Here plaster casts of the tumour-bearing area are made and appliances modelled on these to carry the radium and to fit each patient exactly.

The X-ray Department consists at the moment of a suite of four rooms, each containing an X-ray tube energized at 250 kilovolts. These plants were designed and built by the Research Department of Metropolitan-Vickers Electrical Co., Ltd., and constituted, when first designed, a new departure in the application to medical work of continuously evacuated X-ray tubes and rectifying valves. At the present time, there is being installed a 500 kilovolt unit of similar design. The units are operated with the anti-cathode at ground potential; two advantages accrue from this. First there is the ability to use direct water-cooling of the target from the mains, and second there is the advantage that the high tension is completely removed from the treatment room. Rotation of the head of the tube carrying the target (anti-cathode) is achieved through a gear-driven joint between optically flat steel surfaces. For actual treatment, the emergent beam is defined by applicators which also rotate round the tube, interlocked with the rotation of the target.

The linkage between power units and tubes is of some interest. There are in all four 250 kv. tubes, and two 250 kv. generators. The design is such that each generator can be connected to any or all of the tubes, through one or other of a pair of high-tension leads. To achieve this, each tube has a high-tension change-over switch through which it can be linked to either generator or to earth. The main high-tension leads occupy a special overhead duct behind the treatment rooms. Normal running is usually two tubes to each generator, but there are no fewer than seventy different combinations available for various contingencies. The installation was designed therefore in such a way that any one plant or any one tube could be isolated and repaired in the event of breakdown with the absolute minimum of interference with the general running of the Department.



Areas for which radium therapy service is provided. Figures indicate number of patients referred from each town in 1937. Hospitals receiving radium service, O. Inset map: details of the Manchester and Salford area.

The radiological staff consists of a group of whole-time therapists, and two physicists. The medical and surgical work is dependent on an honorary visiting staff. There are also various auxiliary services. The radiological work is divided amongst the team in such a way that each therapist, in addition to general work, takes over a special small field in which he can become expert and in which he can develop new techniques.

During the last five years, this team has made a number of useful contributions to the science of radio-therapy, particularly in relation to the development of accurate systems of dosage.

To the physically minded, it may seem almost incredible that radium therapy should have been practised until recently on no sound quantitative basis; yet such was the case. Radium dosage was described in terms of the amount of radium used, and for accurate information was relatively meaningless. It was obviously essential to have a unit which states the amount of radiation absorbed at any point, be it in tumour growth or in skin. Some years ago the Manchester School evolved a clinically practical unit of measurement of gamma radiation, selecting for this the roentgen, the internationally accepted unit of X-radiation. This choice was made in order to bring these two essentially similar therapeutic agents to comparable terms. The suitability of the roentgen as a unit of gamma ray therapy was recognized at the recent International Congress of Radiology.

In X-ray therapy also, treatment methods have been open to severe criticism, in that they consisted of a mass of empirical techniques depending on a variety of variable factors, such as so-called 'air dosage', skin tolerance doses, and so forth. The Manchester School has contributed to the clarification of the situation by the development of methods of treatment in terms of accurately measured tumour dosage.

There are three fields in which this knowledge of dosage has proved of immense value. First, information can now be obtained on the tolerance of normal tissue, especially skin, to the effects of radiation, and the importance of the 'time factor' in that respect can be studied. Next, it is at last becoming possible to group tumour growths relatively accurately in accordance with their particular radiosensitivity. Lastly, the value of accurate measurement in the experimental work of the new Research Laboratories of the Institute is inestimable. Research on the biological effects of radiation covers an immense field, but as C. M. Scott has pointed out, the value of much of it has until now been entirely vitiated by the absence of a quantitative outlook.

TABLE 1. NUMBER OF NEW PATIENTS SEEN IN 1936.

Mouth	349
Skin	394
Uterus	200
Breast	298
Pharynx and Larynx	103
Bladder and Rectum	81
Œsophagus and Lung	59
Various Glands	88
Lip	48
Genitalia	51
Other malignancy	160
	1,831
Other conditions—non-malignant	382
	2,213

Cancer is still, after war and the toll of the roads, one of civilized man's most serious menaces, and an inevitable question in considering the work of an institute such as this is as to the results of treatment, and as to whether real advance is being achieved. A very brief review is given, therefore, of the part which radiation plays in the treatment of malignant disease. The scope of radiation therapy can be summarized by an analysis of the types of cases treated at the Institute (Table 1).

Of these numbers, how many are likely to be cured? Table 2 indicates in round figures the achievement of the methods employed in 1932 as assessed to-day (non-malignant group excluded).

TABLE 2. NET FIVE-YEAR SURVIVAL RATE OF ALL CASES TREATED BY RADIATION, INCLUDING ADVANCED CASES.

All types of Malignant Disease (in proportions of Table 1)	40 per cent
Mouth only	30 ,,
Cervix uteri only	30 ,,
Skin only	85 ,,

It will be observed that the figures in Table 2 include the survival rate of all cases treated, whether in the early or advanced stages. A more striking illustration of what can be achieved by radiation therapy is seen in Table 3, from which the very advanced cases have been excluded—a table which at the same time points to the importance of early treatment of malignant disease.

TABLE 3. NET FIVE-YEAR SURVIVAL RATE, EXCLUDING ADVANCED CASES.

All types of Malignant Disease (in proportions of Table 1)	60 per cent
Mouth only	45 ,,
Cervix uteri only	50 ,,
Skin only	90 ,,

Summarizing, it may be said that, while malignant disease remains one of the most serious of diseases, nevertheless something quite definite can be achieved by the methods employed in an institute such as the one under description. The number of patients treated now yearly exceeds 2,000. As estimated from the work of previous years, at least 50 per cent of these will certainly be alive and well three years after, 40 per cent five years after, and unlikely to develop recurrence of their tumour. Unfortunately, many patients at the time they are first seen can only be assisted in a palliative way, the disease having been allowed to progress too far. If we consider the value of treatment in relation only to the earlier lesions, then we find that some 60 per cent of all cases may be expected to be alive and well in five years' time.

As will be seen from Table 1, radio-therapy is at present a method of treatment only applicable to a proportion of all cancer cases, and the number of such cases in even a large population is relatively low. In a population of 100,000 there are probably between 50 and 60 cases of cancer per annum which should be treated by radio-therapy. On this basis, a unit with extensive equipment and a considerable medical staff must serve a very wide area to reach its highest effectiveness. It is estimated that the 2,000 new cases seen annually represents the sifting of cases from a population of approximately 6,000,000. The proportion of cases sent in for treatment from each district tends to vary inversely with the distance from the centre. Thus in the immediate local area (Manchester, Salford and Stockport), practically all cases come for consideration regarding treatment, while in the periphery of the zone served, a smaller fraction is referred unless steps are taken to increase it. This situation is demonstrated by Table 4, which also shows the results of the measures adopted by the Institute to reach patients in the surrounding area.

TABLE 4.

Year	No of patients referred from civic area[*]. (Population 1,039,740)	No referred per 100,000 population.	No. of patients referred from immediately surrounding area[†] (Population 1,663,860)	No. referred per 100,000 population
1931	465	44	362	21
1932	434	41	365	21
1933	474	45	462	27
1934	496	47	736	44
1935	572	55	794	49
Increase over 5 years—25 per cent			Increase over 5 years—133 per cent	

[*] Civic area includes the cities of Manchester and Salford.

[†] Surrounding area is the south-east quarter of Lancashire (excluding Manchester civic area), bounded by the line, Cheshire border, Warrington (exclusive), Preston (inclusive), Yorkshire border.

This improvement in the availability of treatment to patients has been achieved by the development in connexion with the Institute of clinics not only in Manchester in its own hospitals, but also in a large number of voluntary hospitals of towns in the area served (see accompanying map). Treatment clinics are also held, but in a more limited number of such outside hospitals. There the simpler cases are dealt with, while those more complex are brought for treatment to the central unit where the facilities are greater. In the same way the Institute has entered into agreements with City and County Health Authorities by which cases of cancer in their control are seen, and if suitable for radio-therapy are treated.

In conclusion, there are many indications that as national organization for the treatment of cancer evolves, it may be necessary to develop it along lines similar to those now accepted for the treatment of tuberculosis, that is, along modified State service lines. In this case, the unit and the organization described above may prove to have been in some respects a prototype.

Recent Developments in the Geology of the U.S.S.R.

By Prof. N. N. Gornostayev[*]

THE successive Five Year Plans in the Soviet Union have been accompanied by a vigorous development of geological science, and new mineral wealth is being discovered almost daily by the 6,000 geologists who are employed in prospecting over the whole vast area of the U.S.S.R. Soviet deposits of oil, coal, peat, iron, manganese, gold, potash salts and phosphates, are among the largest in the world.

In 1913 the known coal deposits of Russia comprised but 3·2 per cent of the world's resources, as estimated by the Twelfth International Geological Congress. At the Seventeenth Congress held in Moscow last year, the estimated coal resources of the Soviet Union were found to be seven times greater than in 1913, comprising 1,654,361 million tons, or nearly 21 per cent of the world's coal reserves.

In addition to the Donetz Basin, which yielded 87 per cent of the coal mined in Russia in 1913, large coal deposits have been discovered in Kazakhstan, Siberia and the Far East. The coal deposits of European Russia now comprise only 9·1 per cent of the total resources of the U.S.S.R. This more uniform distribution of coal resources has made widespread industrialization much more feasible.

The iron ore deposits of the Soviet Union are now known to be five and a half times greater than was estimated in 1913. The reserves of oil are fourteen times greater than was estimated in 1905. Oil fields have been found along the entire Urals range, and prospecting is in progress on the vast Siberian plains. It is possible that Siberia will be found to contain some of the richest oil deposits in the world. Incidentally, Siberian oil is the oldest known, as it is found in Cambrian formations.

It is now established that about 83 per cent of the world's known resources of potash are concentrated in the U.S.S.R., and these resources are being steadily augmented by new discoveries. More than 73 per cent of the world's manganese ore reserves are contained within the Soviet Union. The huge deposits of apatite found in the Kola Peninsula have doubled the world's resources of phosphates.

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[*] Revised and abridged by Dr. G. W. Tyrrell from an article entitled "Soviet Geology" received from the Soviet Union Year Book Press Service.

The U.S.S.R. holds second world place in respect of gold output. The gold industry, which formerly employed the most primitive methods, has now been greatly modernized. Large nuggets are often obtained, as, for example, one of 32 kgm. which was found in the Miass (Urals) gold field.

The desolate region of Kazakhstan, the roving ground of nomadic tribes, is now the main Soviet source of supply of non-ferrous metals, especially copper, zinc and lead, and has far outstripped the Urals, the former source of these metals. Until recently the U.S.S.R. was thought to be lacking in boron, but huge deposits of boracic salts have been found in the region around Lake Inder in north-west Kazakhstan.

The geological structure of the U.S.S.R. is exceedingly varied. On its territory are huge mountain folds which have risen on the sites of former sea depressions filled with soft clays, sands and limestones (for example, the Caucasus). There are mountains which are fragments of ancient rocks split into uneven blocks which have moved upward or downward (for example, the Tian-Shan, Altai, etc.). There are deep depressions such as Lake Baikal (the largest freshwater lake in the world, more than 1520 m. deep), and the Black and Caspian Seas, formed in geologically recent times.

The wide plains of West Siberia are now known to cover the greater part of the former range of the Urals. The Urals of to-day represent merely the western margin of this great Hercynian range and, moreover, were elevated in comparatively recent geological times.

Formerly, the Crimean mountain range was as extensive as the Caucasian, but, broken by enormous faults, it sank, and now lies beneath the floor of the Black Sea at a depth of more than 2000 m. The Crimean mountains of to-day are merely a remnant of the northern part of the ancient range.

Some Western geologists have maintained that oceanic depressions have always existed, and that the Pacific Ocean constitutes the 'scar' caused by the parting of the moon from the earth. Recent work by Soviet geologists has shown, however, that the northern part of the Pacific, until comparatively recent times, was a vast continent with mountain chains, hills, plains and volcanoes, stretching between Siberia and North America.

The variety and complexity of geological structures in the U.S.S.R. explain the variety of igneous rocks within its territories. Practically all known varieties of igneous rocks have been found. The largest developments of nepheline-rich igneous rocks in the world, with many rare and rare-earth minerals, and enormous deposits of apatite, have long been known to occur within the Kola Peninsula. Entire mountains of sodic sanidinites, hitherto known only in the form of separate lumps in volcanic ejecta, have been found in Kazakhstan.

Study of the mineral springs of the U.S.S.R. has made it possible considerably to extend the health resorts, not only in the world-famed Caucasian region, which has been greatly enlarged, but also in many other parts of the U.S.S.R., including the Trans-Baikal, Yakutia and the Far East. In the vicinity of Moscow itself mineral waters containing bromine, radium and other valuable therapeutic substances have been found. Geochemistry is flourishing, and discoveries of many valuable minerals are largely the result of geochemical prognoses, which are being made with increasing accuracy and confidence.

The study of marl, alluvium, gravels, sands, clays, etc, is making rapid headway, particularly in connexion with the building of large structures and hydro-technical projects. Data on engineering geology and hydro-geology obtained during the construction of the Palace of Soviets, the Moscow Metro, the White Sea–Baltic Canal, the Moscow–Volga Canal, and other projects, have made it possible to plan more confidently large-scale undertakings such as the Volga Dam and the irrigation of the arid steppes of the Trans-Volga region.

The development of life on the earth began with the appearance of primitive plant life and later of animal life. Until recently, geologists have traced the evolution of life more or less systematically from the Cambrian Period. Of Pre-Cambrian formations it was possible to judge only from accidental and isolated discoveries of fossils. But in Siberia fossil remains of Cambrian and Pre-Cambrian age have recently been found in great abundance, and the study of these remains is one of the most fascinating problems of Soviet palæontology. It is possible that ancient Asia may prove to be the cradle of life on the earth, as it was of the higher forms of animal life, mammals, and even of man.

The remains of mammoths have been found in many places, but only in the north of Siberia are complete well-preserved carcasses of these animals, and of their contemporaries, the long-haired rhinoceroses, found in the natural cold storage of frozen swamps. A special expedition has been organized to study these remains in their natural habitat. Remains of the mastodon, an even more ancient member of the elephant family, have been unearthed in the Kuban in North Caucasus. The tusks of this species were spoon-shaped for the purpose of scooping food from silt and muddy water.

The study of fossil animal and plant life in the U.S.S.R. promises to add much that is new to research on the evolution of organisms under various external conditions.

Obituary Notices

Dr. Géza de Horváth

In these days of narrow specialization it is refreshing to look back on a generation of workers who, by their extensive biological knowledge and literary erudition, were able to deal satisfactorily with the multitude of new forms of life which improvement in transport and the rapid exploitation of the world during the latter half of the last century, were bringing to the European museums.

With the death of Dr. Géza de Horváth at Budapest on September 8, 1937, in his ninetieth year, entomology has lost one of the last of such men. When Horváth was a young man, Prof. Carl Stål, working in the Swedish State Museum at Stockholm, was busy founding the modern classification of the Hemiptera, and it was Horváth and his famous Finnish contemporaries Prof. O. M. Reuter and Dr. E. E. Bergroth, more than any others, who were destined to elaborate this system and build up from it our present knowledge of the systematics of the order.

Horváth was born on November 23, 1847, at Csécs in Northern Hungary. He was educated at the Kassa Gymnasium, where he was a pupil of the celebrated Prof. Jeitteles, and from there went up to the University of Vienna to study medicine. After graduating, he at first worked as an assistant in the Hungarian National Museum, but after about eighteen months he left the Museum to take up a medical practice in the provinces.

In 1880 Horváth was called upon to organize a *Phylloxera* experiment station at Budapest and acted for some time as its director. With the solving of the *Phylloxera* problem throughout Europe, the work of this station was directed towards the control of other injurious insects, and in 1890 it was renamed the Institute of Experimental Entomology. With the help of Jablonowski, such pests as the Moroccan locust, the nun moth, the hessian fly, the frit-fly, the grain sawfly, the grain aphis, clover weevils and the sugar-beet beetle were satisfactorily investigated.

Horváth returned to the National Museum in 1895 and worked as head of the Department of Zoology. Here as a specialist on the Hemiptera, he acquired a world-wide reputation. His systematic papers alone run into several hundreds. He made various scientific expeditions abroad and was a member of the permanent committee of the International Congress of Zoology, and of the International Committee of Zoological Nomenclature. In this capacity he visited the United States in 1907. Horváth was elected a member of the Hungarian Academy and was an honorary member of several foreign scientific societies. In 1927 he was elected president of the tenth International Zoological Congress held at Budapest. He retired from the directorship of the Museum in 1921, but continued to work on the Hemiptera until his death. W. E. CHINA.

Sir Edward Denham, G.C.M.G., K.B.E.

We regret to record the death of Sir Edward Denham, distinguished Colonial administrator and captain-general of Jamaica, which took place on June 2 at the age of sixty-one years.

Edward Brandis Denham was born in 1876, the son of the late Mr. Charles Denham of Sydney. He was educated at Malvern and Merton College, Oxford, and was appointed to a cadetship in Ceylon in 1889 after competitive examination. He had risen in the Colonial service to the rank of principal colonial secretary of Ceylon and colonial secretary of Mauritius, when in 1923 he was appointed Colonial Secretary of Kenya at a time when the present issue of the famous White Paper, laying down the principle of the paramountcy of native interests, was bringing about important changes in the attitude of the administration in dealing with various native questions. The communal system of representation, giving separate representation to Europeans, Indians, Arabs and natives was then being introduced, and in 1924 a measure of self-government was granted to the native tribal councils. These changes threw a heavy burden on Denham's shoulders, which was still further increased when, in 1925, the death of the governor, Sir Robert Coryndon, required him to take up the duties of acting governor, an office which he held until the arival of Sir Edward Grigg as Coryndon's successor in October 1925.

While acting governor, Denham made a tour of the Nyanza and Kikuyu provinces and the Kitui district, the most thickly populated parts of the Colony, with the view of studying the changing mentality of the native in contact with Europeans and their civilization. The results of his observation were embodied in an original and extremely valuable report, which was published as a Blue Book. Especially noteworthy were his remarks on the working of the recently established native councils.

In 1928 Denham was promoted to be governor of Gambia, and in 1930 he was transferred to British Guiana, where he did much valuable work in the development of the resources of the Colony. His appointment as captain-general of Jamaica was made in 1934. His successful efforts in social and economic reform, and the part he played in the recent troubled conditions make his premature death an irreparable loss to the island and to the Empire.

We regret to announce the following deaths:

Dr. Ch. E. Guillaume, formerly director of the Bureau International des Poids et Mesures, aged seventy-seven years.

Prof. Rudolf Vondráček, professor of fuel technology and metallurgy in the Brno Technical College, on June 12, aged fifty-seven years.

News and Views

Prof. Georges Urbain

On June 10, a meeting was held in Paris to mark the fortieth anniversary of the first scientific publication of Prof. Georges Urbain, the distinguished French chemist, member of the Institut de France and director of the Institute of Chemistry in Paris. A committee under the chairmanship of Prof. Jean Perrin organized a meeting at the Maison de la Chimie, where Prof. Urbain was heartily greeted by his colleagues, pupils and friends. Prof. Urbain's name is best known in connexion with his work on the rare earths and with the elements lutecium and celtium or hafnium; but the wide field of his other achievements in the fields of phosphorescence, spectrochemistry and theory of valency, was indicated in a most interesting address by Prof. Lebeau, an old school-friend of Prof. Urbain. Prof. J. Perrin and Prof. P. Langevin in their speeches pointed out that Prof. Urbain was first initiated into chemistry by his father, a teacher in chemistry, and that he continued his studies at the Ecole de Physique et Chemie, where Pierre Curie was a laboratory assistant, scarcely much older than the young and talented student. Hard work in pure science did not prevent Prof. Urbain from developing his gifts in art, for he is a composer of music and excels in sculpture. Several of his musical compositions for piano and organ, as well as for piano and a quartet of string instruments, were produced before the audience. A portrait of Prof. Urbain was made for the occasion by the sculptor Aronson, but several of Prof. Urbain's colleagues have had the pleasure of having their effigies made by the great man of science himself.

Dr. A. R. Todd

Dr. A. R. Todd, who has been appointed Sir Samuel Hall professor of chemistry and director of the Chemical Laboratories in the University of Manchester (see p. 1153), graduated in 1928 with first-class honours in chemistry in the University of Glasgow, where he won the Black Medal, the Roger Muirhead Prize and the Alexander Donaldson Scholarship. From 1928 until 1931 he was a Carnegie Research Scholar, working first at Glasgow under Prof. T. S. Patterson and later in Frankfort-on-Main under Prof. Borsche. Afterwards, as 1851 Exhibition Student, he worked for three years under Prof. R. Robinson at Oxford. In 1934 he became assistant to Prof. G. Barger in Edinburgh, where he held a Beit Memorial Medical Research Fellowship. In 1936 he was awarded the Meldola Medal, and in the same year he joined the Lister Institute as assistant in the biochemical department. Dr. Todd has published some thirty papers in chemical journals dealing with work on rotatory dispersion and the Walden inversion, the structure of bile acids, anthocyanin pigments, the chemistry of vitamins B_1 and E and other biochemical subjects. He enters on his new appointment at the end of September of this year.

Tercentenary of the Birth of Prof. James Gregory

The University of St. Andrews will commemorate on July 5 the three hundredth anniversary of the birth of James Gregory, professor of mathematics in the University from 1668 until 1674. The actual date of his birth at Drumoak, twelve miles from Aberdeen, appears to have been November 6, 1638, but the mathematical colloquium to be held in St. Andrews in July affords a suitable opportunity for this celebration. An address on Gregory and his work will be delivered in the Upper Library Hall, where his meridian line was traced on the floor, followed by a graduation ceremonial at which honorary degrees will be conferred on distinguished representatives. On the previous day, the Royal Society of Edinburgh is holding a meeting at which papers will be read on the mathematical and astronomical work of the inventor of the Gregorian telescope, who died in that city in October 1675 shortly after his transference to the chair of mathematics in the University of Edinburgh.

Charles Hilton Fagge (1838-1883)

This distinguished London physician was born on June 30, 1838, at Hythe in Kent, where his family had been in practice for two generations, and was the eldest of three brothers who joined the medical profession. He was educated at Guy's Hospital, to which he was appointed assistant physician with charge of the skin department in 1867, six years after qualification, and full physician in 1880 in succession to Dr. Habershon. He was also for many years curator of the museum, for which he compiled a catalogue of the models of the diseases of the skin in 1876. His literary output was considerable. His most notable papers were the articles on "Diseases of the Valves of the Heart" contributed to Russell Reynold's "System of Medicine" and those on "Sporadic Cretinism", "A Line on the Gums Characteristic of Lead Poisoning", and the "Probable Cause of Lead Colic" in the *Medico-Chirurgical Transactions*. To *Guy's Hospital Reports*, of which he was editor for some five years, he contributed a classical paper on "Acute Dilatation of the Stomach" in 1873, in addition to other articles. In 1866–68, in collaboration with J. H. Pye-Smith, he translated and edited for the New Sydenham Society two volumes of Hebra's "Diseases of the Skin", the translation of the remaining five being the work of Mr. Waren Tay. His work on the "Principles and Practice of Medicine", on which he had been engaged for ten years at the time of his death, was completed and edited by Pye-Smith. The cause of his death on November 19, 1883, at the early age of forty-five years was aneurysm of the aorta, the existence of which in his own person he had discovered about eighteen months previously while demonstrating the use of the binaural stethoscope. He nevertheless preferred to die in harness, a decision which met with the approval of Osler, among others.

A New Treatment of Pneumonia

SYNTHETIC compounds possessing specific curative effects in various infections—'chemotherapeutic agents' as they are termed—have long been sought for, though without much success, at least in bacterial infections. Three years ago, 'Prontosil', a sulphonamide compound, proved valuable in the treatment of streptococcal infections, such as puerperal fever. Quite recently, L. E. H. Whitby, investigating experimentally a number of synthetic compounds, found that one of them, 'M. & B. 693', had a marked specific effect upon the pneumococcus, the microbe of human pneumonia, almost complete protection being afforded against Types i, vii and viii pneumococcus infections, and a high degree of protection against Types ii, iii and v (*Lancet*, 1, No. 22, 1210; May 28, 1938). Encouraging clinical results in cases of pneumonia in man were reported by Evans and Gaisford (*Lancet*, 1, No. 23, 1305; June 4, 1938), and Telling and Oliver now give details of another case treated with this agent (*Lancet*, 1, No. 25, 1391; June 18, 1938). The patient, an old lady, was critically ill with pneumonia, pneumococcus Type iii being recovered from the sputum. After four days' treatment with the drug, recovery commenced and was finally complete. The observation was made that, in the course of treatment, the capsule which surrounds the pneumococcus became lost, and other changes in the organism were apparent. 'M. & B. 693', chemically, is 2-(*p*-aminobenzenesulphonamido) pyridine.

Organization of Archæological Research in India

As was pointed out recently in these columns (see NATURE, May 28, p. 965) little advantage has been taken of the facilities for archæological exploration offered some years ago by the Government of India to bodies from outside the country, nor, if Dr. E. Mackay's excavations be excepted, has a serious and systematic attempt been made on any adequate scale to follow up the discovery of the now famous early civilization of the Indus Valley. An indication that a forward policy is now contemplated is afforded by an announcement of the India Office that Sir Leonard Woolley has accepted the invitation of the Government of India to visit the country next winter before proceeding to Syria to resume his excavations in the spring of 1939. The object of the invitation is to secure his advice in regard to a programme of archæological work. Among the matters upon which it is understood that Sir Leonard will be consulted are, first, the areas which are to be regarded as most promising for future excavation; secondly, the best methods and agencies to achieve the speedy and fruitful development of exploration activities, not only under Government auspices but also by non-official bodies, such as universities and learned societies; and last, the best method of training, or selecting, officers for exploration work, including such points as the most suitable age for recruitment. Since the control of the Archæological Survey has passed into Indian hands, much excellent work has been done, more especially in those departments dealing with the growth of Indian civilization at periods with which her countrymen perhaps are more familiar and more competent to speak than 'foreigners'. The archæology of India is a subject for which her native students have shown both enthusiasm and aptitude; but they have had little opportunity to acquire the breadth of outlook which the study of the pre- and protohistory of their own country demands. The determination to seek outside advice and the choice of an adviser are wise steps, from which archæological studies throughout the world may expect to reap considerable benefit.

Peoples of Ancient Syria

EVER since the recognition of Sumerian influence in the Indus valley through discoveries in the excavation of Mohenjodaro and Harappa, archæological investigation has added continuously to the evidence of the remarkable, and it may be said, unexpected degree and geographical extent of the contacts and movements of cultures and peoples even in the early stages of the development of civilized society. Now Mr. Sidney Smith, in a communication to *The Times* of June 16, indicates how a preliminary examination of the tablets from the Palace excavated by Sir Leonard Woolley at Atchana affords evidence of the extremely mixed character of the population of Syria in the fifteenth century B.C. In ancient times, it would appear, the site of Atchana was known as Alalakh. It was the capital of the country, Mukish-khe, mentioned in Hittite and Egyptian records. It was a vassal State of the kingdom of Mitanni, as appears from a tablet recording an attempt to establish citizenship of a Mitannian province, brought before the king of that people about 1450 B.C. by a subject of Niqmepa, ruler of Mukish-khe. The documents which have been found at Atchana, Mr. Smith states, concern the status of certain citizens, and are in the Akkadian language. From the names recorded it is possible to deduce that the population contained a considerable proportion of Babylonians and of Khurrians, an indigenous people in Mitanni, but spread over a considerable area extending from Kirkuk, east of the Tigris, to northern Palestine, and of whose existence no knowledge survived prior to modern excavation. Niqmepa may be a Khurrian name, but his son's name is Babylonian. This, Mr. Smith points out, is merely another phenomenon of a mixed civilization, in which the predominant elements were Babylonian, apart from local law and administration. He goes on to say that the inscribed seal, to which Sir Leonard Woolley referred in his report, is no proof of Hittite conquest. The language of the Hittite hieroglyphs is not Hittite, though it may be Indo-European. The seal is, therefore, merely further proof of the mixed character of the population.

Patents, Designs and Trade Marks

THE fifty-fifth report of the Comptroller-General of Patents, Designs and Trade Marks presents, as usual, a solid mass of information about the volume of business handled during 1937 in the Patent Office (Patents, Designs, and Trade Marks. Fifty-fifth Report of the Comptroller-General of Patents, Designs, and Trade Marks, with Appendices, for the Year 1937. Pp. 25. London: H.M. Stationery Office. 6*d*. net). Applications for patents, which should reflect the inventive activity of the country, went over the 35,000 mark during the year, and the work of the 821 members of the staff resulted in a surplus of close on £300,000. Two pages of the report are devoted to an account of the trend of invention to-day. Synthetic drugs, for example, sulphonamides, have had much attention, and hormones—to borrow a Stock Exchange phrase—are a strong feature. The special needs of bombers and bombs and the general demands of industry have caused the problems of getting and successfully using the extra-light metals magnesium and aluminium to be continuously tackled.

IN the patent field, application activity often diminishes in quarters where the main problems have been solved and the stage of bulk production has been reached. For this reason, applications for patent protection for mercury arc rectifiers have fallen off, but television applications are more than maintained. The report itself should be read to get a comprehensive survey, but one of the most curious instances of the application of science to the peculiar needs of modern life should be noted; inventors have been busy with various forms of chance-apparatus for use by those who fill up football-pool coupons. Patents make strange bed fellows and air raids precautions succeed pool coupons in the report. The Comptroller has clearly had a busy time with legislation, as 1937 saw both a Patents and a Trade Marks Bill introduced into Parliament. Of these, the Trade Marks Bill has now gone through all its stages and received Royal assent.

Expenditure on Public Social Services

A RETURN showing the total expenditure under certain Acts of Parliament in the financial years 1900, 1910, 1920, 1930, 1935 and 1936 on public social services has recently been issued, covering expenditure from local rates, Parliamentary votes and other receipts, not being loans or receipts for capital purposes. The first part of the return shows that the total expenditure on these services in England and Wales has increased from £31·7 millions in 1900 and £54·95 millions in 1910 to £412·8 millions in 1930 and £440·5 millions in 1935. For 1936, the expenditure is estimated at 326 millions. The largest single item of expenditure is that under the Education Acts, which has increased from 16·9 millions in 1910 to 97 millions in 1935. Expenditure under the General Scheme of Unemployment Benefit in 1935 was 45·7 millions and Unemployment Allowances and Benefits 38·9 millions. Expenditure under the Old Age Pensions Acts has risen from 6·3 millions in 1910 to 39 millions in 1935, under the National Health Insurance Acts from 26 millions in 1920 to 34 millions in 1935. Under the Housing Acts expenditure has risen from 0·4 millions in 1900 to 42 millions in 1935, while under the Acts relating to the relief of the poor, expenditure has risen from 11·5 millions in 1900 to 44 millions in 1935. Public Health Acts now account for an expenditure of 16 millions as against a little over a million in 1900. Expenditure under the War Pensions Acts and Ministry of Pensions Act has decreased from 90·9 millions in 1920 to 36 millions in 1935. Expenditure in Scotland on the same services shows similar trends, the total having risen from £4·3 millions in 1900 to £50·3 millions in 1935. Particulars of the number of persons benefiting from this expenditure are included.

Training for Responsibility and Control

A REPORT on education, selection and training for positions of responsibility and control, by W. R. Dunlop, 57 Gordon Square, London, W.C.1, gives a summary of published views and methods in Great Britain with reference to executive and administrative positions in industry, commerce, agriculture, the civil services, the army, etc. Attention is directed to the confusion or disagreement as to management terminology in general, as to the main function of the educational system, the value of public school education and of social qualifications for positions of responsibility or control. On the other hand, the general agreement that, so far as management is concerned, the subject of a university degree does not greatly matter, which is emphasized by Mr. Dunlop, should be noted by scientific workers in supporting their claims for equal consideration for admission to administrative posts. Other matters on which there is general agreement are the necessity for avoiding excessive specialization in training; the importance of linking training for management with employment; the value of the "Case" method in specialized training; the unreliability of selection by interview or examination and especially the unsatisfactoriness of committee interviewing.

AMONG many specific recommendations of the report are the recognition of the value of the psychological view in education, selection and training and of the importance of moral principles in management. An adequate article in the "Encyclopædia Britannica" is advocated, and in regard to general education the significance of history and geography is stressed. Views on the transfer of subjects problem require further investigation, and more attention should be paid to the wider aspects of selection, such as systems or policies, as well as to the forecasting of vacancies. Managerial job analysis, attention to the claims of older and not exclusively the younger men, probationary periods, to the theoretical side of training schemes in industry and the development of an administrative section in the libraries of Government departments and business firms are also recommended. In addition to the list of findings and recommendations, the report includes a fairly comprehensive bibliography the value of which unfortunately is considerably diminished by the incompleteness of the bibliographic detail.

The Service of Unified Knowledge

SOME time ago (November 18, 1936) we discussed, under the above heading, Mr. H. G. Wells's "Idea of a World Encyclopædia", a project designed "to hold men's minds together in something like a common interpretation of reality". Six months later (May 29), we published an article discussing Prof. Dobrowolski's scheme for paving the way for such a common interpretation by equipping every university with a "faculty of general knowledge". A full translation of its author's own account of the scheme appeared later in the *Sociological Review* (October 1937), including a description of the organization, subject-matter, time-tables and method of instruction of "Universitas Rediviva", a working model of the proposed faculty of general knowledge in operation in Warsaw. In the meantime, Mr. H. G. Wells has outlined in his address at Nottingham to Section L (Education) of the British Association, his ideas as to the informative content of the kind of liberal education that might be expected to produce minds capable of being held together by his world encyclopædia. The importance of such a "holding together of men's minds" has been clearly seen by the creators of the modern dictatorial regimes. In democracies it is equally important but much more difficult to achieve. Both Wells and Dobrowolski would probably subscribe to A. N. Whitehead's dictum: "There can be no successful democratic society till general education conveys a philosophic outlook" ("Adventures of Ideas". Cambridge: University Press, 1933).

Accessions to the British Museum (Bloomsbury)

AMONG accessions to the collections of the British Museum (Bloomsbury) reported at the June meeting of the Trustees is a remarkably fine spearhead found in the Thames at London, which has been on loan since 1931, and has now been presented to the Museum by the owner, Capt. John Ball. The spearhead, on account of its graceful shape, ranks with the famous Battersea shield and other examples of Celtic art in Britain of the period of high æsthetic qualities. It is of iron with two applied plates of bronze on each side, ornamented with Celtic scroll pattern. It dates from the beginning of the first century A.D. The most important accession to the Ethnographical Department consists of a generous selection of the antiquities from the Bay Islands off British Honduras, which were recently on exhibition in London (see NATURE, May 21, p. 932). These have been given by Lord Moyne, by whom the excavations were carried out. The remainder of the collection has been sent to Cambridge for study and distribution among various institutions. The examples of the Bay Islands culture allotted to the British Museum include a number of ocarinas or pottery whistles of various shapes, including a notable specimen in the form of a jaguar, while a remarkable product of the potter's art is a monkey swinging from a bough. The selection also includes a number of the small carvings in jadeite and soapstone and several of the stone hoes, while a large pottery beaker is especially interesting, as being comparable with one carved in white stone coming from the mainland of Honduras, which was already in the Museum. The Bay Islands culture is thought to date from between A.D. 1000 and 1500.

Recent Advances in Bird-Ringing

BIRD-RINGING in Britain, now organized from the bird room of the British Museum (Natural History), shows an increase not in the actual number of birds marked, but in the number of adult birds 'trapped' and thus marked and released, and a decrease in the number of nestlings marked; the mortality amongst nestlings is naturally high and thus the chances of recovery of ringed nestlings fewer. The statistics for 1937 show that 45,181 birds were ringed in Britain (*British Birds*, April 1938), as against 48,663 the previous year, bringing the grand total of birds marked in the country since the scheme was started in 1907 to 575,914. There was a record total of 'trapped' birds last year of 21,900 compared with 19,235 birds last year, and it includes a number of rarities not marked before, such as the waxwing and little bunting. Skokholm Bird Observatory, South Wales, for example, marked 4,402 birds in 1937, including the valuable total of 1,448 Manx shearwaters, 904 gannets and 603 razorbills. Mr. G. Charteris's list of 3,044 birds marked included 1,396 chaffinches, mostly at a winter roost; Mr. P. Morshead's total of 2,546 birds included 1,272 'trapped' starlings; Mr. A. Maynall's 2,024 birds including 348 nestling nightingales. The Zoological Society of London (through Mr. E. A. Billet) ringed a total of 1,144 birds at Whipsnade last year, these including 333 'trapped' jackdaws. Some of the leading boys' schools again take a prominent place in the ringing returns. Owing to the increased cost of the rings and the organization, there is an appeal for funds in addition to the general charges for the rings used.

Systems of Units

THE February issue of the *Journal of the Franklin Institute* contains a paper by Prof. W. M. Hall, of the Massachusetts Institute of Technology, on the formation of systems of units, which embodies portions of a 1936 copyright publication on the subject. The conditions for a self-consistent system of units are laid down and for translational kinematics length and time taken as fundamental. Translational kinetics then gives mass and rotational angle. Thermodynamics introduces temperature, light visibility and sound audibility. Electrodynamics admits of two possibilities: permittivity or permeability may be taken as fundamental and give the electrostatic or electromagnetic systems respectively. The questions of the sizes of the units to be chosen for convenience and of rationalizing or subrationalizing the units in which the coefficient 4π appears are discussed. Tables are given in which the units of the following systems are compared. The electromagnet with centimetre, gram, second and permeability of vacuum fundamental, the electrostatic with permittivity replacing permeability, and rationalized and subrationalized forms of each, the Gaussian mixed system with some quantities expressed in electromagnetic others in electrostatic units, the rationalized form of this, introduced by Heaviside and Lorentz, the Maxwell quadrant (10^9 cm.), 10^{-11} gram, second and permeability of vacuum, the Bennett and others, centimetre, 10^7 gram, and a unit of permittivity of vacuum $= 1/(8 \cdot 989 \times 10^{11})$, the Giorgi, metre, kilogram, second and 10^7 times the permeability of vacuum. The last three systems all have the ampere, volt and watt as units of current, potential and power respectively.

Trend of Design of Electric Locomotives

The paper on the trend of the design of electric locomotives during the last ten years, read to the Institution of Electrical Engineers by C. E. Fairburn, the electrical engineer to the L.M.S. railway, is a valuable contribution to electric traction. He shows clearly that there is a growing demand for locomotives of greater power and speed. This is due partly to the necessity of improving running schedules with heavier trains and of avoiding the higher cost of multiple operation. Fairly complete data are given of ten electric railways in eight different countries and from twelve manufacturing companies. To analyse them is difficult because the outlook and methods vary not only from country to country but also from railway to railway in the same country. In Austria, Germany, Switzerland and Sweden low-frequency alternating current is employed; in Belgium, Italy and Poland, 3,000 volts direct current; France, Holland, Japan and much of the British Empire, use 1,500 volts direct current. Three-phase systems seem to be making little progress. In Germany, the express locomotive of the German State Railways is of 4,150 horse-power. Recent Swiss locomotives have 8,630 horse-power and the articulated express locomotives of the Pennsylvania Railroad can supply 9,500 horse-power for a short period. General experience with high-power locomotives, in particular on the Pennsylvania Railroad, shows that even larger horse-powers are desirable, especially on lines carrying heavy traffic. It is definitely stated that the advantages of electric braking on long gradients lie more in the reduction of wear in the mechanical parts than in the value of the energy returned to the supply system. With high speeds it is advisable to retain mechanical brakes for emergency operation as this makes higher speeds possible with safety.

Water Heating by Electricity

At a meeting of the Association of Supervising Electrical Engineers held in London on April 12, P. Honey discussed the technical aspects of water heating by electricity. Since two trades were involved, namely, plumbing and wiring, the question of responsibility for satisfactory working has to be considered. The retailer of the appliance has to take upon himself the responsibility of planning the installation and, with the co-operation of a hot-water fitter, make certain that the workmanship is good. The problems of the water authorities are similar, in some respects, to those of supply undertakings. Unlike electric supply they have not the stimulus of competition. As water for domestic purposes is rarely charged for by quantity, the most urgent need is to prevent waste. They have therefore insisted that the fittings and appliances should be in accordance with certain specifications. To eliminate 'peak' demands which would cause serious drop in water pressure, the use of feed cisterns is insisted on by many authorities to ensure a more even demand. The amount of storage water held in this way in the houses of consumers is a considerable fraction of the total stored by the authorities. Regulations, therefore, were issued which restricted the connexion of electric water heaters of the thermal storage type direct to the cold water main. For example, in London, no heater larger than three gallons must be connected in such a manner. Those of larger size must be fed from an adequate storage system. No water authority in Great Britain would permit the connexion of a pressure water heater direct to the cold mains in the way frequently done abroad. The cost of servicing electric water heaters of all kinds is not a serious item. The majority of the few electrical defects which occur are probably due to the thermostat and are not serious.

Education in 1932-1934 in the United States

The United States Office of Education has recently published its "Biennial Survey of Education 1932–1934" (Washington: Government Printing Office. Pp. 1222. Price 1.10 dollars). The effects of the economic depression, which touched its lowest point in 1932, are reflected in many of the statistical tables. The total aggregate income for education from kindergarten upwards in 1933–34 was about 2,604 million dollars, of which huge sum more than five sixths represent income of publicly controlled institutions. Compared with the corresponding figures for 1931–32, there was a decrease of 15·5 per cent, and compared with those for 1929–30 a decrease of 22·6 per cent. It is noteworthy that the decrease was twice as heavy in privately controlled as in publicly controlled institutions from 1932 to 1934, although it had been much lighter in the preceding biennium. Statistics of university enrolments which had risen continuously for many years showed a sharp drop after 1932. It is estimated that the percentage of boys and girls who on completion of their secondary school education entered a university or other institution for further education was in 1933 about 26. This is a high figure compared with the corresponding percentage in Great Britain, but it is low compared with the average percentage (44) of the years 1921–1929 in the United States.

University College, London

Its recently issued annual report shows that this most cosmopolitan of all colleges in Great Britain numbered last year among its 3,284 students no fewer than 910 visitors from 52 countries outside the British Isles. By far the biggest contingent, 228, came from India. From Germany came 73, Scandinavian countries 47, Switzerland 30, France 25, Holland 21; from Australia 30, New Zealand 27, Canada and Newfoundland 45, the United States 43, South Africa 37, Egypt 26, Palestine 28, China 35. For some years past the College reports have directed attention to the increase in the number of post-graduate and research students. Last year these advanced students numbered 616, and it is noteworthy that more than 40 per cent of them were from abroad, including 81 from India, 24 from Canada and Newfoundland, 23 from China, 22 from New Zealand, 18 from Australia, 18 from South Africa, 10 from the United States and 10 from Germany. A list of more than five hundred original papers and other publications from the various departments of the College in 1937 is appended to the report. A coloured plan shows graphically the growth of the College site and buildings since 1827.

Health of School Children

The annual report for 1936 of the chief medical officer of the Board of Education, Sir Arthur MacNalty, entitled "The Health of the School Child" (London: H.M. Stationery Office. 2*s*. 2*d*., postage included) states that, during the year in question, the nutrition of more than 1,700,000 children was assessed with the result that 14·6 per cent were regarded as excellent, 74·2 as normal, 10·5 as slightly subnormal and 0·7 as bad; these figures are substantially the same as those in the report for the previous year. Free school meals provided have increased from 87,000,000 in 1935–36 to more than 100,000,000 in 1936–37. More than half the children who could receive milk either free or at half-price still fail to take it. Medical inspection and eyesight, care of the teeth, physical training and recreation and the national health campaign are some of the other subjects dealt with in this report.

Netherlands Indies

The Colonial Institute of Amsterdam, which maintains a research department and an economic museum as well as an ethnographical department in conjunction with the Netherlands Pacific Institute, has published the first number of a new quarterly entitled *Bulletin of the Colonial Institute of Amsterdam* (18*s*. a year). The aim of the new publication is to give authoritative articles in English on various aspects of the Netherlands Indies. Only a small part of each number will be written in Dutch. Articles of scientific interest in the first number treat of malaria in the Netherlands Indies, social organizations of the peoples of Borneo, Celebes and the Moluccas, and air transport in the Pacific.

Asbestos

A recent publication of the Mineral Resources Department, Imperial Institute, is a monograph on asbestos by Mr. G. E. Howling (second edition. 2*s*.). The volume includes a discussion of occurrence, mining methods, uses, marketing and world production, and ends with a full bibliography.

Universal Esperanto Congress

The thirtieth Universal Esperanto Congress will be held in London on July 30–August 6, under the high patronage of H.R.H. the Duke of Connaught. The total membership of the Congress is expected to be about 1,500, of whom some 1,300, representing twenty-five nationalities, had been enrolled at the beginning of June. The official proceedings will, as usual on these occasions, be carried on in the international language alone, no interpreters being employed either at the general meetings or at the sectional gatherings of specialists. Among the social features of the week will be two performances in Esperanto of "Eliza Comes to Stay" by members of the Neilson-Terry Guild of Dramatic Art, who have been learning the language for the purpose. It has been decided to hold next year's Congress at Bern, Switzerland.

The Night Sky in July

The moon is full on July 12^{d} $15{\cdot}1^{h}$ and new on July 27^{d} $03{\cdot}9^{h}$ U.T. The only bright star to be occulted this month is λ Piscium, the reappearance of which will be visible from Greenwich on July 18 at 2^{h} $22{\cdot}4^{m}$, at position angle 198° from the north point of the moon's image. Lunar conjunctions with the planets occur as follows: with Jupiter on July 16^{d} 7^{h}; with Saturn on July 20^{d} 0^{h}; with Mercury on July 29^{d} 5^{h}; and with Venus on July 30^{d} 9^{h}. On July 26, Mercury is near Regulus, the minimum apparent separation (geocentric) being 0·9°; and on July 31^{d} 7^{h} Mercury is in conjunction with Neptune, the separation being 0·4°. Venus is a bright evening star, setting about 1^{h} 40^{m} after the sun in mid-July. Jupiter and Saturn are both visible during the night, Jupiter, a very bright object, southing about $2\frac{1}{4}^{h}$ in the middle of the month and Saturn three hours later. The interesting phenomena (eclipses, transits, occultations) of the Jovian four inner satellites may be followed with the help of the table and diagram given on p. 613 of the *Nautical Almanac* for 1938 or of the table on p. 170 of *Whitaker's Almanack*. At 22^{h} in mid-July, Vega is nearing the southern meridian and precedes the Milky Way. The bright star Deneb (α Cygni) on the galactic equator marks the apex of the bifurcation of the Milky Way, one branch passing southwards through Serpens and Scorpio; the other through Aquila, Scutum and Sagittarius. Interesting objects for telescopic examination abound in this region, which is also the habitat of the novæ. The 6th magnitude double-star, 61 Cygni, was the first star to have its distance successfully measured one hundred years ago by Bessel, who made his measures with a heliometer. His results gave the star's distance as 640,000 times that of the earth-sun distance; modern measures give 680,000 times this unit.

Announcements

The Right Hon. Neville Chamberlain has been elected a fellow of the Royal Society under Statute 12, which provides for the election of persons who "either have rendered conspicuous service in the cause of science, or are such that their election would be of signal benefit to the Society".

PROF. J. E. LITTLEWOOD, Rouse Ball professor of mathematics in the University of Cambridge, has been awarded the De Morgan Medal for 1938 of the London Mathematical Society. The Medal, which is awarded triennially, will be presented at the next meeting of the Society, on November 17.

THE following grants and scholarships from the Lady Tata Memorial Fund for research in blood diseases, with special reference to leukæmia, have been made for the academic year beginning on October 1, 1938: grants for research expenses or for scientific assistance: Dr. Julius Engelbreth-Holm (Copenhagen), Dr. M. P. J. Guérin (Paris), Prof. Dr. Karl Jármai (Budapest), Prof. James McIntosh (London), Prof. Eugene Opie and Dr. J. Furth (New York), Dr. Georg Weitzmann (Leipzig), Dr. Joachim Wienbeck (Breslau); whole-time scholarships: Dr. Jørgen Bichel (Aarhus, Denmark), Dr. Edoardo Storti (Pavia, Italy); part-time scholarship: Dr. Werner Jacobson (Cambridge).

MR. M. A. BAILEY has been appointed director of the National Institute of Agricultural Botany in succession to the late Mr. W. H. Parker, who died in January last. Mr. Bailey was educated at Dulwich College and Clare College, Cambridge, taking the Natural Science Tripos Part I (first-class honours) and the diploma of agriculture. After war service, during which he held the post of brigade major in the Royal Field Artillery, he was appointed botanist to the Egyptian Government. This was followed by service with the Empire Cotton Growing Corporation and his appointment as director of agricultural research to the Sudan Government, from which he has recently retired.

THE annual inspection of the National Physical Laboratory will be held on June 28.

THE new building for the Radcliffe Telescope at the University of London Observatory, Mill Hill Park, N.W.7, will be opened by the Astronomer Royal on July 1 at 4 p.m.

ON the occasion of the twenty-fifth anniversary of its foundation, the Swiss Rontgen Society has elected the following honorary members: Dr. C. Thurstan Holland of Liverpool, Profs. R. Kienbock of Vienna, Holthusen of Hamburg, Hans Meyer of Bremen, Perussia of Milan, De Quervain of Bern and Regaud of Paris.

PROF. WILHELM KREIS, of Dresden, has been awarded the Goethe Medal for Art and Science.

A NEW Institute of Medical Chemistry has recently been inaugurated by the Faculty of Medicine at Keio, Japan. The building alone will cost 100,000 yen. The new institute will serve not only as a research centre but also as a hospital.

DR. VICTOR E. LEVINE, professor of biological chemistry and nutrition at the Creighton University School of Medicine, has established a laboratory at Point Barrow equipped with all the latest apparatus for carrying on medical and biological research in the Arctic.

THE bronze Heberden Medal is to be awarded annually to a registered medical practitioner for the best work in the British Isles on the investigation of rheumatic diseases. The recipient will be invited to deliver the Heberden Lecture, which should contain a review of the work carried out for the award of the medal. The first award will be made in January 1939. Further information can be obtained from the Hon. Secretary, Dr. Kenneth Stone, 58 Chesterfield Gardens, W.1.

THE Institute of International Education announces that a Woolley scholarship in Paris is offered to a student in psychiatry for the year beginning October 1. The scholarship consists of 600 dollars and a room in the United States House of the Cité Universitaire in Paris, under whose auspices the offer is made. The candidate must be an American citizen. Applications should be made to the Institute of International Education, 2 West Forty-Fifth Street, New York.

A SUM of 66,000 dollars has been made available by the Rockefeller Foundation for the department of hospitals for the support of research on chronic diseases at the hospital now under construction at Welfare Island. The subjects for study include rheumatoid arthritis, the role of nutrition in chronic diseases, the role of cholesterol metabolism in arterio-sclerosis, circulatory and respiratory factors in pulmonary emphysema, bacteriological and immunological factors in acute and chronic glomerulonephritis, and various factors in hypertension.

THE Central Association for Mental Welfare has arranged a course for persons engaged in the training of mental defectives in occupation centres and institutions or mental hospitals and for home teachers to be held in London on July 4–23; also a course for officers of local authorities and local associations for mental welfare engaged in the ascertainment and supervision of defectives during the same period. Further particulars may be obtained from the Educational Secretary, Central Association for Mental Welfare, 24 Buckingham Palace Road, S.W.1.

COURSES on the "Physics of Metals", arranged especially for teachers, will be held in the University of Pittsburgh on July 5–August 12. Lectures will be delivered by Prof. N. F. Mott, Melville Wills professor of theoretical physics in the University of Bristol, who will be in residence for six weeks; Dr. John Bardeen, fellow of Harvard University, recently appointed assistant professor of physics in the University of Minnesota; Dr. Francis Bitter, associate professor of the physics of metals in the Massachusetts Institute of Technology; Dr. Foster C. Nix, research physicist at the Bell Telephone Laboratories; Dr. Frederick Seitz, research physicist at the General Electric Laboratories in Schenectady, New York. Colloquia on the physical tools of use in metallurgy, and on the creep, elastic properties, internal friction, mechanism of hardening and fatigue in metals are also being held.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1145.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Kramers' Absorption Law in Astrophysical Problems

KRAMERS' well-known absorption law[1], long used by astrophysicists in their calculations of the opacity of stellar material, was first derived from classical mechanics and the correspondence principle, and may be stated thus:

$$\alpha_\nu = 0\cdot0104 \frac{Z^4 \lambda^3}{a_n n^3} g, \qquad (1)$$

where α_ν is the atomic coefficient of continuous absorption, Z is the effective atomic number, λ is the wave-length in cm., n is the quantum number, a_n is the statistical weight of the n^{th} state, and g is a factor very nearly unity.

Wave mechanical calculations have confirmed this result[2] for hydrogen, but have shown that it does not apply to hydrogen-like atoms[3], much less to other elements, as previously assumed. Laboratory measurements show that it is invalid for the alkalis[4] and not exact for X-ray absorption[5]. However, equation (1) has never actually been verified from observations on atomic hydrogen, which must be made at pressures sufficiently low for external conditions to have no effect[6].

It is not possible to measure the actual continuous absorption of light by hydrogen, but through Milne's fundamental relation[7] between photo-ionization and recombination, Cillié[8] has computed from equation (1) the relative numbers, p_n, of captures of electrons on the n^{th} level of a hydrogen atom in equilibrium with free electrons at an 'electron temperature', T_e. From an emission spectrum due to recombination we can determine the p's observationally from the following equations:

$$p_n = \sum_{r=n}^{\infty} K_{r,n} I_{r,2}, \text{ for } n > 2 \text{ (Carroll}^9\text{)}, \qquad (2)$$

p_2 = the number of quanta in the continuous emission at the head of the Balmer series. (3)

$I_{r,2}$ is the intensity of the $(r-2)^{\text{th}}$ Balmer line, and the K's are functions of the Einstein transition probabilities, which have recently been calculated up to $n = 14$ by Menzel and Pekeris[2].

Two published sources of Balmer emission intensities which might be used in equations (2) and (3) are measurements first in the solar chromosphere spectrum by Menzel and Cillié[10], and secondly in the spectra of several planetary nebulæ, measured at this Observatory[11]. Recently I have also measured intensities in the spectrum from the electrically undisturbed region of an electrodeless discharge in hydrogen. In the nebulæ and in the discharge it can be shown that the recombination of protons and electrons must account for almost the entire emission, and the electron temperatures have been measured (and found to be near 1000° K.). In the chromosphere, however, as Menzel and Cillié point out, the mechanism of line formation is uncertain. Furthermore, no use can be made of their results because (*a*) their "Balmer continuous emission" must include the intensity of unresolved lines (Menzel[12] lists more than 2·6 lines of intensity greater than "O" per angstrom in that region), and (*b*) there may be further errors due to the calibration and standardization.

In this investigation the carefully estimated observational errors are such that the values of p_n listed in the accompanying table must be accurate to about 15 per cent for the nebulæ and 5 per cent for the discharge. We are therefore justified in testing Kramers' law by comparing the observed p_n listed in columns 2, 3, and 4 with the theoretical values for $T_e = 1000°$ K. (If the transition probabilities $A_{m,n}$ used are in error, Kramers' law must similarly be so, since it was calculated by the same methods as the $A_{m,n}$.)

RELATIVE NUMBERS OF CAPTURES ON LEVELS OF THE H ATOM

	Observed p_n (1000° K.)			p_n from Kramers' law	
n	Discharge	Nebulæ		1000° K.	50,000° K.
2	0·012	0·675	0·039	21	37
3	17·9	—	40	13·5	17·6
4	10·0	10·0	10·0	10·0	10·0
5	5·53	5·9	5·0	7·5	6·2
6	2·62	3·7	2·0	6·2	4·2
7	1·19	—	—	4·9	2·9
8	0·725	(*NGC.* 7 62)	(*NGC.* 7027)	4·0	2·2
9	0·366			3·4	1·6
10	0·202			3·0	1·3

Not only are the observed ratios $p_3 : p_4 : p_5 :$ etc. found to differ from those predicted in column 5, but also $p_3 \gg p_2$ (a peculiarity also observed for the alkali atoms[13]), whereas by Kramers' law $p_3 < p_2$.

We are thus forced to conclude that the use of Kramers' law in astrophysical problems is unjustified. A more detailed account of this investigation will shortly be communicated to the Royal Astronomical Society.

T. L. PAGE.

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June 1.

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Mechanism of the Primary Photodissociation Process of Organic Molecules

IN a recent letter to NATURE[1], Bergmann and Samuel advance a theory of photodecomposition of organic molecules according to which two bonds are fissured simultaneously, not by the splitting of two single bonds but by a transition to the repulsive state which corresponds to a reduction of valency of the central atom resulting from the re-formation of the s^2 group of this atom.

This conclusion is not new: it was shown in 1933 by Norrish, Crone and Saltmarsh[2] that the ketene molecule is decomposed photochemically according to the equation

$$CH_2{:}\overset{|}{C}O \rightarrow CH_2 + CO\ (^1\Sigma), \qquad (1)$$

and that the energy of the photolysing quantum (74 kgm. cal.) is insufficient to rupture the double bond (say, 167 kgm. cal.) unless the CO is liberated as normal carbon monoxide rather than as free carbonyl. Similar considerations were held to apply to the photolysis of diazomethane[3].

The idea was then tentatively extended to ketones[4,5]; for example,

$$CH_3COC_2H_5 \rightarrow CH_3 + C_2H_5 + CO\ (^1\Sigma), \qquad (2)$$

but it was emphasized that there was no evidence to show in these cases whether the two alkyl radicals are eliminated simultaneously or one rapidly after the other. Since then it has transpired that in the case of acetone the elimination takes place successively[6]; this was later confirmed more generally since in paraffinoid solution it was shown that the free radical RCO formed can be hydrogenated to aldehyde[7] at temperatures exceeding 60°C.

The apparent result of equation (2) is thus due to the instability of the acyl group, which at 60° and upwards readily decomposes:

$$R\overset{|}{C}O \rightarrow R + CO\ (^1\Sigma), \qquad (3)$$

presumably owing to the tendency of the carbonyl of the radical to revert to the repulsive singlet state.

These results have not been taken into consideration by Bergmann and Samuel, while the photolytic equations which they suggest are unsupported by evidence, and in some cases in disagreement with fact. All the evidence shows that ketones and aldehydes do not decompose by analogy with their equations. In the region of predissociation, formaldehyde yields molecular hydrogen and carbon monoxide in one act[8,9], while the αα dicarbonyl substance glyoxal decomposes according to the equation[10]

$$2HCO.CHO \rightarrow CO + CH_2OH.CO.CHO.$$

The decomposition of methyl glyoxal is analogous and diacetyl appears to be still more complicated, and none of the products can be derived from equations of the type suggested by Bergmann and Samuel.

It should be noted that so far as aldehydes and ketones are concerned, the heats of the reactions

$$RCOR \rightarrow R + R + CO\ (^1\Sigma),$$

$$RCOR \rightarrow R + R\overset{|}{C}O,$$

though at present suffering from some uncertainty, are not very different, and that the threshold of continuous absorption is not sufficiently precise to be correlated with either, even supposing they were known accurately.

The mechanism of the photodissociation of SnI_4 and BiI_3 was first elucidated experimentally by Terenin[11]. Samuel and Parti[12] employ a modified mechanism to explain the long wave-length limit of the absorption spectrum of CI_4. The good agreement they obtain is dependent upon an uncertain assumption about the ratio of the heats of formation of $CHal_2$ and $CHal_4$ and also upon the use of a value 156·2 k.cal. for the heat of sublimation of carbon. Reliable sources[13,19] now consider the latter to be about 124 k.cal., a value which would completely upset their agreement. This has already been pointed out by Cherton[14], and the same remark applies to their other calculations.

Finally, it cannot be too strongly urged that with polyatomic molecules the principle of Franck, Sponer and Teller[15] comes into operation, and that the onset of predissociation is properly shown by the threshold of fluorescence rather than by the threshold of diffuseness[16]. With formaldehyde the former is at about 3700 A., and the latter at 2750 A., while the photochemical yield is unity on both sides of the limit of diffuseness, and the products unchanged[17]. Herzberg and Franz[18] set the true limit of predissociation at a wave-length longer than 3000 A. No evidence in support of Bergmann and Samuel is therefore forthcoming in the case of formaldehyde.

Generalizations of the type advocated by Bergmann and Samuel are unsafe because of the uncertainty of the precise values of the energy of many chemical bonds, and also because of the doubt as to the proper interpretation to be put upon diffuseness in the spectra of polyatomic molecules. They cannot be safely accepted in the absence of supporting chemical evidence.

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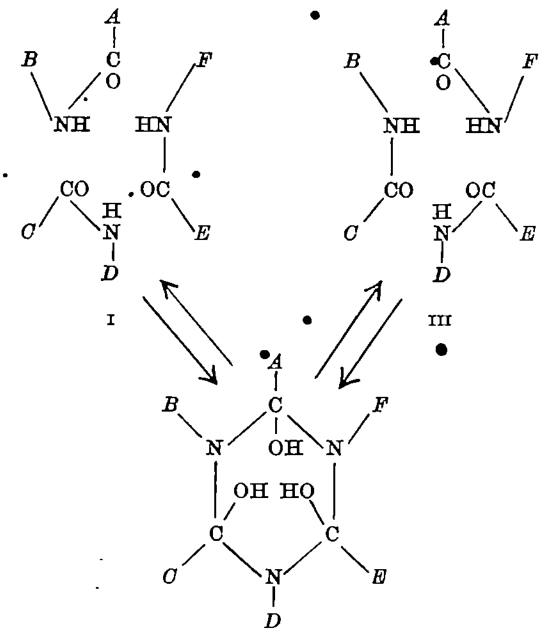
Possibility of the Formation of Cyclols from Simple Peptides

IN a series of communications in NATURE, Dr. D. M. Wrinch[1] has put forward a new hypothesis on the structure of certain proteins—the 'cyclol-theory'. According to this, peptide chains should be capable of uniting to form two- and three-dimensional nets, three peptide residues forming a ring as in II:



A, *C*, and *E* represent residues of the type R.CO.NH.CHR-; *B*, *D*, and *F* residues of the type R.NH.CHR.CO-.

Compounds of this kind (II) are unknown, and a consideration of the thermal data shows that it is improbable that they should occur in considerable quantity in equilibrium with free peptides. It seemed to us of interest to ascertain whether they occur even in minute quantities in tautomeric equilibrium with free peptides, and whether their presence could be demonstrated indirectly.

In the cyclol compound II, the residue *A* is united to both *B* and *F* in the same way. This compound may be formed by condensation of peptide *AB* with *CD* and *EF* (I → II), but also from the peptides *AF*, *ED*, and *CB* (III → II). In the reconversion of a cyclol to its peptides, therefore, not only should the original material be obtained but also a mixture of peptides: in this case, from those in I, those in III as well. In other words, the peptides must be able to exchange residues with one another if cyclols are formed (even in minimal quantity) in tautomeric equilibrium.

Glycyl *l*-leucine and *l*-leucyl glycine were mixed; these should have interchanged to form partially *l*-leucyl *l*-leucine and glycyl glycine if cyclol formation takes place at all. Observation of the optical activity showed, however, that no such reaction can be detected, either in neutral aqueous solution or in solutions of the chlorhydrates or of alkali salts. The rotation of equimolecular mixtures of both peptides was equal to the mean of the rotations of the two peptides (see accompanying table) and remained so for twenty-four hours. Any formation of *l*-leucyl *l*-leucine would have led to a considerable diminution in the rotation.

		neutral	acid	alkaline
$[\alpha]_D^{20°}$	*l*-leucyl glycine	+77·6	+44·3	+25·0
,,	glycyl *l*-leucine	−35·3	−34·1	−19·7
	mixture (observed) ..	+21·7	+5 2	+2·8
half rotation of *l*-leucyl *l*-leucine		+3·5	—	−6·7

Cyclol formation does not, therefore, occur under these conditions. This does not speak favourably for the 'cyclol-hypothesis'. It seems highly improbable that the nature of the peptide linkage may be so modified by lateral substituents, that a reaction which is entirely absent from simple peptides becomes possible in proteins.

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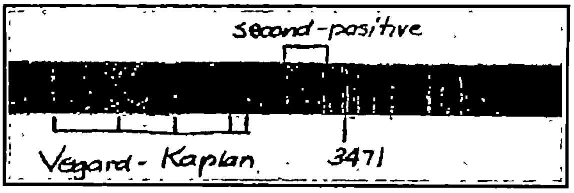
A New Nitrogen Line

RECENTLY[1], I reported the preliminary study of a nitrogen afterglow at high pressures, rich in the Vegard-Kaplan bands and containing a line at 3471 A. which was tentatively identified as the hitherto unobserved transition $^2P \rightarrow {}^4S$ in atomic nitrogen. That report was based on observations of the afterglow from two tubes, in one of which the nitrogen was purer and at a lower pressure than in the other. Further observations on these tubes has enabled us to study the variations in intensity of the Vegard-Kaplan bands and the new line, both with respect to pressure and to purity.

There is definite indication that the 3471 line increases in intensity as the tube approaches the pure nitrogen stage, and that its rise in intensity in one tube follows that of the intercombination bands, and that its fall with pressure in the other tube also follows these bands. The spectrum reproduced herewith shows the line-like character of this radiation, its extraordinary intensity relative to the normally strong second-positive bands, and the large intensity of the Vegard-Kaplan bands. There is also indication in these experiments of the increase with pressure of both the Vegard-Kaplan bands and the 3471 line. The enhancement of these relatively forbidden transitions with pressure is indeed a strange phenomenon, when one remembers that similar transitions in neutral oxygen and in various stages of ionization of oxygen and nitrogen are responsible for some of the strongest lines in the spectra of nebulæ. These nebular lines are strengthened at low pressures. In fact, it is generally agreed that low pressures are necessary for such forbidden transitions, and the present experiments are probably the first evidence to the contrary.



HIGH-PRESSURE NITROGEN AFTERGLOW PHOTOGRAPHED ON A SMALL QUARTZ SPECTROGRAPH. STRONG BANDS TO RIGHT OF λ 3471 ARE DUE TO CYANOGEN; OTHER WEAK BANDS DUE TO NO.

The absence of any of the forbidden transitions of non-ionized atomic nitrogen in the spectra of celestial objects appears to find its explanation in these experiments. More interesting for the physics of the upper atmosphere is the conclusion from these results that the Vegard-Kaplan bands, the 3471 line, and possibly other radiations in the light of the night sky, are emitted in the lower rather than in the higher regions of the upper atmosphere, perhaps so low as 50 km. This conclusion is based on the presence in the light of the night sky of a strong line at 3471 and of the Vegard-Kaplan bands. In fact, the spectrum reproduced here is an excellent reproduction of the light of the night sky.

The tube from which this plate was photographed is now rapidly approaching a pure nitrogen stage. The next two or three photographs should give us valuable information regarding the relationship between this line and the Vegard-Kaplan bands, as well as further proof that the line is characteristic of pure nitrogen.

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May 16.

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[1] Kaplan, NATURE, 141, 645 (1938)

Possible Presence of Metastable Atoms of Nitrogen (^2P) in the High Atmosphere

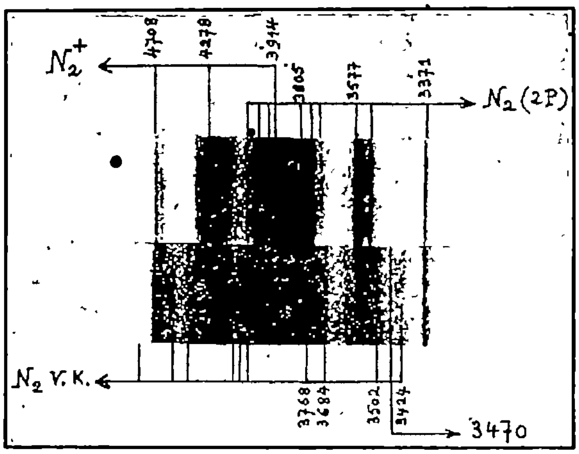
DURING a stay at the Tromsø Observatory, I studied systematically the spectrum of different forms of auroras (arcs, draperies, clouds, corona, etc.). One hundred spectrograms were thus obtained in the autumn of 1937. The analysis of these data is now being carried out, but some important facts are already apparent.

The spectrum of the bright region of an intense aurora (arc, draperies, corona) always offers the same general aspect. Outside the red and green lines of O I, the bands of the three systems of nitrogen, N_2^+, $N_2(1P)$ and $N_2(2P)$ only are observed (see upper spectrum, photographed on a Guilleminot Superfulgur plate having no sensitivity in the green). A very great over-exposure discloses practically no new radiation. The luminescence can be reproduced by submitting nitrogen to an electronic bombardment with a proper accelerating potential[1].

Some diffuse auroras behave in a completely different way. If the exposure is sufficient, their spectrum contains, with the lines and bands previously mentioned, a relatively great number of other radiations, generally weak and difficult to identify. However, these radiations may show so large an increase in intensity that their study becomes easy. It may be ascertained that they are the nitrogen bands $A \rightarrow X$, known as Vegard-Kaplan bands. The heads located at 3424, 3502, 3684, 3768, 4045, 4073, 4171, 4425 and 4535 A. are particularly distinct; these bands are plainly degraded toward the longer wavelengths (see lower spectrum).

With the Vegard-Kaplan bands, and evolving in the same way, an intense and sharp line always appears near 3470 A. (3470·3 A., according to the best measurements). Its appearance is such that it is easily distinguished from the neighbouring bands, and that any trial of identification with the 3469 $N_2(2P)$ band is impossible. As no other plausible interpretation comes to the mind, it seems reasonable to admit the presence of the atomic nitrogen line $^2P \rightarrow {}^4S$, the computed position of which is also 3470 A. This attribution is in perfect agreement with the recent observation by Prof. Kaplan[2] of a high-pressure afterglow in nitrogen, giving near 3470 A. a strong line associated with the Vegard-Kaplan bands.

As Prof. Kaplan suggests, the radiation reported at 3471 A. in the night sky light (Dufay, Gauzit) is perhaps also the nitrogen line $^2P \rightarrow {}^4S$. But the spectrum of the sky is so complex that it is difficult to give weight to this attribution. On the contrary, the simultaneous presence of the 3470 line and of the Vegard-Kaplan bands in the aurora and in the afterglow, with a similar evolution, seems to prove that the radiations emitted in both cases have the same origin. The fact is obvious for the Vegard-Kaplan bands; it is highly probable for the 3470 line. If we consider that active nitrogen is doubtless a mixture of metastable nitrogen molecules and atoms, the attribution of the 3470 line to the transition $^2P \rightarrow {}^4S$ becomes quite normal.



SPECTRA OF BRIGHT AURORA (*above*), DIFFUSE AURORA (*below*).

The presence of nitrogen atoms (^2P) in the auroral region must then be taken into consideration, and we may expect to find also the lines corresponding to the transitions $^2P \rightarrow {}^2D$ (λ = 10,400 A.) and $^2D \rightarrow {}^4S$ (λ = 5206 A.). The first one occurs in a part of the spectrum which has not yet been explored. The other, which is much less probable, was not recognized in the aurora or the light of the night sky. A more complete and thorough analysis of the two spectra and, above all, the study of the 3470 line by the interference method, should give the definitive solution of the problem.

The actual state of our knowledge, however, permits us to conclude that, in the aurora, the mechanism of excitation includes probably the two following stages:

(1) An electronic bombardment, which is the primary phenomenon and produces the permanent radiations of the spectrum.

(2) An afterglow, similar to that of Kaplan, giving rise to the nitrogen bands $A \rightarrow X$ and to the 3470 (N I, $^2P \rightarrow {}^4S$) radiation. This second process seems very important in certain diffuse auroras.

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Quantitative Measurement of Vitamin B_1 by the Thiochrome Reaction

IN 1936, Jansen[1] first suggested that vitamin B_1 could be measured quantitatively by conversion into thiochrome with alkaline ferricyanide and measurement of the fluorescence of the thiochrome. Since that time, information has been collected on the use of this method for the assay of vitamin B_1 in urine[2,3,4] and in other materials including foodstuffs[5]. Evidence, however, is now accumulating that, although results which compare closely with the biological assay can be obtained with crystalline vitamin B_1 and acid-clay adsorbates of the vitamin when the precautions described elsewhere[5] are exercised, the assessment by the chemical method on certain foodstuffs is significantly lower than the biological results.

Biological assay (Int. units per gm.)	Chemical assay (Int. units per gm)	Chemical/Biological
9·5 10 0 10 0 10·0 10 5 Avg. = 10 0	6·8 6·3 7 9 8·1 7 6 Avg. = 7 3	73 per cent
11 0 11 0 11·0 11 2 11 2 11·2 11·5 11·5 11 5 Avg. = 11 2	6·8 7 2 8 1 6·7 6 9 8 6 6·2 6 4 6 4 Avg. = 7 0	62 ,,
12·0 12·0 12 0 12 5 12·5 12·5 12 5 12 5 Avg. = 12 3	5 1 6·5 7 6 6 7 7 2 7·3 7·5 8 6 Avg. = 7 1	58 ,,
14·0 15 0 15 0 16 0 16 2 20 0 Avg. = 16·0	6·8 6 7 6 2 6 6 5 9 8 1 Avg. = 6 7	42 ,,

The accompanying table gives the comparative figures for vitamin B_1 in twenty-eight samples of wheat embryo. The biological assays were carried out by Dr. A. Z. Baker of this laboratory by the bradycardia method[6]. A minimum of six rats was used in each case.

Other foodstuffs appear to give similar results. Certain proprietary yeast preparations, for example, contain substances with a considerable blue fluorescence, and frequently no additional intensity of fluorescence develops after ferricyanide oxidation. The chemical assay therefore appears to be zero, although the usual activity of 6–10 international units per gram of vitamin B_1 is known to be present.

Vitamin B_1-pyrophosphate, which appears to be of fundamental biological significance, is insoluble in isobutyl alcohol[7] and is not therefore included in the chemical assay. It has also recently been suggested[8] that vitamin B_1 exists combined with protein, in which form it might be expected to be difficult to extract chemically from tissues. Therefore the quantitative recovery of crystalline vitamin B_1 added to a substance under analysis cannot be taken as evidence that the results obtained for that substance by the thiochrome method are a complete measure of the vitamin activity of the material.

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[1] Jansen, B. C. P., *Rec. Trav. chim.*, **55**, 1046 (1936).

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[3] Westenbrink, H. G. K., and Goudsmit, J., *Rec. Trav. chim.*, **56**, 803 (1937).

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[6] Birch, T. W., and Harris, L. J., *Biochem. J.*, **28**, 602 (1934).

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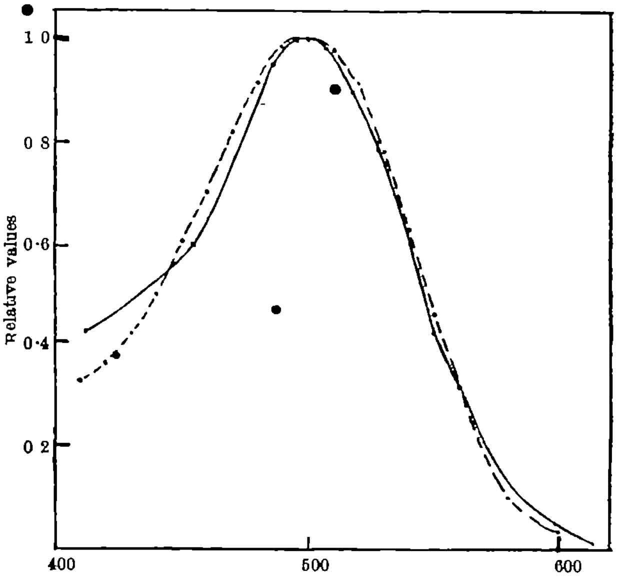
Scotopic Luminosity Curve and the Absorption Spectrum of Visual Purple

MANY attempts have been made to explain the discrepancy between the scotopic luminosity curve and the absorption spectrum of visual purple. Recently, Dartnall and Goodeve[1] have applied the Stark-Einstein law in order to express the luminosity curve in terms of quanta and have shown that the resulting correction was insufficient.

A consideration of various additional possible factors, such as Kundt's rule and the retinal grey, which might explain the discrepancy, convinced me that the scotopic luminosity curve should be corrected for the absorption spectrum of the ocular media. It is known that this spectrum varies considerably with the genus of animal, and for man has not hitherto been determined through the visible spectrum. Recently, however, in collaboration with E. F. McCarthy, I completed measurements of the absorption spectrum in the wave-length range 400–820 mμ for the refractive media of the human eye. Preliminary reports[2] of this work have already been made and a paper giving the results will appear shortly[3].



– – – – ABSORPTION SPECTRUM OF VISUAL PURPLE OF THE FROG (LYTHGOE).

——— SCOTOPIC RETINAL LUMINOSITY CURVE (LUDVIGH AND MCCARTHY).

It will suffice here to give the results obtained by applying the Stark-Einstein law and data on the young normal human eye to transform a scotopic *ocular* luminosity curve into a very different curve, namely, a scotopic *retinal* luminosity curve. This permits the comparison of the absorption spectrum of rhodopsin with the *retinal* luminosity curve instead of with the *ocular* luminosity curve.

The accompanying graph shows the agreement of the transformed data of Hecht and Williams[4] with Lythgoe's data[5] on the absorption spectrum of visual purple. The conclusions drawn from this curve are: (1) The retinal sensitivity for blue is much greater than has been previously assumed. (2) It is not necessary to invoke Kundt's rule, as did Hecht and Williams[4], to explain the discrepancy between the two sets of data. (3) It is not necessary to assume that, because of their relatively high absorption coefficients in the blue, solutions of visual purple recently prepared[5,6,7] are different from those of the solutions of visual purple present, under low illuminations, in the intact retina *in situ*.

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[1] Dartnall, H. J. A., and Goodeve, C. F., "Scotopic Luminosity Curve and the Absorption Spectrum of Visual Purple", NATURE, 139, 409 (1937).

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Cosmological Theory

ON the assumption that the red-shifts observed in the spectra of the extra-galactic nebulæ are due to a Doppler effect, Hubble's observations indicate that the nebulæ are receding from us with velocities proportional to their distance from us. Thus at each point in space there exists a characteristic velocity and a preferred time-axis in four-dimensional space-time, this preferred time-axis being that with respect to which the matter at the point is at rest.

This absolute time and characteristic velocity, which varies from point to point in space, has formed the starting point of two cosmological theories, one proposed by Milne[1] and the other by Dirac[2]. Milne introduces the assumption called the 'cosmological principle', which asserts that the universe is everywhere uniform and has spherical symmetry about every point for an observer moving with the characteristic velocity at that point. Milne's theory further requires that all constants appearing in the theory are to be dimensionless.

Dirac, while accepting the cosmological principle, rejects the 'dimensional hypothesis' of Milne and proposes in its place the assumption that "any two of the very large dimensionless numbers, of the order of 10^{39} and 10^{78}, which appear in Nature are connected by a simple mathematical relation in which the coefficients are of the order of magnitude unity".

The theories of both Milne and Dirac lead to the conclusion that there are two time-scales of importance, one for atomic phenomena and the other for ordinary mechanical phenomena. If we denote the measure of a small interval of time on the first of these scales by dt and the measure of the same interval of time on the other scale by $d\tau$, then Milne's theory requires that

$$dt = (t/t_0)d\tau, \qquad (1)$$

where t is the epoch at which the two measures are made and t_0 is the present epoch, that is, the present age of the universe. In place of (1), Dirac's theory requires the relation

$$d\tau = tdt, \qquad (2)$$

where, in both (1) and (2), the t-scale of time is the natural scale for atomic phenomena and the τ-scale is that for macroscopic phenomena to which general relativity applies.

On Milne's theory, an atomic clock keeps t-time while a planetary clock keeps τ-time, and the laws of Nature and the equations of motion have their usual form when expressed in τ-time. Since a velocity has the same measure on both *time-scales, the t-measure and the τ-measure of a distance have different values*.

A little more than a year ago, I investigated the consequences of the assumption that *the measure of a distance is the same on both time-scales*, and hence a velocity measured in t-time differs from the value obtained when a τ-clock is used. The laws of mechanics, the equations of motion and general relativity are all assumed (as results from Milne's theory) to hold in τ-mechanics. In fact this requisite *defines* τ-time. The first consequence of this theory is that the proper energy of an elementary particle mc^2, which is constant in τ-mechanics, varies inversely as the square of the epoch in t-mechanics. If we now *define* the number of elementary particles in the universe as the total energy of the universe divided by the element of energy mc^2, and assume that the total energy of the universe is conserved, we have the result that the number of particles in the universe varies as the square of the epoch, a suggestion which was originally put forward by Dirac[3].

Without the introduction of any further assumptions and without any appeal to general relativity, the results below follow.

$$GM = kc^3t,$$

where G is the gravitational constant, M the mass of the universe, c the velocity of light and k a dimensionless constant which is taken as unity. This shows that the gravitational constant depends upon the total amount of matter in the universe—a conjecture which has often been made in the past. The total number of particles in the universe is given by

$$N = \tfrac{1}{2}t^2,$$

where t is to be expressed in atomic units e^2/mc^3. The present age of the universe is found below to be 2×10^9 years. This gives the value $2 \cdot 31 \times 10^{79}$ for N, which is of the same order as the value obtained by Eddington[4].

The radius of the spherical model of the universe is found to be $R = ct$, which is *constant* in both t-mechanics and τ-mechanics. The value is $1 \cdot 89 \times 10^{27}$ cm., which is of the same order as the radius of the Einstein universe, namely, $1 \cdot 23 \times 10^{27}$ cm. On this theory the red-shift in the spectra of the extra-galactic nebulæ is due, not to a Doppler effect, but to a decrease in the velocity of light in t-time. The formula obtained for the red-shift is

$$\frac{d\lambda}{\lambda} = \varepsilon^{d/t_0} - 1,$$

where d is the distance of the nebula in light-years and t_0 is the present age of the universe. When d is small compared with t_0, this reduces to the usual linear relationship $d\lambda/\lambda = d/t_0$. Hubble's empirical formula is $d\lambda/\lambda = 5 \cdot 71 \times 10^{-10}d$, and thus $t_0 \sim 2 \times 10^9$ years.

The theory also gives the equation

$$m = \frac{\sqrt{2}}{137}\,\frac{h}{2\pi c}\,\frac{\sqrt{N}}{R}$$

for the relation between the mass m of an electron and the number of particles in the universe at the present epoch. This should be compared with Eddington's equation[4]

$$m_0 = \frac{h}{2\pi c}\,\frac{\sqrt{\frac{3}{2}N}}{R},$$

where m_0 is the mass of a neutral particle of the comparison fluid. From Eddington's theory, $m_0 \sim 136\ m$.

Finally, the theory leads to the uncertainty relation in the form

$$\Delta p\,\Delta q \sim \frac{h}{4\pi},$$

and thus links quantum theory with cosmological theory.

It thus appears that a reasonable and self-consistent theory of cosmology can be built up from the initial assumption that a planetary or pendulum clock measures time at a different rate than does an atomic clock, the relationship between the two measures of a small interval of time being given by (1). The theory is based essentially upon this single assumption, together with the principle of the conservation of energy. An observer, measuring time by an atomic clock, concludes that, although the total energy of the universe remains constant, the number of elementary particles as defined above is increasing as the square of the epoch, and that there exists a definite epoch of creation. An observer, measuring time by a rotating planet, finds the usual laws of mechanics and the Newtonian and relativistic equations of motion to hold good. He concludes that the number of particles in the universe is constant, and that the universe has existed, though not necessarily in its present configuration, for an infinite time.

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[1] Milne, *Proc. Roy. Soc.*, A, 158, 324 (1937) and earlier papers.
[2] Dirac, *Proc. Roy. Soc.*, A, 165, 199 (1938).
[3] Dirac, NATURE, 139, 323 (1937).
[4] Eddington, "Relativity Theory of Protons and Electrons", p. 272.

Thermal Expansion and 'Co-operative Phenomena'

A RECENT investigation[1] on the dielectric polarization of a ketone near the melting point shows a considerable difference between the temperature—polarization curves at constant volume and at constant pressure. The change of volume thus appears to have a considerable effect on the free rotation of molecules in the lattice, which is a 'co-operative phenomenon'.

It seems not unlikely that volume changes might be of importance in other 'co-operative phenomena'. The order-disorder transition of β-brass is experimentally investigated at constant pressure. The existing theories take no account of the experimentally observed change of volume. Actually, the theoretical maximum of specific heat is too small, and the slope of the temperature—specific heat curve at temperatures below the maximum is about 1/15 of the experimental value, which discrepancy may be due to the neglected expansion.

In order to test this view, I carried out a calculation of the specific heat at constant pressure. The energy of a zinc-copper pair is assumed to be proportional to the square of volume change. A similar assumption is made for the mean energy of copper-copper and zinc-zinc pairs, their minimum energy lying at higher volumes than the minimum of copper-zinc. In each of these parabolic energy curves a parameter is introduced. The method of calculation is similar to the theory of Bragg and Williams.

The specific heat—temperature curve obtained can be adjusted so as to give good agreement with experiment. It appears to be not very sensitive relative to variations of one parameter. The assumed dependence of copper-zinc energy on volume is compatible with the energy as calculated from the compressibility of brass and the observed expansion. By this calculation, the details of which are to be published shortly, it is shown that even a small expansion may have considerable effect on the specific heat.

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[1] Muller, A., *Proc. Roy. Soc.*, A, 166 (1938).

Occurrence of *Zelleriella*, an Opalinid Ciliate, in South Africa

THE fauna and flora of the southern extremity of Africa present a number of striking resemblances to those of South America on one hand and Australia on the other. I have recently come across an unexpected addition to this number in finding *Zelleriella* in the recta of two different species of *Rana* from the neighbourhood of Cape Town. According to Bigalke[1] there appear to be no records of the establishment of any exotic amphibia anywhere in the Union of South Africa and we must therefore assume that the Cape Zelleriellas are indigenous. The following zoogeographical data suggest their significance.

(1) *Zelleriella* is the dominant Opalinid of tropical America, its principal hosts being the toothed bufonids (Cystignathidæ or "Leptodactylids"). Elsewhere, except for one questionable record from a toad from "Asia", they have only been found in Australia, where their hosts are exclusively leptodactylids.

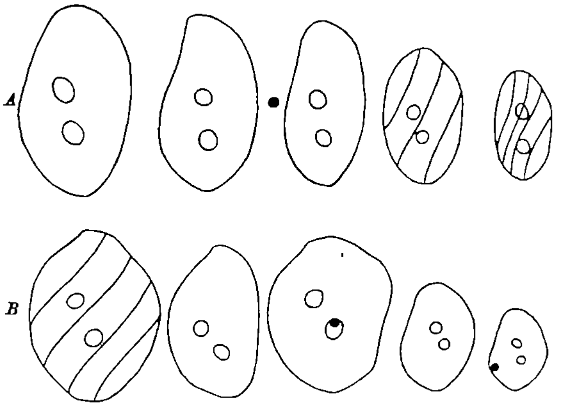
(2) The toothed bufonids also occur at the present day only in Central and South America and in Australia.

(3) From these facts Metcalf[2] concludes that the leptodactylids originated in Argentina–Patagonia and crossed to Australasia by an early Miocene land-bridge. *Zelleriella* was originally a parasite of these toads and migrated with them, but infected other amphibia as it spread northwards in America. The recent discovery in India of a Miocene Cystignathid closely resembling the present-day Australian genera, however, weakens this argument[3].

(4) The Cape Zelleriellas apparently do not extend far towards the north, for none were found by Fantham[4] in his extensive investigation of the parasites of amphibia in the Transvaal. In view of their ability to live in a variety of amphibian hosts, it is difficult to believe that these ciliates can have come from the north without leaving representatives in other parts of Africa. Their presence in the Cape consequently is most easily explicable on the hypothesis of former land connexions with the other southern continents, in which case their history must

extend back to late Secondary times. As no toothed bufonids occur in Africa, the question of their original hosts in this continent is a puzzle on any hypothesis.

(5) The distribution of the other genera of Opalinids also fits in with this idea. *Protoopalina* is by far the commonest member of the family throughout Africa, and it is noteworthy that the species regarded by Metcalf as archaic are those found in Patagonia, Papua, Australia and Africa. *Opalina* and *Cepedea*, though otherwise practically cosmopolitan, have not been recorded from either Australia or the Cape. Both occur in Central Africa, and Fantham[4] (1923, 1924, 1927, 1931) found *Opalina sudafricana* very occasionally in *Bufo regularis* at Johannesburg. (Incidentally, if Metcalf's view is correct that the *Opalinæ angustæ*, to which this species obviously belongs, form a natural subdivision of the genus, this record is a curious one. The *Opalinæ angustæ* are characteristic of the tree-frogs of North America, only one species, *O. obtrigona*, having crossed over to Europe and Asia, to which it was carried by its host, *Hyla arborea*.) In Africa, it seems, all these ciliates spread much less freely than their hosts.



A. Zelleriella [*africana A*] from *Rana delalandii*

B. Zelleriella [*africana B*] from tadpole of *Rana fuscigula*. Mag. approx. 120 diameters.

(6) The Ranidæ are an Old World group showing their greatest diversity of type in Africa. Only one species has penetrated to North America, and this has been found infected with *Zelleriella* in California, the northernmost limit of the parasite.

(7) The common frog for class purposes here is *Xenopus*, a member of the Pipidæ (Aglossa). This family is at present found only in South America and Africa. It is, however, regarded as of northern origin, and no Zelleriellas have been found in any member of it.

In the present state of our knowledge, it is impossible to subdivide the Zelleriellas into species, and we cannot therefore say whether the Cape forms are more nearly akin to those of Australia or of America. They have been found once in *Rana delalandii* and once, from a different locality, in a tadpole of *Rana fuscigula* (I am indebted to Dr. W. Rose for the identification of the frogs). The two forms differ somewhat and may be referred to as *Z.* [*africana A*] and *Z.* [*africana B*] respectively, the brackets being used, as by Metcalf, to indicate that the names are for reference only and do not necessarily imply specific status. In neither is there any clear demarcation of ectosarc from endosarc, and the chief differences are that form *B* is broader and less regular in outline than form *A* and that the cytoplasm of *A* is vacuolated whereas that of *B* is granular.

The principal measurements of adult specimens are :

	Form *A*	Form *B*
Greatest length	124μ — 213μ	92·5μ — 167μ
Ratio : length/breadth ..	1·72 — 2·07	1·28 — 1·65
Nuclei	12·5 × 15·6μ — 20·3 × 23·1μ	9·6 × 10·6μ — 19·7 × 22·2μ
Distance between rows of cilia	1·3 — 2·0μ	1·85 — 2·6μ

Typical outlines are shown in the accompanying figures, the direction of the rows of cilia being indicated in a few cases.

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[1] Bigalke, R., *S. Afr. J. Sci.*, **33**, 1936 (1937).

[2] Metcalf, M. M., "The Opalinid Ciliate Infusoria", *Bull. U S. Nat. Mus.*, 120 (1923).

[3] Noble, G. K., "The Biology of the Amphibia" (New York and London, 1931).

[4] Fantham, H. B., *S. Afr. J. Sci.*, *passim* (1918–32).

Irregular Mitosis and Meiosis induced by Acenaphthene

PARTICLES sublimed from the crystals of the biologically active substance which, according to Shmuck, induced morphological peculiarities similar to those induced by colchicine, were used for altering the normal procedure of the mitotic and meiotic processes.

Germinating seeds from cereals and grasses (wheat, rye, oat, barley, maize, rice. *Festuca, Lolium,* etc.), covered by crystals of acenaphthene for 4–8 days, grow slowly, forming very thick and short roots and leaves. Leguminous plants (*Vicia, Ervum, Lathyrus, Medicago,* etc.) reacted after a longer exposure (6–12 days). Species of Compositæ tested occupied a position between these two groups of plants.

Mitosis in treated seedlings proceeds abnormally. The activity of the factors responsible for the arrangement of the chromosomes in a regular equatorial plate and for the formation of the achromatic figures (spindles) is inhibited. The chromosomes do not become arranged in a regular equatorial plate. They divide but do not move toward the poles, thus forming polyploid nuclei. Sometimes the chromosomes become abnormally spread into the cytoplasm, giving rise to polynucleate cells. The latter might lead to heteroploidy.

Branches with floral buds of nine *Nicotiana* species were treated with acenaphthene particles. In buds in which meiosis proceeded, abnormal processes were induced. One usually finds during the meiotic metaphase the expected number of bivalent chromosomes, but they do not become arranged on a regular equatorial plate ; they occupy positions similar to those of diakinesis. The chromosomes divide without being 'pulled' to the poles. They spread abnormally into the cytoplasm in groups of several chromosomes or even as single chromosomes. This conditions the formation of variable numbers of nuclei at the end of the second division. Each nucleus or group of nuclei is separated during cytokinesis, thus forming a variable number of microspores with one or more than one nucleus. Consequently the microspores have unequal chromosome numbers. This gives rise to a large percentage (50–100 per cent) of abortive pollen. The viable pollen grains are equal in size, containing unequal chromosome numbers. They can give rise to plants with aberrant chromosome numbers.

DONTCHO KOSTOFF.

Institute of Genetics,
Academy of Sciences,
Moscow.

Decomposition Reactions of Organic Compounds in the Gaseous State

PERHAPS Prof. Hinshelwood will excuse me if I suggest that no useful purpose is effected by discussing the treatment of isolated sets of experimental data on the lines indicated in his letter in NATURE of June 4, p. 1010. Space would not permit me to go into the question in detail; and to counter with similar illustrations from his own work would be waste of time. Doubtless our methods are very far from perfect, and I may say that after, not merely twelve, but forty-two years' experience of work with gases, I find that the difficulties are such that the greater part of the work of most labourers in this fascinating field washes out.

That we hold differences of opinion as to the way in which problems in kinetics of gas reactions should be handled is well known. I do not suppose that anyone who is not interested in the subject reads my papers, or those of Prof. Hinshelwood; but it is scarcely reasonable to imagine that anyone criticize his work on the basis of hearsay information regarding mine. If anyone does so, or *vice versa*, does it matter ?

M. W. TRAVERS.

Department of Chemistry,
University, Bristol.
June 9.

Points from Foregoing Letters

FROM his measurements of intensities in the Balmer emission spectrum due to recombining protons and electrons in the gaseous nebulæ and in an electrodeless discharge tube, T. L. Page concludes that Kramers' absorption law is invalid for hydrogen. The use of this law in astrophysical problems is therefore unjustified.

Prof. R. G. W. Norrish enumerates several objections to the theory put forward by Bergmann and Samuel to account for the photo-decomposition of organic molecules by the simultaneous fissure of two bonds, that is, by a reduction of valency of the central atom.

Prof. K. H. Meyer and W. Hohenemser find that the two peptides glycyl *l*-leucine and *l*-leucyl glycine do not interchange their constituent groups in solution. From this they infer that, under the conditions of the experiment, no molecules of the cyclol type are formed.

Further studies of the high-pressure nitrogen afterglow leads Prof. J. Kaplan to the view that the new 3471 line is closely related in its intensity variations with the Vegard-Kaplan bands. The spectrum reproduced is a good laboratory reproduction of the night sky spectrum and suggests the hypothesis that the light of the night sky originates low in the upper atmosphere.

Photographs of spectra of bright and diffuse auroras are submitted by R. Bernard. The spectrum of the diffuse aurora shows an intense sharp line at 3470 A. This may be ascribed to atomic nitrogen ($^2P \rightarrow {}^4S$), and the author concludes that the mechanism of excitation in the aurora probably includes two stages: an electronic bombardment producing the permanent radiations of the spectrum; and an afterglow giving rise to the nitrogen bands.

The chemical assay of vitamin B_1 gives lower values than the biological assay, according to results obtained by Dr. M. Pyke. The author ascribes this to incomplete extraction.

Using data of Hecht and Williams on the absorption of visual purple, and taking into consideration the absorption spectrum of the ocular media, Ludvigh and McCarthy have obtained the retinal luminosity curve for scotopic (twilight) vision. Comparison of this curve with that for the absorption spectrum of visual purple of the frog (Lythgoe) leads E. Ludvigh to revise some of the previously accepted views and to conclude that the retinal sensitivity for blue is much greater than has been previously assumed.

From the initial assumption that a planetary or pendulum clock measures time at a different rate than does an atomic clock (as explained by Milne), also accepting the principle of the conservation of energy and assuming that the measure of a distance is the same on both time-scales, Dr. F. L. Arnot deduces that for an observer measuring time by an atomic clock the number of particles in the universe varies as the square of the age of the universe (2×10^9 years). On the other hand, using the pendulum time scale, the number of particles in the universe appears constant, but the age of the universe becomes infinite.

Dr. R. Eisenschitz announces that he has calculated the specific heat of brass at constant pressure, and that the 'specific heat - temperature' curve obtained can be adjusted so as to give good agreement with experiments. The assumed dependence of the energy of a copper-zinc pair on volume is compatible with the energy as calculated from the compressibility of brass and the observed expansion.

The presence of *Zelleriella*, a minute parasite of certain toads and amphibians of South America and Australia, is reported by Dr. H. Sandon from South Africa. This parasite is not found in North Africa or Asia, and its presence in South African frogs lends support to the hypothesis of former land connexions between the southern continents.

Germinating seeds of dry barley and other cereals, etc., covered with crystals of acenaphthene for a few days, show changes in the type of their growth, according to Prof. D. Kostoff. These changes are found to correspond to abnormal behaviour of the chromosomes during the process of division of the cells. The activity of some factors responsible for the arrangement of the chromosomes during mitosis and meiosis is apparently inhibited.

Research Items

Bushmen and Hottentots

In the course of an investigation of a quantity of skeletal material, adult and infant, from burials in the rock-shelter on Oakhurst Farm, George, Cape Province, South Africa, excavated by Mr. A. J. H. Goodwin (see page 1151), Prof. H. R. Drennan has found it necessary to define the characteristics by which the Bushman and Hottentot types are differentiated (*Trans. R. Soc. S. Africa*, 25, 3, 1938). A comparison of the skeletal material from Oakhurst and the Matjes cave, both associated with the Wilton stone age culture, leads to the conclusion that the Hottentot, instead of being a Bushman-Bantu cross, as has been held generally, may be the product of an evolution from a 'Wilton race', the larger head and greater stature in comparison with the Bushman being an inheritance from a Boskop or Boskopoid type. The Wilton race, it is generally recognized, has strong affinities with late palæolithic man in Europe and northern Africa. As regards the special features of the Hottentot skull, as distinguished from that of the Bushman, it tends to be 5–15 mm. longer, but as there is no proportionate increase in breadth, and often a diminution, the majority are dolichocephalic, whereas a majority of the Bushman skulls are mesaticephalic. The Hottentot skull is consequently more an elongated oval than of the marked Bushman pentagonoid form. The vault is definitely higher, the breadth-height index bringing out the difference very strongly. The width of the face is only slightly greater than in the Bushman, in keeping with the narrowness of the cranium; but the length is definitely increased in relation to the length of the base of the skull, giving a downward extension of the jaw which has the appearance of prognathism, whereas it is really 'subgnathism'. The orbital index is usually lower than in the Bushman. Both races are platyrrhine. The mandible of the Hottentot is distinctive, being more massive and much longer, but it is not much wider, and therefore has a much higher mandibular index. The ramus is also more robust, and even wider in relation to the height than the Bushman ramus.

Study of Life and Climatic Relations

Miscellaneous Publication No. 280 of the U.S. Department of Agriculture, dated January 1938, is a quarto brochure of 188 pages on "Bioclimatics. A Science of Life and Climatic Relations". Its author, Dr. A. D. Hopkins, was formerly an official entomologist but resigned in order to devote his time to research on this subject. The purpose of this publication is to give the results of prolonged studies made by the author on the principles of life and climatic relations, and their application to agriculture, with the hope that specialists in different sciences will adopt such as may be applicable to their own lines of work. The bioclimatic zone and zonal types of a place, area, or local region are the most reliable indexes to the species of animals and plants, and to the types of agriculture, that are best adapted to the local conditions. Under the requirements of the bioclimatic law, the phenomena of life and climate should be equal, under equal influences at the same level, across the continents along lines which depart from the parallels of latitude at the assumed constant rate of 1° of latitude and 5° of longitude. These lines are termed isophanes. Since, however, the influences of local or other factors are never equal, departures or variations of the observed effects from the requirements of the law must occur. Such variation as determined by bioclimatic methods and expressed in units of time, temperature or distance serve (*a*) as measures of the relative intensity of the modifying influences and (*b*) as indexes to the interpretation of causes and factors and to the prediction of bioclimatic elements at any given geographical position. It is stated that the laws, principles, systems and methods as outlined in these pages, taken in conjunction with the tables, maps and test examples, enable the application of bioclimatic principles to be made to many branches of economic biology and agriculture.

Immature Stages of Aquatic Diptera

Prof. O. A. Johannsen completes his study entitled "Aquatic Diptera" in Memoir 210 of the Cornell University Agricultural Experiment Station, which comprises Parts 4 and 5 of the series. Part 4 deals with the large subfamily Chironominæ and Part 5 with the family Ceratopogonidæ. Many additions to knowledge of these two groups have been made in recent years, especially by European workers. The results have made it evident that in the Chironominæ the immature stages offer fewer and less sharply marked characters than do the adults, and considerable difficulty, therefore, attends the identification of these stages. In this connexion, the keys to the genera and species together with the accompanying figures of larval and pupal characters should prove a useful aid. In the Ceratopogonidæ, it will be noted, the few terrestrial forms are also included in order to make the account more complete. The part dealing with this family is written by Miss Lilian C. Thomsen.

Crustacea and Pycnogonida of the John Murray Expedition

Dr. M. Ramadan describes the Astacura and Palinura and Dr. W. T. Calman the Pycnogonida of the John Murray Expedition 1933–34 (British Museum (Natural History). Scientific Reports, 5, No. 5 and No. 6; 1938). Only ten species of Astacura and Palinura were collected, one of which, *Puerulus sewelli*, is new. There are two appendixes to this part, one on the luminosity of Penaeidæ, in which the photophores of *Hymenopenaeus debilis* are described, and the other on the structure of the ocular peduncles in deep- and shallow-water forms of the Penaeidæ. Comparison of the ocular peduncles in deep- and shallow-water penaeids shows that the simplest form of peduncle is found in the deep-water forms, and as a rule the cornea is hemispherical, whilst a complex peduncle and reniform eye occur in the shallow-water forms. Fourteen species of Pycnogonida were obtained by the Expedition, no fewer than six of which are new. *Colossendeis angusta* from deep water in the Gulf of Aden has an extremely wide distribution, perhaps world-wide, always in cold water and (except in the Arctic) at great depths. Lieut.-Colonel Seymour Sewell is of the opinion that the two specimens captured without doubt came along with the Antarctic bottom drift up the east coast of Africa or else with the deep Atlantic water that enters the Indian Ocean round the Cape of Good Hope.

Autecology of *Zostera*

T. G. TUTIN has recently issued an interesting discussion of the growth and habitat of *Zostera* in connexion with its curious disappearance from many Atlantic localities, first from the American seaboard in 1931 and then a year or two later from its European localities (*New Phytol.*, 37, No. 1, 1938). The plant was so reduced in many cases as to affect seriously the distribution of other marine life, such as fishes and wild game birds; in Canada alone the annual financial loss from its reduction was conservatively estimated at some £30,000. Two parasites have been identified in the diseased patches in both America and Europe, a *Labyrinthula* and a fungus *Ophiobolus halimus*, but Mr. Tutin's conclusion is that these parasites have probably been generally present and cannot be assigned a major role in the widespread disappearance of the plant. He points out that the sunshine deficiency in the year 1931–32 in the British Isles amounted to some 20 per cent below normal, that no year in the previous ten years showed a deficiency approaching this and that the plant as a result was less vigorous and succumbed more readily to parasites that were always present. The widespread disappearance on the American seaboard at almost the same time is regarded rather as a coincidence than as evidence of the operation of a parasite the activities of which have spread a year later across the Atlantic. Recovery may depend upon seed propagation, as seedlings are free from the parasite and may be expected in that case to be slow in many localities where temperature conditions especially are not favourable to flowering, seed production and germination. The same causes might explain the fact that the plant still flourishes in its Mediterranean localities, for there the habitat is suitable to propagation by seed.

Growth-Promoting Substances in Horticultural Practice

A VERY useful paper by Dr. M. A. H. Tincker (*J. Roy. Hort. Soc.*, 63, Pt. 5, 210; May 1938) gives timely results of a number of growth-promoting substances upon the rooting of a wide variety of cuttings. β-indolyl acetic acid, α-naphthalene acetic acid, phenyl acetic acid, iso-indolinone and indolyl butyric acid have been used, and various methods of application have been tried. The most suitable treatment appeared to be the standard method of placing prepared cuttings with their bases in a solution of the substance for 24 or 48 hours. A certain amount of success was also obtained by the application of solutions to the rooting medium. The use of lanolin pastes containing the growth-promoting substances was deemed unsuitable for garden routine, though useful for unilateral application in experimental work. An interesting fact is that the polarity of root cuttings of *Anchusa italica* was influenced by treatment with α-indolyl acetic acid, and the results in general show a useful increase in facility or strength of rooting. Extensive though this paper is, the results require to be multiplied exceedingly. Dr. Tincker reports, for example, considerable success with ten varieties of *Pelargonium zonale*, following treatment; but the increasing experience of gardeners suggests that *Pelargonium* varieties respond somewhat irregularly to treatment with growth-promoting substances, and it is conceivable that with further varieties, or with other substances, Dr. Tincker would have had different results.

A Smut Disease of Brassicaceous Crops

CABBAGES and allied plants are subject to several destructive diseases, but yet another pathogenic fungus has recently been added to the list. Dr. B. B. Mundkur describes (*Phytopath.*, 28, No. 2, 134, Feb. 1938) a new smut fungus from India. The species is *Urocystis brassicæ*, and although it is somewhat similar to *U. coralloides*, described by Mitra upon mustard, it is described as a new species by reason of its different spore size, and its dissimilar host range. Radish, turnip, cabbage and other related plants are attacked, and the fungus induces galls upon infected roots. The smut is soil borne, and brings about considerable reduction in yield.

Olivine-Fourchites from Antarctica

IN the course of an exploratory expedition from the base camp of the Byrd Antarctic Expedition II, an extinct volcano was discovered in the Raymond Fosdick Mountains. The specimens representing the lava flows, all of which are olivine-fourchite, have formed the subject of a petrological study by C. N. Fenner which is of exceptional interest and significance (*Bull. Geol. Soc. Amer.*, 49, 367–400; 1938). The physical and mineralogical structure of the rocks made possible the separation of the phenocrysts—olivine and pyroxene—from the ground-mass. Analyses of these three products have been made and with the resulting information it has been possible to compare the actual course of crystallization of the magma with what has been deduced from theoretical considerations. The ground-mass has been found to have an ultra-basic composition. This leads to the conclusion that, contrary to inferences reached in the theory of crystal fractionation, wholly liquid magmas of ultra-basic composition can exist. In this connexion it is of interest to note that in a recent presidential address N. L. Bowen has admitted that "difficulties accumulate for him who questions the existence of anchi-monomineralic magmas" (*Am. Min.*, 129; 1938). Fenner has also found that in passing from phenocrystic pyroxene to ground-mass pyroxene, there is decrease of SiO_2 and MgO accompanied by increase of Al_2O_3, iron oxides and CaO. These results do not seem to be in accord with generalizations from experimental work on silicate systems, such as have been used to support the theory of crystallization differentiation. It is pointed out that the final test of conclusions regarding magmas lies in the behaviour and properties of the magmas themselves and of their actual minerals, and that this test should be applied in a more rigorous manner. Inferences from the behaviour of simple laboratory melts should not be generalized to cover conditions to which they may not be applicable.

Phosphors Without Metallic Activator

THE fluorescence of teeth suggests the existence of a type of fluorescent substance different from the more familiar phosphor resulting from firing a salt with a small amount of foreign metal as activator. W. H. Byler (*J. Amer. Chem. Soc.*, 60, 1247; 1938) has prepared phosphors from several inorganic compounds and mixtures without the use of metallic activators, for example, by treating calcium phosphate with phosphoric acid and firing at 400°. Pure basic and acid phosphates of calcium show fluorescent intensities of only 2 and 3 on an arbitrary scale after optimum heat treatment at 400°, but a correct mixture of the two develops an intensity of 10 when similarly treated. Phosphors developed from mixtures of calcium phosphate with certain organic compounds such as tartrates were also studied. Since teeth are made up largely of calcium phosphate in the apatite structure and contain about 1 per cent of organic matter, it is considered that their fluorescence may be due to this type of complex. The general conclusion is reached that, in the absence of a specific metallic activator, fluorescence resulting from heat treatment of inorganic compounds is due to the formation of complexes of critical composition through partial decomposition, or of critical physical condition through modification of crystal structure.

Phenazine Derivatives

A NEW species of bacterium which has been named *Chromobacterium iodinum* isolated at the National Institute for Research in Dairying at Reading produces a violet, copper-glinting pigment outside the organism at the later stages of its growth. This pigment has been examined by G. R. Clemo and H. McIlwain of King's College, Newcastle-upon-Tyne (*J. Chem. Soc.*, 479 ; 1938), and found to be a phenazine derivative of formula $C_{12}H_8O_4N_2$. On reduction, it yielded a compound, $C_{12}H_{10}O_2N_2$, in which two atoms of oxygen in the original compound are replaced by hydrogen. Since no product of biological origin has yet been obtained with a nitro-group (NO_2, which would reduce to NH_2) and the reduction product is readily converted on crystallization to $C_{12}H_8O_2N_2$, the interesting conclusion is reached that the pigment is 1:2-dihydroxyphenazine di-N-oxide, a derivative of the hitherto unknown phenazine di-N-oxide. Other derivatives of this have been prepared, and the synthesis of the purple pigment is to be attempted. The phenazine compounds which have been isolated from natural sources are now three in number, namely, pyocyanine, chloraphine and the present pigment. These are all bacterial pigments, but phenazine compounds have been shown to exhibit biological activity in a variety of organisms and enzyme systems, and it is anticipated that phenazine derivatives will be found much more widely distributed in Nature.

American Steam-Distilled Wood Turpentine

INTER-STATE regulations governing commerce in steam-distilled wood turpentine and gum spirits have emphasized the need for a satisfactory method of distinguishing these two products. Actually they are both derived from the same species of pine, though the former is prepared from stump oleoresin and the latter from fresh gum. Different methods are also employed for their preparation. Even so, continued improvement in the process of refining steam-distilled wood turpentine has made their distinction less and less easy. The United States Department of Agriculture has recently published a Bulletin (No. 596, December 1937) describing a suitable technique for the examination of such products and summarizing the chief differences between steam-distilled wood turpentine and gum spirits discovered by the application of this technique. In short, this process, which consists of systematic fractional distillation, has revealed that the hydrocarbon components of gum spirits consist practically entirely of dicyclic terpenes, whereas those of steam-distilled wood turpentine consist of appreciable proportions of monocyclic terpenes. There is a considerably larger proportion of the dicyclic terpene α-pinene in steam-distilled wood turpentine than in gum spirits. The quantity of β-pinene present in gum spirits is substantial while that in steam-distilled wood turpentine is negligible.

Critical Phenomena in Gases

RECENTLY, three papers by Prof. J. E. Lennard-Jones and A. F. Devonshire have appeared dealing with critical phenomena in terms of interatomic forces (*Proc. Roy. Soc.*, A, **163**, 53 (1937); **165**, (1938); *Physica*, iv, 10, 941 (1937)). An atom in a dense gas is assumed to be confined for the greatest part of its time to a cell, and consequently its average environment closely resembles that of an atom in a liquid or in a crystal. Instead of trying to calculate the properties of such a dense gas from binary encounters, the atom is considered to be subjected continually to multiple encounters. On this basis, by an application of the methods of classical statistical mechanics, an equation of state is derived and values of the critical temperatures of hydrogen, neon, argon and nitrogen are calculated ; these values agree well with those observed. An extension of the method to liquids makes it possible to calculate boiling points in terms of interatomic forces ; those calculated for neon, argon and nitrogen agree well with observed values. In addition, a theoretical interpretation is given to Trouton's rule and to the modified form of it suggested by Hildebrand. Calculations of the vapour pressures and heats of vaporization of the inert gases have also been made.

Wave Mechanics and Stellar Statistics

THIS is the subject of an interesting investigation by Dr. H. Jehle, University College, Southampton (*Z. Astrophys.*, **15**, 182 ; 1938). Jehle deals with the statistics of an assembly of macroscopic mass-points by means of a generalized wave mechanics in ordinary space time. The wave equation differs from Schrödinger's equation only so far as h/mc is replaced by a macroscopic length σ which is characteristic for the assembly in question. Indeed, such a Schrödinger equation can be split into a continuity equation and in a Hamilton-Jacobi equation; and these on the other hand, can be identified with the continuity equation and the Hamilton-Jacobi partial differential equation for the streaming field of a statistical distribution of mass-points. Thus the classical laws of motion are not modified, unlike the case of a single particle in ordinary wave mechanics, but the assumption is introduced that in this assembly the product interval of position times interval of velocity is greater or equal to $\sigma.c$. This is in particular an assumption about the peculiar velocities. This theory has originally been designed for big stellar systems, and it offers an explanation of the following problems : the 180°-symmetry and the very slow development of the structure of spiral nebulæ ; the greatest possible flattening and the average mass density in nebulæ. In the case of the solar system an application of the wave mechanical perturbation theory explains the distribution of the major axes of the planets that is, Bode's law, as well as the exceptions to it (Neptune), and the corresponding distributions in the systems of the moons. The well-known resonance relations between the periods of revolution are given by similar considerations, being in close correspondence to the classical theory of resonance.

The Physical Society

Cambridge Meeting

THE Physical Society has developed the custom of holding at least one of its meetings each session in some centre outside London, and on June 18, through the kindness of Prof. E. V. Appleton, acting director of the Cavendish Laboratory, the meeting was held at Cambridge. About two hundred fellows and their guests attended.

The morning was spent in visits to the Cambridge Press, where Mr. Lewis and his staff did everything possible to make the technical side of printing as clear as possible, or to the Cambridge Field Station of the Radio Research Board, or to the works of the Cambridge Instrument Co., Ltd. Here both the works and the research section were on view, and members and their friends appear to have been particularly impressed by a device for measuring the thickness of sheets of non-magnetic material, which functions without the necessity of access to both sides.

The visitors to the various exhibits assembled at St. John's College for lunch, where the guest of honour was Sir J. J. Thomson. Speeches were short, but the president, Prof. Allan Ferguson, expressed the pleasure of the Society at the presence of Sir Joseph, the sympathy with Cambridge—and corresponding congratulations to Teddington—at the translation of Prof. R. H. Fowler, and a sense of satisfaction with the recognition (by the award of an O.M.) of the work of Sir Arthur Eddington, as well as the sincere thanks of the guests to the Master and fellows of St. John's for allowing them to lunch there. In his reply "J. J." expressed his relief that the finances of the Cavendish Laboratory were no longer his responsibility, and delighted all physicists by the announcement that he has again taken up experimental work there.

The Society devoted the afternoon to a meeting and an inspection of the laboratories, whilst through the kindness of Mr. Barnard, secretary of the Cambridge Antiquarian Society, those whose interests lie outside physics were enabled to enjoy a tour of the colleges, meeting the main party at tea, and thus at any rate seeing one room of the Cavendish Laboratory.

The proceedings at the meeting were opened by Prof. Appleton, who pointed out that one of the main interests of the Laboratory had always been the structure of matter, and mentioned that when Prof. Bragg assumes the professorship in October, he will bring with him the subject which he has built up for himself, and will contribute, from a different aspect, to the studies already in progress there. On the subject of radio research, he explained the frequency modulation method, and showed results obtained on the direct observation of interference fringes in space between the ground wave and the reflected wave. He also dealt with the peculiar fact that, during anomalous periods, the absorption of short waves is diminished at the same time as that of long waves is increased, the explanation being that the increased ionization at these times makes the reflecting layer more perfect for short waves, which are reflected without much penetration, but that long waves are absorbed because they travel farther into the layer. The connexion with sunspots was also expounded, and the problem of why some are associated with high ionization and some are not was mentioned, but left as one of the as yet unsolved problems.

Prof. Appleton was followed by Dr. J. D. Cockcroft, who explained the low-temperature equipment at Cambridge, and described the anomalies of liquid helium II in viscosity and thermal conductivity. He mentioned that the helium liquefier, which functions without pre-cooling with liquid nitrogen, begins to condense helium in about two hours from starting, and then has a yield of about 2 litres per hour. Next he described the cyclotron, and the story of the work on nuclear physics was carried on by Mr. P. I. Dee, who gave an account of some of the more recent work carried out at Cambridge in this fundamental subject.

After the formal meeting, parties were conducted around the Cavendish and Mond Laboratories, where the various research equipment was shown by workers who had generously given up their Saturday afternoon leisure in the general desire to make the visit as pleasant and enjoyable as all the visitors seem to have found it.

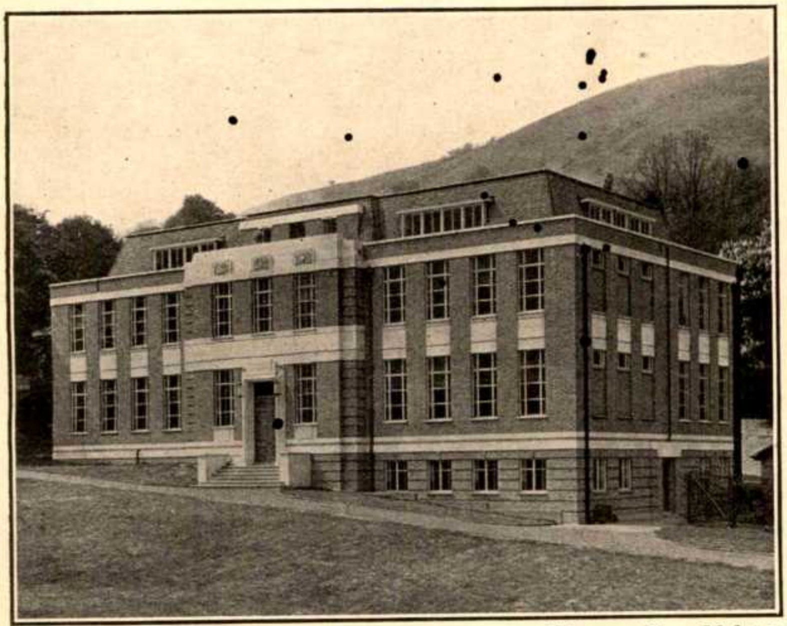
New Science Block at Malvern College

EARL BALDWIN OF BEWDLEY, who has been a member of the Council of the College for many years, opened the new Science Building at Malvern on Saturday, June 18, in the presence of a large company of Old Malvernians, parents and friends of the school. Dr. G. D. Bengough, who left Malvern in 1895, was there, but Malvern's only Nobel prizewinner, Dr. F. W. Aston, was unable to be present.

The building is to be known as the Preston Science School, after the head master, Mr. F. S. Preston, who retired in 1937, at the end of whose tenure of office the building was erected. Before opening the building, Earl Baldwin paid a tribute to Mr. Preston's work at Malvern through twenty-three years, to his high personal qualities and to his breadth of judgment in providing the School with the best equipment available for the teaching of science.

The new building has three floors, which are soundproof. The ground-floor is devoted to the teaching of chemistry, and consists of three teaching laboratories and a large lecture room, capable of seating sixty, together with ample storage space and a laboratory attendant's room. Heating is by radiation from panels concealed in the plaster of the ceiling. Ample fume-cupboards, worked by suction-fans on the roof of the building, are provided. There is a vacuum installation with fourteen points in the different rooms and a hot-water supply to certain sinks.

The advanced chemistry room has desk accommodation for twelve and is to be used both for practical work and for lecturing to small classes of senior boys. There is a glass-working table and a large ventilated combustion-hood, fittings which are also present in the large Fifth Form laboratory. The elementary laboratory has desk accommodation as well as bench space for twenty-four boys. The lecture room has a fume-cupboard, an epidiascope and a fixed mirror-galvanometer with ground-glass scale, the leads being taken to terminals on the lecture bench.



Photo] [*Norman May, Malvern*

PRESTON SCIENCE SCHOOL, MALVERN COLLEGE.

The first floor is intended for the teaching of physics. There are three teaching laboratories, an optical dark room, a photographic dark room which is very fully equipped, a workshop with rectifier plant, a smaller lecture room and a room for storage on this floor. The lecture room has an equipment similar to that of the room on the floor below, except that in addition there is a transformer for supplying an alternating current arc. The advanced laboratory has slate shelves built into the walls for supporting instruments which must be protected from vibration, and a beam is built into the angle of the walls for Young's modulus experiments. All the physics rooms have a variety of benches and tables to which gas, electric light and power are supplied. The surfaces of the tables are free from taps or any other obstruction.

The second floor has four rooms in all, two of which are designed for the teaching of biology. One of them is fully equipped for lecturing and dissection, there being a particularly useful device for washing and cleaning dissecting boards. The other room is arranged primarily for botanical work. These two rooms are connected by a small preparation and store room. A third room on this floor contains four aquaria, a large sink, working benches, drawers, shelves and bookcases ; it is to be used by boys interested in natural history, for arranging, investigating and storing their specimens. The remaining room, which is furnished as a library, contains about six hundred scientific books and many periodicals.

The architects of the building were Messrs. George Hubbard and Son, of 45 New Bond Street, London, and the fittings were designed by Messrs. Munby and Smith, of 9 Old Square, Lincoln's Inn, London.

The Structure of Benzene*

FOR many years attempts were made to explain the peculiarities of aromatic compounds by making various special hypotheses relating to the benzene nucleus. It is a satisfactory feature of the present situation that the theory of benzene is simply a special—and specially important—case of an established general extension of valency theory, and that this extension uses essentially the same physical principles as are applied in the interpretation of valency itself. These are the postulates of the 'new' quantum theory (fundamentally the principle of complementality), which provide at once a physical basis for the forces of valency, and for such departures from the ordinary valency rules as are illustrated so strikingly in the parent of the aromatic series.

From an experimental point of view, we are concerned to establish the correct stereochemical model for benzene, and to discover, also in a quantitative way, as much as possible about the internal forces which maintain that model. Theory creates a predilection for a model of plane, regular hexagonal symmetry, because theory works out most simply if such a model be first assumed. The available experimental methods for the determination of a molecular model are (1) by X-ray or electron interferometry, (2) from rotation-vibration or vibration-electronic spectra. The interferometric method indicates the plane, regular model to a rather close degree of approximation, but the spectroscopic method, which is particularly sensitive, and eminently suitable for application to this problem, was at first claimed to establish a contrary conclusion. For this reason, and also because the spectroscopic method, by giving vibration frequencies, supplies direct information about the internal forces, this method has been recently pursued by Angus, Bailey, Wilson and others; and it has been employed in relation not only to ordinary benzene, but also to benzenes in which a part or the whole of the hydrogen is present in the form of deuterium.

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* Substance of the Bakerian Lecture to the Royal Society, delivered by Prof. C. K. Ingold, F.R.S., on June 16.

This use of deuterium greatly increases the amount of information obtainable from the spectra; for isotopic substitution leaves the whole force-system of the molecule unchanged, wherefore the vibrations which are responsible for the observed frequencies can be identified by comparing the frequency shifts caused by isotopic substitution with those calculated from the known changes of atomic mass under the assumption of unaltered forces (Teller). Four spectra are studied: Raman scattering, infra-red absorption, ultra-violet fluorescence, and ultra-violet resonance emission. All give information concerning the molecular form and vibrations of the ground state of the molecule. Five benzenes have been examined moderately completely, whilst two others (formulæ in parentheses) are under examination: C_6H_6, C_6H_5D, 1 : 4-$C_6H_4D_2$, 1 : 3 : 5-$C_6H_3D_3$, (1 : 2 : 4 : 5-$C_6H_2D_4$), (C_6HD_5), C_6D_6.

By a comparison of frequency shifts and other spectroscopic characteristics amongst the spectra of these compounds, the frequencies of a large number of vibration-forms have been identified. From this information, with the aid of spectroscopic rules which depend ultimately on a consideration of the physical mechanism of production of the various spectra, it is possible unequivocally to establish the plane, regular model for the isolated (gaseous) benzene molecule. The previously claimed contrary indication is explained as due to the use (or accidental presence) of liquid, wherein the intermolecular forces are sufficient to deform the molecules to a spectroscopically significant extent. An approximate specification of the internal forces could be made at present, but in order to render such a specification complete with respect to harmonic forces, we require further identified frequencies, wherefore the extension involving $C_6H_2D_4$ and C_6HD_5 is necessary.

A Stone Age Rock-Shelter in South Africa

OAKHURST rock-shelter, situated in an enclosed valley on a farm thirteen miles east of the town of George, Cape Province, South Africa, four miles from the Indian Ocean, and two from the coastal lakes, has been excavated by Mr. A. J. H. Goodwin (*Trans. R. Soc. S. Africa*, 25, 3; 1938). Between February 1932 and February 1935, six sits were paid to the cave, varying in duration om a month to a week, during which the excavation was carried out.

The shelter, which is some sixty feet in length and about twenty-five feet deep at surface level, is divided into two parts. Of these, the inner is separated from the outer and southern portion by a hanging buttress of rock. There is a talus on the southern and eastern sides. The inner portion of the shelter has been left undisturbed for future examination. It is anticipated that much richer deposits will be found re, judging from the midden material which had shed out under the buttress. The outer portion been excavated down to the base of the deposits. hese were of considerable thickness, the total depth cavated being one hundred and twenty-six inches.

The shelter is situated in a dense forest, about twenty feet above a stream in a high sandstone overhanging cliff of schistose quartz-bearing sandstone. It is approached by an old elephant path. Nearby were rock paintings in red, partially obliterated and not clear enough to photograph, and game pits.

A large amount of skeletal material was found in the deposits. The bones had been much disturbed y root action; while digging for subsequent interents had frequently interfered with earlier burials. was, therefore, possible to distinguish with rtainty eighteen graves only. There had been many more, but the contents were commingled, and at mes it was difficult to distinguish grave furniture from introduced material. The skeletal remains had also suffered much from the pressure of gravestones. The greater number of burials occurred at a depth of between fifty and sixty inches from the surface, while a space of some seven by five feet included more than half the graves. As the later people buried at a depth of thirty inches, and the earlier at a depth of fifteen inches only, the graves for the most part occurred at approximately the same level.

The major part of the deposits consists of decayed vegetable matter with a high percentage of wood ash. In addition there are vast quantities of shell present throughout the deposit, this in the upper layers constituting a great part of the bulk. Until the deposits had been built up to some height the shelter could not have afforded much protection against the weather. Hence in the early layers there is evidence of temporary occupation only—the remains of one-night fires and burnt bones. With the advent of Smithfield *B* man, occupation takes on a more permanent character. The prevailing stone used by all the occupants of the cave was white quartz, probably from a vein of quartz, one hundred yards away, which has been quarried. Chalcedony and agates were also used, brought from neighbouring beaches.

The uppermost three feet of the deposit consists generally of Wilton material. In the top nine inches only was pottery, below this at a depth of thirty-six inches was a normal Wilton culture, in which stone crescents in white quartz and chalcedony are common. Following this short normal phase (that is, above it), comes a long period in which shell crescents (*Mytilus edulis*), the first shell implements to be described in South Africa, take the place of stone. Apart from this diversion from stone to shell, there is little change, save for the addition of pottery in the latest phase.

Among the ornaments nacre was rare; but vast numbers of ostrich-shell beads were retrieved. In addition there was a single cowrie shell, and a number of naturally bored shells had been brought to the cave, presumably for ornaments. A hippopotamus tusk and one ivory bead were found, as well as borers, arrow points, and tubes of bone. Fish bones, scarce at the beginning of this period, were found in large quantities in later levels, pointing to the development of a considerable competence in fishing. Banked ash at the southern end indicated a protection fireplace, dividing the cave shelter into two compartments, one for general purposes and one for sleeping.

Below the thirty-six inch level Smithfield *C* material extends down to a depth of sixty inches, the richest level being between thirty-six and fifty-four inches. Throughout the deposit only implements of the general scraper type could be recognized with certainty. More than five thousand scrapers in white quartz were collected from the Smithfield deposit. There were as well two hundred flakes of brown chalcedony. The quartz flakes, almost a solid mass, in parts up to two feet in depth, indicated that the shelter at this period must have been a workshop. Throughout this deposit ostrich shell beads in large numbers were found, but nacre ornaments are rare.

At the base of the Smithfield *C* deposit between two buffer layers was a carbon floor or layer, representing a period of peculiarly fierce forest fire, which was presumably the cause of the desertion of the cave by the Smithfield *B* people. The Smithfield *B* culture extended from a depth of sixty inches down to seventy-seven inches or more in parts. It is to be remarked that there is no great difference to be observed between the implements from above and below the carbon floor. The variation is rather one of size, or in distribution of sizes. The scrapers, for example, are much larger. All implements are still of the general scraper family. The deposit as a whole is far less rich than the Smithfield *C* layer and represents the normal debris of a home site. The major part of the material is quartz, chalcedonic quartz being rare and brown chalcedony absent. One end scraper is of fossilized wood from the Tertiary Enon beds. A Mossel Bay point and a Still Bay type mark the overlying deposit as post-dating the "Cape Flats complex".

Below seventy-seven inches evidence of the sterile character of the lower deposits begins to become apparent. In one section a few good Smithfield *B* specimens still appear between the eighty-four and ninety inch levels; but below ninety-six inches formal implements disappear. In the underlying material there are only scattered hearths with burnt bones and quartz split by fire or broken by man, but no implement types that could be recognized. Though there are suggestions of Middle Stone Age technique on some of the flakes, these must be ignored, as deduction from the sugary quartz would be impossible to maintain. There is, however, evidence to show that use was made of the shelter for a very considerable period before Smithfield *B* man appears.

The pottery has been submitted to a careful an detailed analysis by Mr. J. F. Schofield, who term it "Hottentot", and suggests that its specific characters, lugs and an occasional oval section, are a adaptation to the use of the pack-ox by a nomadic people.

The skeletal material has been studied by Prof. M. R. Drennan, whose detailed report deals with the relation of the Oakhurst people to the Wilton race and the Hottentot. The skeletal material shows that these people had many Bushmen characters, but they were of a special type, being much taller and more robust, with bigger heads. They resembled the type to which the term 'Hottentot' has been applied—a term which accordingly has to be define (see Nature, p. 1146). The main conclusion is tha the Boskop type must be regarded as the ancestor of the Hottentot. The infantile material, which is the first series of any extent to be examined sy tematically, has provided data for a study of grow in infancy.

Submarine Light Measurements

At the meeting of the International Council for the Exploration of the Sea held at Copenhagen on May 23–28, a special session was devoted to submarine light measurements. H. H. Poole gave a brief summary of the results obtained by different workers on the variation of surface loss with weather conditions, pointing out the difficulties involved and stressing the importance of further work on the effect of surface conditions on the angular distribution of submarine daylight.

H. Pettersson described the work of himself and his co-workers on the angular distribution at depths of 5 and 10 m. below a smooth water surface. Their measurements showed that, with the sun shining, the illumination was chiefly concentrated within a comparatively small solid angle round the calculated path of a ray of sunlight, as refracted by a smooth surface, the direction of maximum illumination being slightly nearer the vertical at 10 m. than at 5 m. From these results it is possible to calculate the ratio of the total illumination (as measured by a photometer with a spherical receiving surface) to the vertical illumination (as recorded by a plane photometer with its window horizontal). This is important, since the former is the governing factor in photosynthesis, and the latter is usually measured. The values found for the ratio total/vertical ranged from about 1·5 with the sun at 20° altitude to 1·35 with diffuse daylight.

M. Graham described measurements of the opaci of the water at 44 stations in the North Sea made (*a*) the Lowestoft absorption photometer, (*b*) meas ments of the percentage of daylight at a depth 10 m., and (*c*) Secchi's disk. For finding the orig and history of the water masses involved he conside that the use of Secchi's disk has much to recommen it, but that the most promising method is that o Pettersson's transparency meter, in which an artificial light source and a photo-electric cell are used at any required depth.

E. K. Gabrielson and E. Steemann Nielsen reported experiments on the photosynthesis of various diatom in light of different colours. Their results show that for a given amount of energy violet-blue lig produced about twice as great assimilation of car dioxide as either yellow-green or orange-red, the lat spectral regions being about equally efficient.

The special sub-committee on the standardizati of photo-cells for daylight measurements held severa meetings, and hopes soon to be in a position to undertake this standardization in energy units for different spectral regions.

Science News a Century Ago

Beginnings of the Gas Industry

ON June 28, 1838, the chemist Friedrich Christian Accum died in Berlin at the age of sixty-nine years. He was born on March 29, 1769, at Buckeburg, Westphalia. At twenty-four years of age, he came to England and for nearly thirty years made his home at 11 Compton Street, Soho, London. He was well-known as a lecturer, and is remembered to-day for his share in the founding of the gas industry and his books on practical chemistry. He first made a mark with his book on "Theoretical and Practical Chemistry" published in 1803. This was followed by a "Treatise" and a "Manual" on the analysis of minerals, and his book on "Crystallography", of 1823, the first in English based on Haüy's epoch-making work. By this time he had become interested n coal-gas lighting. He carried out some of the earliest experiments for the Gas Light and Coke Company, gave evidence on its behalf before a committee of the House of Commons and in 1812, when the Company was granted its charter, he became one of the directors. He undertook to supply plans and estimates for gasworks, and installed gas-lighting for the Government at the Royal Mint. These occupations led him to write his two books, a "Practical Treatise on Gas-Light" (1815) and a "Description of the Process of Manufacturing Coal-Gas" (1819), both of which were widely read in Great Britain and abroad, contributing much to a general knowledge of the new method of illumination.

Chemistry of Foods

ACCUM was also known for his books on the chemistry of foods published in 1820–21. The first f these was his "Treatise on the Adulterations of ood, and Culinary Poisons", of which 4,000 copies ere sold in a year. On the cover was a representation f a skull and cross bones and the legend, "There is death in the pot. II Kings, c. 4 v. 40", leading to the book being popularly called "Death in the Pot". This was followed in 1821 by a "Treatise on the Art of making good wholesome Bread, etc.", a "Treatise on the Art of Brewing" and "Culinary Chemistry, exhibiting the Scientific Principles of Cookery", probably the first English book of its kind. For some time, Accum was a member of the Royal stitution, the Linnean Society and the Royal Irish ademy, and was well known for his lectures at Surrey Institution, which had been founded in itation of the Royal Institution, for the south of ondon. The Institution occupied the buildings close to the Thames near old Blackfriars Bridge, which once housed the Leverian Museum. The Institution was in existence from about 1806 until 1823, but before it had closed its doors Accum had returned to Germany. In 1820 he was suspected of removing pages from scientific works at the Royal Institution and a search warrant having been obtained he was charged at Bow Street. The magistrate, however, scharged him. The managers of the Royal Institu- n then indicted him before the Westminster sizes. Pleading not guilty, his case was allowed stand over until the next sitting of the court, but cum failed to appear. He had returned to Berlin, where in 1822 he was given a post at the Technical Institute. At Berlin too he published a work in two volumes on the "Properties of Building Materials". Several of his books were published in London by his fellow-countryman, Rudolph Ackermann (1764–1834), whose premises in the Strand, London, were among the first to be lighted throughout by gas.

The Salamander

IN its issue of June 30, 1838, the *Athenæum* had the following note: "M. Paravez has written to the French Academy of Sciences that a fossil Salamander in the collection of Prof. Van Breda, at Leyden, about three feet long, contains in the part corresponding with the abdomen, the fragments of frogs, eels, etc., thereby affording a proof that antediluvean species fed upon the same substances as the Salamanders of our own time. A large Salamander brought by M. Siébold from Japan, still lives in the museum at Leyden, which is principally fed upon frogs. This Salamander is described in a Japanese Encyclopædia, and M. Paravez finds in this work the same fables which exist in Europe concerning the animal, namely, its insensibility to fire. The same stories concerning the chamelion are also found in the Encyclopædia, and bring further conviction to M. Paravez, that a very ancient centre of civilization has existed, whence come the ideas concerning art and science, which have been transmitted to us by the Greeks and Romans, and which are also to be found in Chinese books."

University Events

EDINBURGH.—Prof. J. Bertram Collip, of the Department of Biochemistry in McGill University, Montreal, who was awarded the Cameron Prize for 1937, delivered the prize address on "Results of Recent Studies on Anterior Pituitary Hormones" on June 16.

LEEDS.—At a Congregation to be held on July 4, the following honorary degrees will be conferred, among others: D.Sc. on Prof. Alfred Fowler, emeritus professor of astrophysics in the Imperial College of Science and Technology, and Mr. C. J. T. Cronshaw, managing director, Imperial Chemical Industries (Dyestuffs Group).

MANCHESTER.—Dr. A. R. Todd, of the Lister Institute, and reader in biochemistry in the University of London, has been appointed Sir Samuel Hall professor of chemistry and director of the Chemical Laboratories in succession to Prof. I. M. Heilbron, who is taking up the chair of organic chemistry at the Imperial College of Science and Technology, London.

OXFORD.—In Convocation on June 22, honorary degrees were conferred on the following, among others: D.C.L., Sir James Irvine, vice-chancellor and principal of the University of St. Andrews, Lord Desborough, and Miss Eleanor Rathbone, M.P.; D.Sc., Prof. G. I. Taylor, Yarrow research professor of the Royal Society; D.Litt., Prof. S. A. Cook, regius professor of Hebrew in the University of Cambridge.

Dr. M. Cattle has been appointed tutor in natural sciences at St. Hilda's College.

S. Wylie, New College, research scholar in mathematics in the University of Aberdeen, has been elected to a lectureship (the equivalent of a research fellowship) at Christ Church.

Prof. J. B. S. Haldane has been awarded the Weldon Memorial Prize for 1938.

Societies and Academies

London

Royal Society (*Proc.*, A, 166, 325–449, June 3, 1938).

S. RAMACHANDRA RAO and S. SRIRAMAN : Diamagnetism of cadmium.

C. F. GOODEVE and L. J. WOOD : Photosensitivity of diphenylamine-*p*-diazonium sulphate by the method of photometric curves.

A. J. BRADLEY and A. TAYLOR : An X-ray study of the iron-nickel-aluminium ternary equilibrium diagram.

F. W. JONES and C. SYKES : Atomic rearrangement process in the copper-gold alloy, Cu_3Au (2).

MAX BORN and KLAUS FUCHS : Statistical mechanics of condensing systems.

C. L. SMITH and W. Y. CHANG : An accurate determination of the range-distribution curve of the radioactive α-particles from ^6Li.

HANS MUELLER : On the theory of scattering of light.

Paris

Academy of Sciences, May 2 (*C.R.*, 206, 1273–1332).

V. A. KOSTITZIN : The differential equations of the problem of natural selection in the case of the mutation of a sex chromosome.

FRÉDÉRIC ROGER : The indetermination of analytical functions at their critical points.

HENRI PAILLOUX : The dynamical study of a problem of kinematics.

MAX TEISSIÉ-SOLIER and LOUIS CASTAGNETTO : The determination of the criterion of alternating vortices and the oscillations of relaxation.

JEAN LOUIS DESTOUCHES : The notion of the corpuscle. Application to the heavy electrons.

ERNEST BAUMGARDT : The transparency of solid plates to ultra-sounds. Measurements of the transparency of soft iron disks of different thicknesses to ultra-sounds produced by a quartz emitter lead to a value for Young's modulus agreeing with that determined by the statical method.

PIERRE VERNOTTE : Properties of the Fourier solution in complex systems : application to the distribution of a (heat) flux between bodies in contact.

HENRI BIZETTE and BELLING TSAÏ : The magnetic susceptibility of liquid nitric oxide, NO. The magnetic susceptibility was found to be $3{\cdot}53 \times 10^{-4}$ per cubic centimetre. From this, it is concluded that about 97 per cent of the molecules are polymerized, as against 93 per cent deduced from measurements of the magnetic rotatory power.

THÉODORE KAHAN : The potential barrier in nuclear mechanics and the nuclear dimensions of heavy radioactive bodies.

MARCUS BRUTZCUS : The *a priori* calculation of the calorific powers of hydrocarbons.

ANTONIN ANDANT : The automatic photography of the Raman spectra of liquid mixtures. Application to quantitative determinations. The apparatus described secures that the times of exposure shall be rigorously equal and that the source of light shall remain constant. With this apparatus eight spectra given by the same liquid were absolutely identical.

HENRY CASSAN : The reaction of formation of gas in a producer outside conditions of equilibrium.

MME. JULIETTE GAVORET : The isoelectric point of cellulose. Adsorption and swelling.

HENRI GUÉRIN : Study of the system As_2O_5, BaO, H_2O at 17° C. Characterization of a new barium arsenate, $BaO.2As_2O_5.3H_2O$.

MAURICE GIRARD : The semicarbazone and thiosemicarbazone of *p*-methoxyphenylpyruvic acid. The corresponding dioxytriazine and sulphoxytriazine.

RENÉ JACQUEMAIN and MLLE. GEORGETTE DEVILLERS : Some aminobenzoic esters of ethanediol and propanediol.

PANOS GRAMMATICAKIS : The action of mixed organo-magnesium compounds on the phenylhydrazones of trialkylacetophenones.

MARC BASSIÈRE : The structure of sodium isocyanate. Results of X-ray study of the crystalline salt. The structure is completely analogous with that of sodium nitride (hydrazoate). The arrangement of the atoms of the isocyanic group confirms the formula $O{=}C{=}N{-}$.

MAHMOUD GHALI and ROBERT BUREAU : The proportion of mud in the waters of the Nile, their level and recording at a distance.

PAUL BERTRAND : The successive appearance of the vascular plants and their instantaneous adaptation.

M. and MME. FERNAND MOREAU : New observations on the hormone formation of the perithecia i the Neurospora.

ROGER ULRICH : The comparison of the accumulated lipids in the green pericarps and in the albumen of the seeds of the ivy (*Hedera Helix*).

LOUIS MAUME and JACQUES DULAC : The maintenance of the chemical individuality of the stalk and ear in wheat, at definite physiological stages and in different varieties and media.

MLLE. MARIE THERÈSE FRANÇOIS : The characters of oils from aleurites and their relations with the methods of preparation.

M. and MME. PIERRE ALLORGE : The presence of epiphyllous liverworts in the islands of the Azores.

PAUL ANCEL and PIERRE VINTEMBERGER : The factors of the determinism of bilateral symmetry the egg of *Rana fusca*.

ETIENNE BURNET and JEAN DEBIESSE : T diagnosis of species of the genus *Brucella* by t absorption spectrum of culture broths.

JEAN VIEUCHANGE and MLADEN PAÏC : The actio of ultracentrifugation on the neutralizing antibodie of antivaccinal immunosera.

Amsterdam

Royal Netherlands Academy (*Proc.*, 41, No. 4 ; 1938).

H. A. BROUWER : Preliminary remarks on ge logical investigations in the Lesser Sunda Islands n Australia.

M. W. WOERDEMAN : Inducing capacity of embryonic eye. A contribution to the elucidation this problem by bringing optical vesicles of differe ages (cf. *Axolotl*) in contact with ectoderms of differen stages of development.

J. G. VAN DER CORPUT : (1) On two, three or four prime numbers (5). (2) Contribution to the additive theory of numbers (2).

R. WEITZENBÖCK : On trivectors (6).

H. R. KRUYT and J. OOSTERMAN : Flow potentials electro-endosmosis and electrophoresis with platinu

P. E. VERKADE, J. VAN DER LEE, A. J. S. v ALPHEN and M. ELZAS : Researches on fat me bolism (2). Injection experiments on dogs v sodium salts of normal saturated dicarboxylic ac

E. DUBOIS : The fossil human skull recen described and attributed to *Pithecanthropus erec* by G. H. R. von Koenigswald. The author disagree with Koenigswald's conclusions, and criticizes his reconstruction of the (much broken) skull cap.

J. W. N. LE HEUX: Researches on some interference phenomena of vibration curves.

A. QUISPEL: A new method for the investigation of aerial and soil algæ. The surface to be studied is treated with 'Zaponlac' and acetone to fix the organisms and is then painted with gypsum, collodion or *Geiseltallack*. The cast is allowed to harden and is then stripped off, so removing the algæ quantitatively.

G. J. DE GROOT and J. B. THOMAS: Bio-electric potentials and the movements of the motile leaf pulvini in *Phaseolus multiflorus* L.

L. A. H. BOUWPAN: A new genus (*Kugleria*) of the family of Requienida (Pachyodonta).

R. L. STARKEY: Spore formation by the sulphate-reducing vibrio. The specific sulphate-reducing organism known as *Vibrio desulfuricans* produces spores which are very tolerant of high temperatures.

P. GLEES: Neuroplasmatic connexions between cells of the radix mesencephalica trigemini in *Scyllium anicula*.

G. P. FRETS: Dimension and form with the growth f the seeds of *Phaseolus vulgaris* L (2).

Brussels

Royal Academy (*Bull. Classe Sci.*, 24, No. 2, 1938).

L. GODEAUX: Construction of surfaces and of algebraic varieties of divisor greater than one.

O. DONY-HÉNAULT: Discovery of the thermal metallurgy of zinc in Belgium at the beginning of the nineteenth century.

R. GERBAUX: A case of geometrical isomerism in the epoxy-nitrile series. The synthesis of two compounds believed to be *cis*- and *trans*- 2.3 epoxy- -methylbutanitrile.

J. BRANDES: Precocious modification of the rimordial morphogenesis in amphibians by the tion of ultra-violet radiation.

Moscow

Academy of Sciences (*C.R.*, 18, No. 7; 1938).

S. BERNSTEIN: (1) The best approximation of $[x-c]p$. Limitation of modules of successive derivations of utions of parabolic equations.

V. S. LUKCHIN: Some generalizations of the problem of infinitely small deformations of rotation rfaces with negative curvature.

B. GAGAEFF: The functions satisfying equations of iptic type.

. G. PINSKER: Analytical representation of some rtially additive functions.

V. ŠMULIAN: The regularly closed and weak ompact entities in a space of the type (B).

D. A. FRANK-KAMENECKIJ: (1) Non-stationary free convection. (2) The temperature distribution in a reaction vessel and the static theory of thermal explosions.

L. A. ARCIMOVIČ and V. A. CHRAMOV: Energy loss of fast electrons by radiation.

L. V. GROŠEV and I. M. FRANK: The probability creation of pairs in krypton by γ-rays.

P. A. REHBINDER and A. A. TRAPEZNIKOV: hanical properties of films and stability of foams.

. A. TRAPEZNIKOV and P. A. REHBINDER: bilizing effect of adsorption layers and their hanical properties.

. V. NIKOLAEV and A. G. ČELIŠČEVA: The thesis of inyoite.

M. N. KALININ: Preparation of esters of the rthosilic acid.

O. E. ZVIAGINCEV and E. L. PISARŽEVSKAIA: The action of sulphide minerals on solutions of gold chloride and cyanide.

N. A. IZGARYŠEV and E. S. SARKISOV: Mutual displacement of metals from vapours of their salts and the application of this process in the prevention of corrosion.

N. NEKRASOV: The non-equilibrium oxidation-reduction potential.

P. L. BEZRUKOV: Lower Silurian geosynclinal phosphorites in the north-eastern branch of the Karatau Range.

A. E. FERSMAN: The tetrahedral structure of minerals.

N. A. SKOPINCEV: Organic matter in sea-water and foam in the south-eastern part of the Caspian Sea (October–November 1936).

DONTCHO KOSTOFF: (1) Studies on polyploid plants (18). Cytogenetic studies on *Nicotiana sylvestris* × *N. tomentosiformis* hybrids and amphidiploids, and their bearing on the problem of origin of *N. tabacum*. (2) Heterochromatic (inert) region in chromosomes of *Crepis capillaris*.

A. I. ZHURBIN: Comparative study of cell sizes of auto- and allopolyploids.

E. I. HARETSCHKO-SAWITZKAJA: A method for obtaining seeds in self-fertilization of autosterile varieties of *Beta vulgaris*.

A. I. POTAPOV: Soil reactions in the forests of Lenkoran and western Georgia from the point of view of citrus and tea cultivation.

C. S. AFANASIEV: A new valuable rubber plant (*Scorzonera kirgisorum* sp. n.) from the Pamiro-Alai.

D. K. TRETYAKOV: (1) External canaliculi of the lateral line of fishes. (2) Seismosensory canals in the flying fish.

A. A. WOITKEWITSCH: Morphogenetic activity of the various parts of the hypophysis.

R. J. KOVDA and A. A. WOITKEWITSCH: Biological action of an ultra-high frequency electric field.

B. NOVIKOV: Sex hormone and characters of partial monomorphism in *Perdix perdix* L.

A. M. VASIUTOČKIN: (1) The degeneration of seminal tubules. (2) Regeneration phenomena in frog intestine.

Washington, D.C.

National Academy of Sciences (*Proc.*, 24, 165–198; April 15, 1938).

G. A. LEBEDEFF: Intersexuality in *Drosophila virilis* and its bearing on sex determination. Genetical and morphological investigation of some intersexes, which are morphologically hermaphrodites of all grades, indicates that they start to develop as females, but after the 'turning point', any imaginal disks which differentiate become male organs. The time at which the 'turning point' occurs determines the degree of maleness or femaleness of the adult hermaphrodite. Applying these results to normal sex determination, it is suggested that sex is determined by the balance between the gene for femaleness (in the X-chromosome) and that for maleness (in the third chromosome), the balance being maintained by suppressors controlled by the XY mechanism.

S. HECHT and E. G. PICKELS: Sedimentation constant of visual purple. Frog's visual purple was examined in an air-driven ultracentrifuge (160,000 times gravity). The single sedimentation boundary was photographed with both the blue and the green radiation from mercury, and gave experimentally the same value for the sedimentation constant. This indicates that the asymmetry of the absorption curve is an integral property of the visual purple. Bleached visual purple gave the same constant, showing that bleaching does not cause drastic splitting of the molecule. The molecular weight is probably about 270,000 and the molecule itself not quite spherical.

B. H. WILLIER, MARY E. RAWLES and F. C. KOCH : Biological differences in the action of synthetic male hormones on the differentiation of sex in the chick embryo. The hormones were injected into eggs incubated for 43–72 hours. Androsterone and dehydroandrosterone are more toxic than testosterone propionate ; the former have both masculinizing and feminizing effects, whereas the latter has a masculinizing effect only on differentiating gonads and gonoducts.

F. D. MURNAGHAN : (1) The generalized Clebsch-Gordan formula. (2) Analysis of representations of the real orthogonal group.

A. L. FOSTER : Natural systems.

H. M. MACNEILLE : Extensions of measure.

R. OLDENBURGER : Representation and equivalence of forms.

Forthcoming Events

Tuesday, June 28

NATIONAL PHYSICAL LABORATORY, at 2.30.—Annual Inspection by the General Board.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 9.—H. J. Braunholtz : "Ethnographical Museums and the Collector : Aims and Methods" (Presidential Address).

Thursday, June 30

ROYAL SOCIETY, at 4.30.—Prof. A. N. Richards : "Processes of Urine Formation" (Croonian Lecture).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.

JUNIOR SCIENTIFIC OFFICER at the Building Research Station, Watford—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (June 27—quote ref. *J.* 38/6).

PRINCIPAL of Wakefield Technical College—The Director of Education, 27 King Street, Wakefield (June 27).

LECTURER IN BOTANY in Bedford College for Women, Regent's Park, London, N.W.1—The Secretary (July 1).

LECTURER IN ELECTRICAL ENGINEERING in the Brighton Technical College—The Education Officer, Education Offices, 54 Old Steine, Brighton, 1 (July 1).

LECTURER IN MECHANICAL ENGINEERING in the School of Engineering, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (July 1).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Manchester Municipal College of Technology—The Principal (July 4)

DEMONSTRATOR IN PHYSIOLOGY and DEMONSTRATOR IN PHYSICS in the London (Royal Free Hospital) School of Medicine for Women—The Warden, 8 Hunter Street, W.C.1 (July 8)

DEMONSTRATOR IN BOTANY in the University of Birmingham—The Secretary (July 9).

CHEMIST in the Department of the Government Chemist—The Government Chemist, Clement's Inn Passage, Strand, W.C.2 (July 9).

IRWIN PROFESSOR OF AGRICULTURE in the Benares Hindu University—The Pro-Vice-Chancellor (July 15).

LECTURER IN ANATOMY in the University of Aberdeen—The Secretary (July 15).

DEMONSTRATOR IN PHYSICS in King's College, Newcastle-upon-Tyne—The Registrar (July 16).

GOLDSMID PROFESSOR OF MATHEMATICS in University College, London—The Academic Registrar, University of London, Senate House, W.C.1 (July 29).

SECRETARY of the Institution of Professional Civil Servants—The Hon. Secretary, I P C.S , 69 Victoria Street, London, S.W.1 (July 30).

SCIENTIFIC OFFICER under the Water Pollution Research Board—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (July 4—quote ref. *J.* 38/7).

ASSISTANTS (grade III) in the Meteorological Office—The Secretary (S.2.a.), Air Ministry, Adastral House, Kingsway, W.C.2.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial Forestry Institute · University of Oxford. The Black Poplars and their Hybrids cultivated in Britain. By G. S Cansdale and Members of the Staff of the Imperial Forestry Institute. Pp. 52+1 plate. (Oxford : Imperial Forestry Institute.) 3*s.* 6*d.* [76

University of Reading : National Institute for Research in Dairying. Annual Report for the Year ending 30th September 1937. Pp. viii+80. (Reading : National Institute for Research in Dairying.) [106

Department of Scientific and Industrial Research. Report of the Building Research Board, with a Report of the Director of Building Research, for the Year 1937. Pp. vi+172+13 plates. (London · H.M Stationery Office.) 3*s.* 6*d.* net. [106

Agricultural Research Council. A.R.C. Report Series, No. 3 : Dairy Research ; a Report by the Dairying and Animal Products Committee on a Review undertaken by them of Dairy Research in Progress in Great Britain, including a Review of the Work of Dairy Bacteriologists in England and Wales. Pp. v+101+1 map. (London : H.M. Stationery Office.) 2*s.* net. [106

Society of Chemical Industry : Chemical Eng[illegible]ing Group. Proceedings, Vol. 19, 1937. Pp. 138+1 plate. (London : Chemical Engineering Group.) 21*s.* [136

Forestry Commission. Eighteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1937. Pp. 50 (London . H.M. Stationery Office) 1*s* net [13

Ministry of Health. Circular 1705 : Maternal Mortality ; Medica Practitioners called in by Midwives. Pp. 8 (London : H.M. Stationery Office) 1*d.* net. [156

Association of Special Libraries and Information Bureaux Select List of Standard British Scientific and Technical Books. Compiled at the request of the British Council Second edition, revised and enlarged. Pp. 42. (London : ASLIB.) 2*s.* 6*d.* [156

Air Ministry : Aeronautical Research Committee : Reports and Memoranda. No. 1807 (2822) : Measurements of Acceleration and Water Pressure on a Seaplane when dropped into Water. By E. T. Jones, G. Douglas, C. E. Stafford and R. K. Cushing. Pp. 18+11 plates. 5*s.* net. No 1811 (2807) · Note on Wind Tunnel Tests on the Design of Cabins. By J. H. Hartley, D. Cameron and W. H. Curtis Pp 17+1 plate. 3*s.* net No. 1813 (2920) · Drag Tests on a Fabric covered, and a Polished Plywood, Wing in the 24 ft. Tunnel. By K. V. Diprose. Pp. 15. 2*s.* 6*d.* net. No. 1815 (3204 . The Divergence Speed of an Elastic Wing. By A. G. Pugsley and G. A. Naylor. Pp. 20 3*s.* net. No. 1817 (3194) : Experiments on an Elliptic Cylinder in the Compressed Air Tunnel. By D. H William and A. F. Brown. Pp 10. 1*s* 6*d* net. No. 1820 (2873) : Notes o a Method of Analysis of Ground Run during Take-off. By S. I Gates. Pp. 13. 2*s.* net (London . H.M. Stationery Office.) [15

The Colonial Empire in 1937–38 : Statement to accompany the Estimates for Colonial and Middle Eastern Services 1938. (Cmd. 576 Pp. 79. (London : H.M. Stationery Office.) 1*s.* 3*d.* net. [

Other Countries

Indian Science Congress Association · Silver Jubilee, 1938 Progress of Science in India during the past Twenty-five Yea Edited by Dr. B. Prashad. Pp. lvi+767. (Calcutta · Indian Scie Congress Association.) 5 rupees.

Light · Corpuscle vs. Wave. By Charles A. Spickler Pp (Yardley, Penna. : The Author) [

Bericht über das Geobotanische Forschungsinstitut Rübel in Zuri für das Jahr 1937. Von E. Rübel und W. Lüdi. Pp. 104. (Zürich Geobotanische Forschungsinstitut Rübel.) [10

Publications of the Kapteyn Astronomical Laboratory at Groninger Edited by Prof. Dr P. J Van Rhijn. No. 48 : Dark Clouds Kapteyn's Special Areas 2, 5, 9 and 24 and the Proper Motions of t Stars in these Regions. By B. Hiemstra. Pp. ii+74+1 plate (Groningen : Hoitsema Bros.) [

Progress Report on the Scheme of Research on Quality in C with special reference to Rice, during the Period December 193 November 1937. By Dr A. Sreenivasan. Pp 1+22. (Bangalo Indian Institute of Science.) [1

Reports of the Great Barrier Reef Committee. Vol. 4, Part Nos. 7, 8 and 9 Pp. 51–142+4 plates. (Brisbane : Governmen Printer.) [13

Canada. Department of Mines and Resources : Mines and Geology Branch, Bureau of Mines. Limestones of Canada : their Occurrence and Characteristics. Part 4 : Ontario. By M. F. Goudge. (No. 781.) Pp xii+361+4 maps. (Ottawa . King's Printer.) 75 cents. [136

Egyptian University. Bulletin of the Faculty of Science No 14 · The Osteology of the Lizard *Scincus scincus* (Linn) By M. R. El-Toubi. Pp. 38. 3.5 P.T. Bulletin of the Faculty of Science No. 15 : Egyptian Soil Structure in relation to Plants. By A. H. Montasir Pp. 47+5 plates. (Cairo . Egyptian University.) [1

San Diego Society of Natural History Occasional Papers No. A Statistical Study of the Rattlesnakes. By Laurence M. Klau Pp. 53 Transactions Vol 8, No 33 : New and Obscure Dec Crustacea from the West American Coasts. By Steve A Gla Pp. 411–454. Vol. 8, No 34 . A Study of the Skull of the Pleisto Stork, *Ciconia maltha*, Miller. By Loye Miller. Pp. 455–462. Diego, Cal · Society of Natural History)

University of Illinois : Engineering Experiment Station Circ No 31 · Papers presented at the Short Course in Coal Utiliza held at the University of Illinois, May 25–27, 1937. Pp 200. cents. Bulletin No. 300 : Pressure Losses resulting from Change Cross-Sectional Area in Air Ducts By Prof. Alonzo P. Kratz a Julian R. Fellows. Pp. 58. 65 cents. (Urbana, Ill. : University o Illinois Engineering Experiment Station.) [14